

December 2019

PR19 final determinations

Securing cost efficiency technical appendix

PR19 final determinations: Securing cost efficiency technical appendix

About this document

Cost assessment is the setting of an efficient total expenditure (totex) allowance for each company for the price control period.

This document sets out our approach to cost assessment as part of our final determinations. We explain how we develop our view of efficient totex for each company for the 2020-25 period.

Our approach to cost assessment is based on the methodology set out in our [PR19 methodology document](#). Our assessment is implemented through a suite of models, which we publish alongside this document.

Our decisions take into account the representations made on all our draft determinations, responses from companies to our queries and additional information provided following further engagement with companies and other stakeholders as part of the final determination process. In the interest of brevity, where no representations have been made on our draft determination proposals, we do not repeat our reasoning in all cases. Please see the [PR19 draft determinations](#) for further details.

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Amendment	Date
<p>Page 165, Table A1.1: Figures in the Bristol Water row have been amended for company view and % efficiency challenge in the wholesale water and total columns and figures in this row have been amended for company view in the wholesale water and total columns.</p> <p>Page 168, Table A1.3: Enhancement costs (£m) – Figures amended for Anglian Water, Northumbrian Water, South West Water, Southern Water, Thames Water, United Utilities, Wessex Water, Yorkshire Water, Affinity Water, Bristol Water and Industry in the Company View of Other enhancement activities and Total enhancement columns.</p>	30 April 2020

1. Securing cost efficiency for customers

As part of PR19 we set a total expenditure (totex) allowance for companies for the period 2020-25. Our totex allowance is a material component of customers' bills now and in the future. Customers are dependent on their water company. It is important that customer bills reflect efficient costs.

In [Delivering W2020: Our final methodology for the 2019 price review](#), we set out our expectation that water companies make a step-change in efficiency by 2025, allowing them to deliver better services for customers, and to protect and to improve the environment, while at the same time keeping bills affordable for all.

In our final determinations, we set a cost-outcomes package that provides a strong incentive for companies to be efficient and at the same time deliver a marked improvement in their level of performance on outcomes that matter to customers and the environment. Our cost-outcomes package is demanding but achievable. It will incentivise companies to innovate, which will pave the way for a more efficient, higher performing sector, with a more meaningful, trusted relationship with customers.

1.1 Cost projections by water companies for 2020-25

In September 2018 water companies submitted their business plans for the period 2020-25. In their business plans companies forecasted a total expenditure of £55.4 billion for the five-year period – an increase of 10% relative to the expenditure in 2015-20.¹

Most companies claimed to be making efficiency improvements in their proposed costs for 2020-25. Companies accepted our challenge and recognised that there is scope for a step up in efficiency. Our final determinations provide a further efficiency challenge to company proposed costs. This reflects the difference between our view and companies view on the size of the efficiency gain to be achieved and the allocation of risk between customers and shareholders.

¹ Totex figures excludes third party services costs, pension deficit recovery payments, other cash items and non s-185 diversion costs.

Three of the 17 companies for which we set a price control—Severn Trent Water, United Utilities and south West Water—received a ‘fast track’ status and an early draft determinations. The remaining 14 companies submitted a revised business plan in April 2019. Most companies reduced costs in their revised business in April 2019, with an overall reduction of £754 million (1.4%). In their response to our draft determinations in August 2019, companies reduced their requested total expenditure by a further £2.4 billion (4.4%).

The reduction in expenditure is due to a number of factors. Some companies have responded to our challenge at the initial assessment of plans stage and at draft determinations and scrutinised further their business plans to remove inefficient costs that customers should not be paying for. Some of the reduction is due to a change in approach. For example:

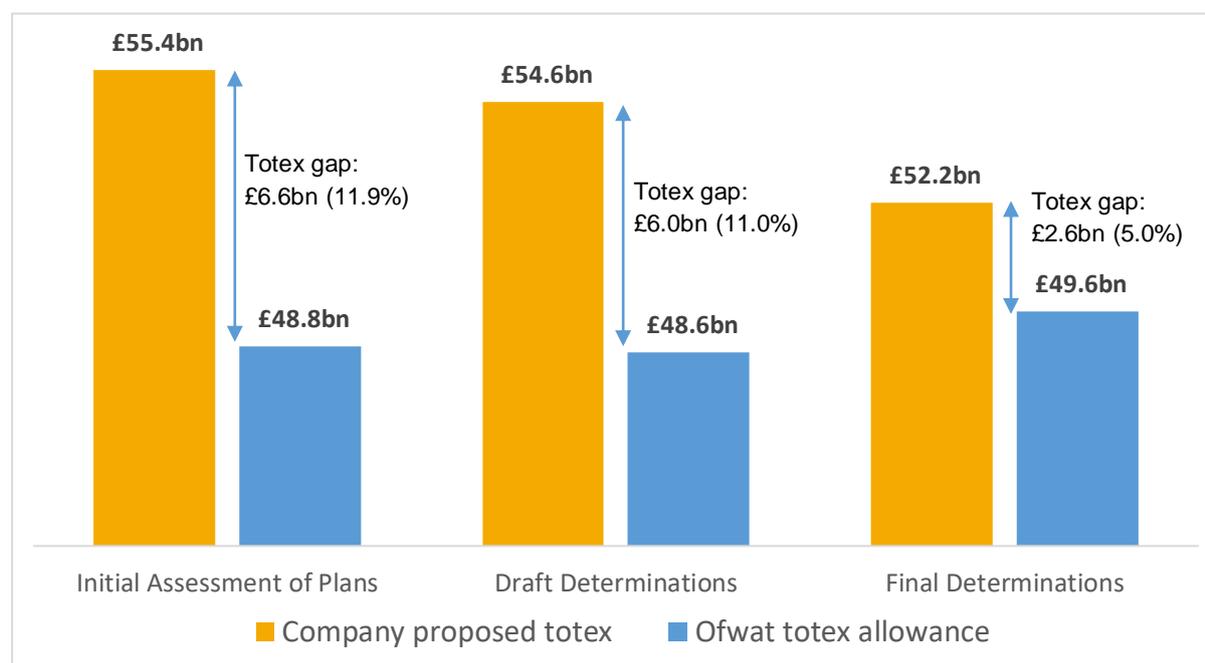
- Companies have removed around £400 million of costs related to atypical diversions (i.e. diversions not covered by section 185 of the Water Industry Act 1991). These costs could be recovered outside of the price control allowance.
- Companies have removed around £193 million of costs related to schemes that are expected to be delivered through direct procurement for customers.

We have reviewed representations to our draft determinations. We have revised our approach and decisions where appropriate. We outline the key changes in our approach for final determinations below. Following a significant reduction in requested costs by companies and an increase in our cost allowance in view of further evidence, the cost difference between our allowance and companies’ requested costs has significantly reduced at final determinations. Figure 1 shows total cost projections for all water companies relative to the current period, and our cost allowance. Annex 1 provides detailed tables of business plan costs by company relative to our view of efficient costs.

These total expenditure figures of £49.6 billion quoted here do not include:

- the conditional funding of £480 million we are providing to Thames Water to improve the resilience of water supplies in London and to improve the performance of the London water network;
- the £469 million we are providing through a gated process for the development of strategic regional water resources solutions to help support drought resilience challenges; and
- £200 million of funding we are providing for the innovation fund.

Figure 1: total expenditure over different stages of price review 2019 (£ million of 2017-18)



1.2 Key changes in our cost assessment approach

We have reviewed company responses to our draft determinations and have made a number of key changes to our approach. We discuss the rationale for our decisions in this document. The key areas of change are:

- **Data for modelled base costs:** we incorporate data from 2018-19 annual performance report (APR) to our econometric models to form our view of modelled base costs;
- **Diversions costs:** we exclude costs for diversions that are not requested under section 185 of the Water Industry Act 1991 from modelled base costs;
- **Growth costs adjustments:** we make upward or downward adjustments to our base allowance for companies with a high or low forecasts of population growth in 2020-25;
- **Forecast of cost drivers:** we use companies' forecasts of water treatment complexity for setting base allowance in 2020-25 instead of forecasts based on historical data;
- **Catch up efficiency challenge:** we strengthen the catch-up challenge applied to wholesale modelled base costs. We use the 4th placed company in wholesale water and the 3rd placed company in wholesale wastewater as an efficiency benchmark, rather than the upper quartile company at draft determinations;

- **Frontier shift efficiency challenge:** we reduce the frontier shift challenge from 1.5% per year to 1.1% per year, but we extend to all wholesale base costs. We also apply the frontier shift challenge to our allowance for the environmental programme and new meter installations;
- **Real price effects:** we continue to make an allowance for real price effects for labour costs with an ex-post true up at PR24 on outturn manufacturing wage growth. Based on updated information from water companies we increase the proportion of costs accounted for by labour costs from 35% to 39%;
- **Enhancement funding for leakage:** at draft determinations we made enhancement funding for leakage only where the company forecasts to perform beyond the forecast 2024-25 upper quartile level on both measures – leakage per property and leakage per kilometre of main. For final determinations we consider the weighted performance on the two measures as the criterion for leakage enhancement funding;
- **Drainage and Wastewater Management Plans (DWMPs):** following Defra's recent consultations on DWMPs, and additional information provided by companies, we make partial allowances to develop DWMPs to ensure a more consistent basis for long-term planning of drainage and wastewater services as recognised by the 21st Century Drainage Programme supported by Water UK, Defra and the EA;
- **Residential retail:** we assign a higher weight to results from our total costs models relative to our 'bottom up' models. We also update a number of our cost driver data.

2. Overview of our cost assessment approach

In this section we explain the components of our approach to cost assessment.

2.1 Building blocks of our approach

Our view of the efficient totex allowance for companies is built up from a number of building blocks. These are set out in table 1 below.

Table 1: Building blocks of our totex assessment

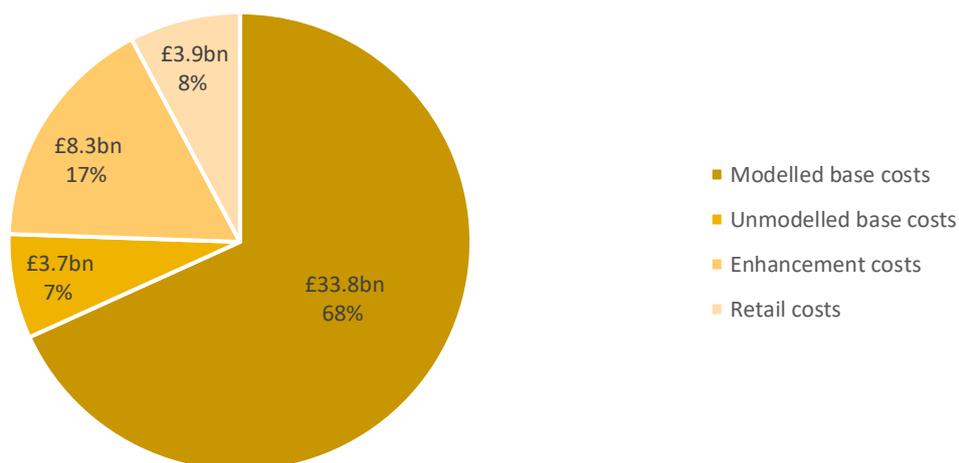
	Building block	Costs included	Assessment approach
Wholesale services	Modelled 'base' costs	<ul style="list-style-type: none"> Operating expenditure (excluding specific cost items included in 'unmodelled base costs') Maintenance capital expenditure Specific enhancement lines (see section 3.2) 	<ul style="list-style-type: none"> Econometric models using outturn data (see Annex 2) Assessment of cost adjustment claims Efficiency challenge: a 'catch-up' challenge to high performing companies in the sector plus a net frontier shift estimate.
	Unmodelled base costs	<ul style="list-style-type: none"> Business rates Water abstraction charges (water only) Traffic Management Act costs Wastewater Industrial Emissions Directive costs (wastewater only) 	<ul style="list-style-type: none"> Various methods as appropriate. Assessment based on business plan (forecast) data. Assessment of cost adjustment claims A net frontier shift estimate
	Enhancement expenditure	<ul style="list-style-type: none"> Enhancement expenditure as reported in business plans (tables WS2 and WWS2), except lines that we now include in modelled base costs (see section 4) 	<ul style="list-style-type: none"> Various methods as appropriate: <ul style="list-style-type: none"> benchmarking models deep/shallow dive assessment Assessment of cost adjustment claims A net frontier shift estimate for certain categories
Retail services	Residential retail	<ul style="list-style-type: none"> Residential retail costs 	<ul style="list-style-type: none"> Econometric models using outturn data (see Annex 2) Assessment of cost adjustment claims Efficiency challenge: average of historical and forward-looking upper quartile performance
	Business retail (where applicable)	<ul style="list-style-type: none"> Business retail costs 	<ul style="list-style-type: none"> Based on benchmarking with historical/other companies/residential retail

We add together these four building blocks to come to our view of the efficient total cost allowance for each company as set out in figure 2.

Figure 2: Building blocks of our totex assessment



Figure 3: Materiality of allowed cost per building block (2017-18 prices)



Price controls for which we set an allowed cost at PR19

At PR19 we set efficient totex allowances for the following price controls for each company:

- water resources control;
- water network plus control;
- wastewater network plus control;
- bioresources control;
- residential retail control; and
- business retail control for Dŵr Cymru and Hafren Dyfrdwy.

We also set two separate price controls which are company-specific:

- Tideway wastewater control for Thames Water; and
- Havant Thicket water control for Portsmouth Water

Structure of the rest of the document

In the remaining sections of this document we discuss the assessment method we apply for each of the building blocks of our approach.

- In **chapter 3** we explain our approach for assessing base costs, including both the modelled and unmodelled costs.
- In **chapter 4** we explain our method to assess enhancement costs.
- In **chapter 5** we explain our approach to frontier shift and real price effects.
- In **chapter 6** we explain how we bring our assessment together to set allowances to the different controls.
- In **chapter 7** we explain our approach for assessing residential retail costs.
- In **chapter 8** we explain our approach for assessing business retail costs.
- In **chapter 9** we explain our approach to assessing cost adjustment claims.
- In **chapter 10** we explain our approach to cost sharing.
- In **chapter 11** we explain additional details of our cost assessment approach.

3. Our assessment of base costs

Base costs are routine, year-on-year costs, which companies incur in the normal running of the business to provide a base level of service to customers.

We distinguish between modelled based costs and unmodelled based costs. Modelled base costs, which are the majority of base costs, are assessed using econometric models. Unmodelled base costs consist of a small number of items whose particular characteristics make them more suitable for a separate assessment. We discuss each below.

3.1 Modelled base costs

To assess the efficiency of a company's proposed modelled base costs we develop our own, independent, view of efficient costs.

Our independent view of efficient costs is an important part of our incentive-based regulatory regime, taking account of the information asymmetry between Ofwat and the companies. As companies know that we do not start with their own view of costs but rather with an independent view, this approach reduces the incentive for companies to inflate their requested expenditure to influence our view of efficient costs. Our overall approach rewards efficient business plans, which means that some efficient companies may receive more in allowances than requested in their business plans. These companies help set the efficiency challenge for the sector as a whole.

Changes to our data and modelling approach since the initial assessment of plans and draft determinations results in higher excess allowance for a number of efficient companies. Notably, our view of Portsmouth Water's efficient costs in the wholesale water control (water resources and water network plus) is 16% higher than the amount the company requested in its business plan. At final determinations, we intervene by capping the excess cost allowance in wholesale water for Portsmouth Water at 10%.

At PR14 we applied a cap to companies' excess allowance at 5% above their requested costs. In our PR19 methodology we said that we do not intend to apply a cap as we did at PR14. However, we said that where appropriate, we would intervene in a suitable way to protect the interest of customers, and it would be inappropriate for us to rule out the use of capping. Our 10% cap for Portsmouth

Water is significantly higher than the one we applied at PR14. Our cap leaves considerable reward for Portsmouth Water's efficient business plan. We consider this strikes an appropriate balance between protecting customer interests while also retaining the incentive for the company to submit stretching business plans in future price reviews.

Our independent view of modelled base costs is based on:

- econometric cost modelling based on companies' actual expenditure over 2011-12 to 2018-19;
- an independent forecast of the cost drivers;
- an efficiency challenge that includes a catch up and a frontier shift component;
- an assessment of our modelled base cost allowance based on alternative model specifications; and
- an adjustment due to the inclusion of enhancement opex in our historical modelled costs.

We discuss each in the sections below. We cover frontier shift in chapter 5 (see also annex 3).

Econometric modelling

3.1.1 Our final determination decision

We use econometric models to benchmark companies' costs and set efficient cost allowances, taking into account differences in the characteristics of companies' operating regions which are largely beyond the company's control (eg population density). Once we remove differences in costs that are due to (largely exogenous) company characteristics, any remaining variation in cost across companies is attributed largely to variation in efficiency. This allows us to identify companies that are relatively efficient and use them as a benchmark for the rest of the sector.

We benchmark base costs related to operating expenditure (opex) and capital maintenance expenditure (capex). Because companies do not distinguish between base and enhancement opex in the annual reports they submit to us, the opex included in modelled base costs relates to both base and enhancement. In addition, we include some capex enhancement activities in our base costs, which we summarise in table 2 and 3.

Table 2: Enhancement wholesale water activities added to modelled base costs

Activity	Description
New developments	Expenditure for local distribution assets to provide a water service to new customers.
New connections element of new developments	Expenditure on local network assets associated with new developments in water services.
Addressing low pressure	Expenditure to reduce the number of properties with low pressure.

Table 3: Enhancement wholesale wastewater activities added to modelled base costs

Activity	Description
New development and growth	Expenditure for the provision of new development and growth in sewerage services.
Growth at sewage treatment works	Expenditure to meet or offset changes in demand from new and existing customers at sewage treatment works.
Reduce flooding risk for properties	Expenditure for enhancing the sewerage system to reduce the risk to properties and external areas of flooding from sewers.
Transferred private sewers and pumping stations	Expenditure on assets falling within the scope of the statutory transfer of private sewers and lateral drains.

We consider it appropriate to include costs driven by population growth because growth activities and base costs share similar characteristics, notably companies experience these costs on a year-on-year basis. The integrated approach also mitigates for known reporting differences between operating, capital maintenance and growth related expenditure. For example, some companies reported zero costs under historical new connections capex because they reported the costs as opex instead, as noted by South East Water in its representation to their draft determination. Regulatory Accounting Guidelines (RAGs) also allow companies to apply a level of discretion when proportioning costs between growth related expenditure and capital maintenance. These differences in reporting may therefore make standalone growth and base model results misleading.

In water, our base costs also include expenditure to address low pressure for the same reason: companies have always had a requirement to address low pressure and there has been no change to the statutory threshold they need to obtain. Four

companies report enhancement expenditure against this activity for 2020-25, and the same companies reported enhancement expenditure against this activity in the past. We consider that this is likely to be a result of inconsistent interpretation of enhancement expenditure in this area across companies, where the majority of companies report related costs as base expenditure. Including these costs in base costs therefore provides consistency in the classifications of these costs across companies.

In wastewater, we include costs associated with transferred private sewers and pumping stations. These assets have been transferred to the ownership of the water companies between October 2011 and October 2016. Any remaining cost is largely for maintaining these assets and is therefore considered part of base costs.

As in retail, our models exclude a small number of base cost items (eg pension deficit repair contributions and third party costs) which we discuss in section 3.2.

We also exclude expenditure under the New Roads and Street Works Act 1991 (NRSWA) and other diversion costs falling outside section 185 of the Water Industry Act 1991 (hereafter called “non-section 185 diversion costs”). The treatment of these costs is removed from the price control and we exclude them from our totex allowance. We provide further details of our assessment of diversion costs in ‘Our approach to regulating developer services’.

Our emphasis is to develop models that are consistent with engineering, operational and economic understanding of cost drivers. We aim to develop models that are sensibly simple (without pursuing simplicity for its own sake) and capture the main cost drivers in each cost category.

We calculate model coefficients based on the industry’s actual expenditure over eight years (2011-12 to 2018-19). We use different models to benchmark different costs:

- in water, we use models to benchmark costs at water resources plus, treated water distribution and wholesale water levels (“water resources plus” is our term for water resources, raw water distribution and water treatment combined);
- in wastewater, we use models to benchmark costs at sewage collection, sewage treatment, bioresources and bioresources plus levels (“bioresources plus” is our term for bioresources and sewage treatment combined).

We combine information from the different levels of aggregation to form our view of efficient costs. We triangulate across multiple models to ensure we do not rely on

any one model but on a suite of models. We place equal weights on all models at each level of aggregation.

Our suite of econometric models follows an extensive consultative and development process. During 2016 and 2017 we worked closely with stakeholders, through our cost assessment working groups, to develop and refine data and tools for cost assessment, drawing on lessons from PR14. In March 2018, we issued [Cost Assessment for PR19: a consultation on econometric cost modelling](#). This presented an extensive range of econometric cost assessment models developed by Ofwat and water companies. We considered stakeholders' feedback to select the models for our cost assessment. We have engaged with CEPA to support us in the development of econometric models for the wholesale water and wastewater controls, and with Vivid Economics to further develop our wholesale wastewater models in light of consultation responses. We have also received feedback from our academic advisors, Professor Andrew Smith and Dr Thijs Dekker of the University of Leeds, who have provided review and challenge throughout the process.

We refer to our initial assessment of plans document [Supplementary technical appendix: Econometric approach](#) for more detail of our model development approach and selection criteria.

3.1.2 Changes from our draft determinations

- We include the newly reported 2018-19 data (from the annual performance reports) to our estimation of econometric models.
- We apply positive and negative cost adjustments to our modelled cost baselines for companies with high and low expected growth respectively.
- We exclude non-section 185 diversion costs from modelled base costs.
- We apportion wastewater allowances between bioresources and wastewater network plus using the apportionment reported in companies' business plans.

3.1.3 Stakeholders' representations

The majority of companies' representations on modelled base costs relate to our approach to assessing growth-related expenditure. We focus on representations in this key area.

Severn Trent Water, Affinity Water and Northumbrian Water agree that growth costs can be included in base models and acknowledge this move as a sensible and

pragmatic approach for final determinations. Severn Trent Water sets out in its representations that we should not make further significant changes, given this may lead to the risk of producing models that are not robust with no opportunity for scrutiny from the sector. United Utilities says it does not have any conceptual issues with moving growth to base costs. Thames Water, Dŵr Cymru, Portsmouth Water and SES Water either do not comment or propose no alternative approach for final determinations.

In contrast, Anglian Water, Southern Water, Wessex Water, Yorkshire Water and South East Water are critical of the approach to modelling growth-related expenditure². They argue that our base econometric models do not include specific cost drivers for growth costs and therefore do not capture differences in growth related costs between companies with high and low growth rates. By using a single driver for new and existing properties, they claim that the coefficient represents the average impact on costs of an existing and a new property. They argue that this results in an unfair redistribution of expenditure from companies with a higher growth rate towards companies with a lower growth rate.

These companies also consider that the implied marginal cost of a new property from the base models is very low compared with historical expenditure, and does not align with the unit rates that we intend to use in the developer services reconciliation adjustment.

Several companies also disagree that all growth expenditure can be considered 'routine'. They claim that while on-site connections are more routine, wider reinforcement work and upgrades of treatment assets involves more lumpy investment.

Northumbrian Water and Wessex Water do not consider it appropriate to include sewer flooding risk in the base cost models as these are driven by cost drivers that are not included in the base cost models (eg climate change and urban creep).

Companies provide a range of possible alternatives to our modelling approach to growth costs.

- Excluding growth costs from base costs and using deep dives for their assessment.

² Anglian Water, Northumbrian Water, Dŵr Cymru, Yorkshire Water, Wessex Water and South East Water commissioned Reckon LLP an industry report on the inclusion of growth-related expenditure into base costs. See Reckon LLP "Review of Ofwat's treatment of growth-related expenditure in PR19 draft determination", August 2019.

- Excluding growth costs from base costs and developing improved standalone growth models using the developer services data.
- Excluding growth costs from base models and applying the base cost efficiency challenge to the company forecast growth expenditure, consistently with the developer services reconciliation adjustment mechanism.
- Retaining the approach, but applying positive and negative adjustments to account for high and low growth companies through deep dive analysis.

Except for representations on growth-related expenditure, most companies either acknowledge that we have produced a robust set of models with sensible results or do not raise significant representations on our econometric modelling suite. Nevertheless, there are a few minor comments on particular aspects of our econometric modelling. Bristol Water claims the coefficient of the weighted average complexity variable in our wholesale water models is counterintuitively higher than the coefficient of this variable in our water resources plus model. The company also challenges our density variable in wholesale water models, claiming the variable becomes insignificant if Thames Water were to be removed.

Anglian Water, Wessex Water, Thames Water and Bristol Water express support towards the adoption of the 2018-19 data to our base modelling sample. Companies say this would ensure that we set base cost allowances using the most recent historical data available.

3.1.4 Our assessment and reasons

In relation to the inclusion of the new 2018-19 data, we went through a quality assurance process of the 2018-19 annual performance report data and assessed the impact of the new data on the quality of our base econometric models. We find that the models remain robust and stable. Using the additional year of data makes the sample size larger and ensures we use the most recent historical information available. We therefore incorporate the 2018-19 data in our econometric models, increasing the sample size from seven to eight years of historical data.

In relation to representations on our integrated approach to growth-related costs, we consider that an integrated approach remains a preferred option to stand-alone models or a deep dive assessment of company's proposals of growth related costs.

Companies raised a number of issues related to the stand-alone growth models we used at the initial assessment of plans. Companies argued that the models have a wide range of unit costs across companies (which may be a result of differences in

reporting); that we should consider self-lay penetration in water; and that results in wastewater were sensitive to the inclusion of Hafren Dyfrdwy in the sample. We accepted the issues raised by the companies and considered that the integrated approach of assessing base and growth-related costs together provided a suitable mitigation.

The data provided by companies in response to our developer services data request does not enable us to develop standalone models that better capture the cost drivers of growth expenditure. Further, it does not provide additional insight into the relationship between self-lay penetration and new connection costs. There are still data inconsistencies due to the wide range of assumptions companies use to produce the data. Northumbrian Water and Hafren Dyfrdwy recommend that we do not rely on the data to set efficient cost allowances as they could not provide the data to the same level of accuracy as they do for other regulatory submissions. For these reasons, we did not test using self-lay penetration as a driver in the base models. We remain of the view that any potential distortion to modelling results due to different self-lay penetration rates is mitigated by the fact that the impact of this factor on modelled base costs is relatively low, therefore we do not make any cost adjustments for differences in self-lay penetration. We will continue to work with the industry to improve the quality of developer services data in time for the next price review in 2024.

For final determinations we remain of the view that the integrated approach is appropriate as growth related costs have similar characteristics to base costs. For example, growth related expenditure is routine – companies have incurred it in the past and will incur it in the future, and it can be explained by similar cost drivers to base costs. For example, company scale and density, and factors that proxy for energy requirements such as booster pumping stations and pumping capacity.³

Regarding the inclusion of ‘reduce flooding risk for properties’ in our wholesale wastewater base models, we find that companies generally forecast a flat profile of investment over 2020-25, and that the investment is reasonably driven by population growth and the size of the company. We therefore consider that the inclusion of this cost in our base models is appropriate.

We consider that cost allocations between base and growth costs as well as between self-lay and water company provisions is likely to overestimate the

³ See CEPA criteria for when it is appropriate to include enhancement costs in base costs econometric models. Source: [CEPA, 2018. PR19 Econometric Benchmarking Models](#). Page 34.

challenge. The integrated approach provides reasonable mitigation, which further supports our view that is a preferred option to using stand-alone models.

However, we accept that the integrated models may suffer from missing growth variables and that may lead to the base econometric models only funding the average historical growth rate across the industry. We therefore make an adjustment to our base allowance depending on whether the company operates in an area with a relatively high or low forecast of population growth, relative to the historical average for the sector.

We make upward adjustments for companies with high expected growth in 2020-25, and downward adjustments for companies with low expected growth in 2020-25 relative to the historical sector average. We take a conservative view of downward adjustments by applying a fifty percent cut to our estimated negative adjustments.

Table 4 provides our total adjustments to base allowance in respect of expected growth rates for all companies:

Table 4: Growth symmetrical unit cost adjustment

Company	Wholesale water adjustment (£m)	Wholesale wastewater adjustment (£m)
Anglian Water	11.50	29.06
Dŵr Cymru	-5.14	-11.17
Hafren Dyfrdwy	-0.70	-0.03
Northumbrian Water	-5.03	-21.39
Severn Trent Water	-6.93	-12.70
South West Water	-0.19	-0.24
Southern Water	5.57	25.42
Thames Water	27.70	81.07
United Utilities	-16.83	-37.68
Wessex Water	1.89	9.97
Yorkshire Water	-10.69	-24.00
Affinity Water	9.29	
Bristol Water	3.60	
Portsmouth Water	-0.40	
South East Water	7.05	
South Staffs Water	-2.39	

SES Water	1.66	
Industry	19.95	38.33

We calculate the growth unit cost adjustments as follows.

- We calculate the average industry historical growth rate of connected properties across the period 2011-12 to 2018-19 (excluding outliers). For wholesale water, this is 0.70% per annum. For wholesale wastewater, this is 0.71% per annum.
- We calculate the forecast growth rate for each company for 2020-25 based on Office for National Statistics (ONS) household growth projections;
- We calculate the difference between the ONS forecast growth rate and the average industry historical growth rate for each company.
- We determine the benchmark historical growth unit cost based on the upper quartile company. For wholesale water, this is £783 per new connected property. For wholesale wastewater, this is £1,715 per new connected property.
- We multiply the output of step 3 with the output of step 4 to obtain the company-specific adjustments. We halve the negative adjustments.

In addition to these adjustments, we use a deep dive assessment where appropriate to complement our modelling approach. We consider that this is the most appropriate way to address companies' representations while mitigating the risk of significant changes at this late stage of the regulatory process. In these deep dive assessment we consider if companies present strong evidence or arguments of material factors that are not captured in our models plus the adjustments that we make, and whether they are not mitigated through our wider approach that includes the Developer Service Reconciliation Adjustment.

Companies also make representations on our econometric models that do not relate to growth costs. Bristol Water highlights the higher magnitude of the weighted average complexity variable in our wholesale water models compared to our water resources plus models. We consider that the company does not provide sufficient and convincing evidence to demonstrate that this difference is counterintuitive. The two coefficients are not comparing like for like: the coefficient in the wholesale water model also captures the effect of the additional variable for booster pumping stations. Once this driver is removed, the magnitude of the coefficient approaches that in the water resources plus model. The company also claims our density variable becomes insignificant if Thames Water is removed from the sample. We

tested this and find the variable remains significant in both treated water distribution and wholesale water models. We therefore maintain our view from draft determinations that these drivers are robust.

Independent forecast of cost drivers

3.1.5 Our final determination decision

Our view of efficient costs over 2020-25 is dependent on forecast values of the explanatory factors, or cost drivers, used in our econometric models. As a result, these forecasts have a direct impact on our view of efficient allowances.

It is important to protect customers from potentially inflated forecasts that feed into cost estimates and customer bills. It is therefore an important part of our incentive-based regulation to develop an independent view of cost drivers over the forecast period.

We have revised our approach to forecasting cost drivers through the price review process. At the initial assessment of plans most of our forecasts were fully independent from companies' business plans. We often used historical information to forecast the values of our cost drivers for 2020-25. Our forecasts were based either on an extrapolation of historical trends or on the average level of the cost driver over a number of recent historical years.

At the slow track draft determinations and final determinations, we have better information than we had early in the price review process, and consequently we consider it appropriate to place weight on companies' business plans for some of the variables' forecasts, as shown in table 5. Our approach to forecasting cost drivers at final determinations better reflects what companies are expected to deliver during 2020-25 consistent with our final determinations, while maintaining the properties of our incentive-based regulation.

While forecasts based on historical values or trends are independent of company business plan forecasts, they may not capture changes in growth rates. This is the case for the number of connected properties, so we have considered independent

and recognised sources to base our forecasts on and have decided to use household growth projections from the Office for National Statistics (ONS)⁴.

For cost drivers that are directly driven by growth and we do not have a trusted, independent source, we put some weight on company forecasts, subject to a sense check of these forecasts. We reviewed company forecasts of volume drivers such as length of mains, length of sewers and sewage load entering the treatment works. For length of mains and sewers, companies' forecasts tend to be higher than projection of historical growth rates and we put 50% weight on companies' forecasts. For sewage load, most companies' forecasts are either lower or roughly the same as what would be implied by historical growth rates of the variable. We therefore use companies' forecasts of this variable to set base allowances except for Anglian Water and Northumbrian Water, whose forecasts of sewage load are significantly higher than what would be implied by historical growth rates. We have not found sufficient and convincing justification for these high forecasts in business plans or representations and apply a 50% weight for on the projection of the historical trend for these two companies.

There are other cases where we consider it appropriate to use the company forecast of the cost driver, for example for forecasts of sludge produced. This is because the bioresources price control is an average revenue control (ie there is a reconciliation between forecast and outturn volumes of sludge at the end of the period) and because our regulatory framework includes an incentive for companies to accurately forecast sludge. For final determinations, we also use company forecasts in the case of water treatment complexity, following representations from companies that historical levels do not reflect their expected programme of work.

In its representations to the draft determinations in August 2019, Wessex Water reduced its sludge forecast by four percent based on improved measurement, leading to an equivalent reduction in 2018-19 sludge production. We welcome this change, as measurement is a key input to how we set the bioresources average revenue control. Following an industry query issued to all companies, Severn Trent and Dŵr Cymru submitted revised forecasts. Both companies explain they took steps to revise the forecasts in the light of 2018-19 actual sludge production. We accept the improved forecasts.

⁴ Data on household projections in England can be obtained here: [England household projections: 2016-based](#). The Welsh data are provided separately by StatsWales and are available here: [Wales Households projections](#)

Table 5 provides a summary of the cost drivers in our econometric models and our forecast method for each driver. Our forecasts of cost drivers are included in feeder model 3 for wholesale water and wholesale wastewater, where we provide additional details of our rationale.

Table 5: Our forecast approach of explanatory factors in our base econometric model

Variable	Forecast method
Connected properties (water and wastewater)	Forecasts based on household growth rate projections produced by the Office for National Statistics (ONS).
Length of mains (water), Sewer length (wastewater)	Forecasts based on each company's forecast of the variable (50% weight) and a linear projection of the historical growth rate of the asset (50%)
Water treatment complexity (water)	Forecasts based on each company's forecast of the variable.
Number of booster pumping stations (water)	Forecasts based on a linear projection of historical growth rates.
Load received at sewage treatment works (wastewater)	Forecasts based on each company's forecast of the variable (100%), except for Anglian Water and Northumbrian Water where we place 50% on a linear projection of historical growth rates of sewage load for the company*.
Sludge produced (wastewater)	Forecasts based on each company's forecast of the variable.
Percent load treated in size bands 1-3 or in size band 6 (wastewater)	Forecasts based on the average of the last four years of historical data for each company.
Pumping capacity (wastewater)	Forecasts based on the average of the last four years of historical data for each company.
Load with ammonia consent below 3mg/l (wastewater)	Forecasts based on each company's 2018-19 level.
Weighted average density (water and wastewater)	Forecasts based on ONS population projection numbers for water and wastewater.
Sewage treatment works (wastewater)	Forecasts based on each company's forecast of the variable.

* Anglian Water and Northumbrian Water forecast sewage loads that are significantly higher than would be expected from historical growth rates. We therefore put some weight on historical growth rates for these two companies.

3.1.6 Changes from draft determinations

We adopt the companies' forecast of water treatment complexity for 2020-25 instead of forecasts based on historical levels as at draft determinations. This affects two cost drivers: "the percentage of water treated in treatment complexity bands 3 to 6" and the "weighted average treatment complexity".

3.1.7 Stakeholders' representations

We received representations on our approach to forecasting connected households, length of mains and sewers, load treated and water treatment complexity.

Anglian Water, Southern Water, Thames Water, Wessex Water, Yorkshire Water and South Staffs Water consider that ONS projections of household growth are too low and do not reflect the most up-to-date information. They claim that companies' forecasts of new connections using Local Authority planning information are more credible than ONS-based forecasts and that these have previously been agreed with the Department for Environmental, Food and Rural Affairs (Defra), the Environment Agency (EA) and Ofwat through the water resources management plan (WRMP) process.

Both South Staffs Water and Anglian Water revise their new connections forecast downwards following draft determinations. These companies acknowledge that the new connection forecasts underlying the WRMP are an optimistic view of the future, and that companies are protected through the developer services reconciliation adjustment if outturn new connections end up being higher than forecast. Similarly, customers are protected if outturn new connections are lower than forecast.

Anglian Water and Southern Water remain of the view that we should use companies' forecasts of length of mains and length of sewers, given they are aligned with their forecasts of new connections. Anglian Water presents a similar argument in relation to the sewage load variable. Additionally, Anglian Water argues that using a linear projection of historical trend to forecast load is inconsistent with the decision to use ONS rates to forecast connected properties.

Yorkshire Water, Southern Water and South Staffs Water consider that our forecasting approach for water treatment complexity is not appropriate. At draft determinations, for most companies we used the average level of complexity over a number of historical years to forecast treatment complexity in 2020-25. The companies argue that this method is not consistent with our enhancement assessment of raw water deterioration and taste, odour and colour, where we recognise the need for investment to address water quality risks, which will result in increased treatment complexity in 2020-25.

3.1.8 Our assessment and reasons

The ONS is a recognised independent source, which is widely used for forecasting. We recognise that local authority growth projections are consistent with the forecasts used by companies in their WRMPs. Local authority forecasts tend to be at the upper end of the range of possible growth rates. This may be appropriate for long term supply-demand balance planning, where these forecasts are used to identify capacity required and it may be appropriate to err on the high side. However, to set efficient base allowance in a manner that protects customers and does not expose companies to undue risk over a five year regulatory period, we consider that ONS forecasts are more appropriate. We reviewed ONS household growth projections and found that they are typically higher than historical growth rates and lower than company growth forecasts. We therefore continue to use ONS household growth projections to forecast connected properties.

Further, at PR19 we introduced the developer services reconciliation mechanism. If the number of new connections turns out to be higher than our forecast, companies are largely protected through the mechanism. Customers are similarly protected if the number of connected properties turns out to be lower than projected.

We retain our approach of forecasting length of mains and length of sewers giving equal weight to companies' view and to historical growth rates. We also retain our approach of forecasting sewage load using companies' forecast of the variable except for the two companies whose forecast is significantly above historical growth rates. We do not consider that the forecasts of these variables need to align with companies' forecast of population growth, first because we do not use companies' forecast of population growth and, second, because growth in assets does not necessarily move at the same rate as population growth. We consider that our approach strikes a balance between reflecting any change in growth rate in 2020-25 relative to growth rates in the historical period, and pegging the growth rates to historical growth rates to ensure forecasts are not unduly inflated.

We accept Yorkshire Water, Southern Water and South Staffs Water's representations on the forecast of water treatment complexity. The companies' programmes of work – which we accept as part of our final determinations – would lead to a step change in treatment complexity in line with what they forecast, and using historical data would not sufficiently capture this change. Comparing all companies' forecasts of treatment complexity with our independent forecasts, we find that there are no significant differences, except for those companies where the step change can be linked to a specific programme of work in 2020-25. We therefore adopt company forecasts of treatment complexity for all companies. This impacts

two cost drivers that we use to set base allowances: “percentage of water treated in treatment complexity bands 3 to 6” and “weighted average water treatment complexity”.

Our efficiency challenge for modelled base costs

Our efficiency challenge for modelled base costs includes two components:

- a catch up component, which provides a challenge to average and low performing companies to catch up with high performing companies in the sector; and
- a frontier shift component, which provides a challenge for the sector, including for the high performing companies, based on expected improvements in productivity through innovation and technological progress.

We discuss below our approach to setting the catch up challenge. We discuss our approach to frontier shift in chapter 5.

3.1.9 Our final determination decision

We use our econometric models to identify high performing companies in the sector. We have a range of econometric models at different levels of aggregation. For the purpose of setting the catch-up challenge we aggregate our modelling results to the wholesale water and wholesale wastewater level to identify the most efficient companies in each service.

We use the performance of the most efficient companies as a benchmark. We expect the rest of the companies to catch-up to this benchmark.

In our [PR19 draft determinations: Securing cost efficiency technical appendix](#) we set out our concerns that the wastewater catch-up efficiency challenge did not provide a sufficiently strong efficiency challenge. This was evidenced by the fact that the sector received a higher bioresources base cost allowance than it requested, despite applying an upper quartile efficiency challenge. We said that for final determination we would consider applying a separate catch-up efficiency challenge to each of the wholesale wastewater controls – bioresources and wastewater network plus. We would also consider using the bioresources models alone to set the bioresources controls.

Following companies' representations, we decide not to apply a separate catch up challenge for bioresources and wastewater network plus for final determinations. Instead, we consider it necessary to strengthen the catch-up challenge at the wholesale level.

For wholesale water base costs, we set the catch-up efficiency challenge at the fourth placed company (out of seventeen companies). That is, a level of base cost efficiency that four companies have achieved and thirteen companies are lagging behind.

For wholesale wastewater base costs, we set the catch-up efficiency challenge at the third placed company (out of ten wastewater companies)⁵. That is, a level of base cost efficiency that three companies have achieved and seven companies are lagging behind.

The level of catch-up challenge that we set at final determinations is beyond that of the "upper quartile" company we applied at draft determinations.

3.1.10 Changes from our draft determinations

- We strengthen the catch-up challenge applied to modelled base costs.
 - For the water resources and water network plus controls, we move from an "upper quartile" catch-up challenge, equivalent to the fifth most efficient company, to the fourth most efficient company in the sector in wholesale water.
 - For the bioresources and wastewater network plus controls, we move from an "upper quartile" catch-up challenge, which is between the third and fourth most efficient companies, to the third most efficient company in the sector in wholesale wastewater.
- We apportion wholesale wastewater efficient costs to the bioresources and wastewater network plus controls based on business plan proportions.

⁵ In our historical sample from 2011-12 to 2018-19 there are 10 wastewater companies as Hafren Dyfrdwy did not exist in its current form during these years.

3.1.11 Stakeholders' representations

Only Thames Water makes representations on the upper quartile catch-up challenge, arguing that the companies found to be upper-quartile efficient are small and do not represent the efficiency challenges that big companies face.

Several companies responded to our request for views on the application of separate catch-up efficiency challenges to each of the wastewater network plus and bioresources price controls. Anglian Water, Northumbrian Water, United Utilities and Dŵr Cymru disagree with using a separate catch-up efficiency challenge for the bioresources price control.

Anglian Water presents evidence on the inverse relationship between companies' relative efficiency in bioresources and wastewater network plus. It suggests that cost allocation differences between the price controls may be driving this and that efficiency should therefore be assessed at the wholesale level. United Utilities also mentions the allocation issue of costs between the two price controls. Similarly, Dŵr Cymru mentions the trade-offs and cost allocation differences as reasons to not use a bioresources specific catch-up efficiency challenge. Northumbrian Water suggests that the benefit of triangulating across a suite of models would be lost if applied to smaller individual controls.

United Utilities proposes the alternative approach to allocate allowed costs between bioresources and wastewater network plus based on proportions from business plans, consistent with the approach taken to wholesale water. Dŵr Cymru makes the same suggestion.

In relation to the above, Anglian Water reports that liquor treatment costs may have not been reported consistently across companies. The company notes that companies reported future liquor treatment costs in the bioresources price control, while historically these costs were reported as sewage treatment costs. This might understate the allowance for the bioresources price control.

3.1.12 Our assessment and reasons

In relation to the application of separate catch-up efficiency challenges to wastewater network plus and bioresources price controls, following companies' representations we maintain the use of a single catch-up challenge calculated at wholesale wastewater level. For final determinations we allocate allowances between bioresources and wastewater network plus based on proportions from business plan

costs, which is consistent with United Utilities' and Dŵr Cymru's representations. This approach is consistent with the approach taken for wholesale water; addresses concerns of cost allocation and trade-offs between controls; and addresses the issue of companies receiving a significantly higher cost allowance in bioresources than its requested cost. This approach also addresses Anglian Water's concerns regarding the reporting of liquor treatment costs, as allowances are apportioned based on company business plan costs and therefore reflect the new reporting guidelines for liquor treatment costs.

Further stretch of the catch up challenge

At PR14 we set the catch-up efficiency benchmark at the 'upper quartile' level of historical cost efficiency. In our PR19 methodology we said that at PR19 we will look to strengthen the efficiency challenge of PR14. We said that we would expand the set of evidence we use to inform our efficient cost baselines. We would use historical and forward-looking cost performance to identify the most efficient companies in the sector, which will set the benchmark for the rest of the companies. By using all available information to set our cost baselines, we ensure that our baselines are stretching, so that customers do not pay more than necessary for the services they receive. We said that we would determine the appropriate level of efficiency challenge for the five years of 2020-25 when we set draft and final determinations.

Despite what we indicated in our PR19 methodology, at draft determination we did not use forward-looking data from business plans to set the efficiency challenge in wholesale controls (although we did so in the residential retail controls). Instead, we only used historical 'upper quartile' cost performance to set the efficiency challenge. At draft determinations the historical upper quartile performance delivered a strong challenge.

Following changes to our data and modelling approach since draft determinations (e.g. the removal of non-section 185 diversions costs and the inclusion of the 2018-19 data), the stringency of the historical upper quartile as a catch up efficiency challenge has reduced. Out of 17 water companies, 12 companies now forecast modelled base costs for the period 2020-25 that are lower (i.e. more efficient) than the projected efficient costs under the historical upper quartile. This compares to only six out of 17 at the slow track draft determinations. The historical upper quartile does not appear to deliver a strong challenge for the sector at final determinations. We acknowledge that part of the reason for the reduced challenge is companies reducing their requested costs in August 2019 representations to draft determinations. This may reflect that companies have improved the understanding of their costs through the price review process. It is appropriate for us to re-assess

whether the catch-up efficiency challenge sufficiently protects the interest of customers.

We acknowledge companies' representations and incorporate the new data from the 2018-19 annual performance reports to our econometric models. Evidence suggests that 2018-19 was a high cost year relative to historical years. The evidence from business plans also suggests that it was a high cost year, in terms of base costs, relative to the costs forecasted by companies for the 2020-25 period. Both in water and wastewater most companies forecast annual base costs over 2020-25 that are lower than the costs incurred in 2018-19. In water, the sector forecasts annual costs that are lower by 16.2% from the costs in 2018-19, and in wastewater the sector forecasts annual costs that are 5.2% lower. This is not driven by one or two large companies, but by the majority of companies. It is therefore appropriate that we consider how to use business plan forecasts to calibrate the catch up challenge for final determinations.

We also note that the level of the historical upper quartile challenge has steadily decreased from the initial assessment of plans to draft determinations, and again following the incorporation of the 2018-19 data after draft determinations. The upper quartile challenge is also significantly lower than the corresponding value at PR14, and relative to the efficiency challenge of the frontier companies. See table 6.

Table 6: Comparison of the upper quartile challenge at different price controls and different stages at PR19⁶

	Wholesale water	Wholesale wastewater
PR14 final determinations	6.5%	10.4%
PR19 initial assessment of plans	4.8%	3.7%
PR19 slow track draft determinations	4.2%	1.4%
PR19 final determinations	3.9%	1.2%

Other regulators have also previously set more stretching benchmarks than the upper quartile. Most recently, the Northern Ireland Utility Regulator used the fourth placed company (out of fifteen companies) to set the efficiency benchmark in the

⁶ The upper quartile percentage represents the reduction in costs, for a given level of outcomes, which an average efficient company needs to achieve to catch up with the upper quartile efficient company.

price control determination for NIE Networks for the period 2017-2024 (RP6)⁷. Postcomm, Ofcom and Monitor have previously employed an upper decile benchmark in their regulation of Royal Mail delivery offices, British Telecom and acute health care providers respectively⁸.

The price review is an asymmetric process with asymmetric information between companies and the regulator. The process allows companies to make representations and provide evidence to draw attention to areas where they may deserve a higher allowance. Companies have less incentive, and other stakeholders less ability, to draw attention to situations where we may have made an over generous allowance. Against this backdrop, we said in our PR19 methodology that our approach would include an adjustment process, where we would consider downward adjustments to our baselines based on our own analysis.

As part of our wider cost assessment approach we have made adjustment to companies in light of cost adjustment claims, representations and our consideration of alternative econometric models. These measures and provisions of our wider framework reduce the impact of statistical errors on our final cost allowances. They are also one-sided in most cases, increasing allowances for companies.

In consideration of the process asymmetry, and given the evidence that the historical upper quartile does not provide a stringent catch up challenge to company forecasts of base costs, we consider that it is appropriate to strengthen the challenge for final determinations. We set the catch up challenge at the fourth most efficient company in wholesale water and the third most efficient company in wholesale wastewater.

Our choice retains a credible set of companies to determine a catch-up efficiency challenge for the rest of the sector. For water the set of companies comprises Portsmouth Water, Yorkshire Water, South West Water, and South Staffs Water. In Wastewater the companies are Severn Trent Water, Wessex Water and Northumbrian Water. The set of water companies includes a mix of smaller and larger companies. The companies in the set also represent a mix of outcomes performance, and also represent a mix of investment cycle positions. Most of these companies were identified as relatively efficient in our price review 2014.

Setting the challenge at the fourth placed company in water and third placed company in wastewater still leaves eight out of 17 companies whose business plans'

⁷ The exact upper quartile would have been equal to the company at position 4.5. Source: <https://www.uregni.gov.uk/rp6-final-determination>.

⁸ Source: https://www.ofcom.org.uk/__data/assets/pdf_file/0019/69400/benchmarking-report.pdf

modelled base costs are more efficient than our efficient benchmark. Moreover, it leaves sufficient headroom relative to the most efficient companies in the sector. We consider that our catch-up challenge remains on the conservative side and could have been stretched even further. However, taking into account the overall stretch of our determinations, we consider this choice to be appropriate and in the interest of customers.

Table 7 shows the catch up challenge at different industry performance levels. We consider that our choice of catch up challenge is at the low end of a credible challenging range.

Table 7: Comparison of the catch-up challenge at different performance level

Benchmark	Wholesale water	Wholesale wastewater
Upper quartile	3.9%	1.2%
4th company	4.6%	2.0%
3rd company	5.7%	8.7%
Frontier	21.4%	15.0%

3.1.13 Assessment of our modelled base cost allowance based on alternative model specifications

We aim to develop models that are operationally sound, capture the main cost drivers and are statistically robust. We recognise that there are practical limitations to the use of statistical modelling in cost assessment. All models are subject to error and a degree of bias. To mitigate the risk of error and bias, we triangulate cost estimates from a diverse set of models (ie by placing weights on different results) to estimate efficient costs. These models capture a range of drivers and different levels of aggregation, as outlined in Annex 2.

For final determinations, we carry out an assessment of our modelled base cost allowance in wholesale water. We do that by comparing our modelled base allowance to results from alternative model specifications. The alternative specifications are informed by company representations, and include the following cost drivers.

- The number of new connected properties to more explicitly control for differences in growth related expenditure.
- Average pumping head⁹ to proxy for the energy requirements of each company, in place of the number of booster pumping stations.
- The percentage of lengths of mains renewed or relined as a proxy for the level of maintenance activity undertaken and network age.

⁹ The larger the pumping head, the higher a cubic meter of water needs to be pumped and the higher the pumping costs. Average pumping head reflects topography and the volume of water pumped.

- The distance from the upper quartile 2024-25 leakage target, and its squared term, as a driver of leakage costs based on PwC analysis¹⁰.
- The distance from the upper quartile 2019-20 leakage target (and its squared term) as a driver of leakage costs based on PwC analysis¹¹.

To assess the need for an adjustment, we compare our final determination view of wholesale water base allowances to those companies receive from these alternative specifications¹². We assess the difference against two criteria.

- We consider whether our preferred model specifications lead to either the highest or lowest allowance compared to all alternative model specifications.
- We assess the materiality of the difference between our view and the alternative specifications. Because we already mitigate for model bias by triangulating across a set of different econometric models, we set a relatively high bar for the need of adjustment of 2 percent.

United Utilities, Wessex Water and Yorkshire Water all meet the first criterion for the application of a negative adjustment (ie our preferred model specifications lead to the highest allowance compared to the alternative model specifications) but do not meet the second criterion. Only Anglian Water meets both criteria, resulting in a positive adjustment of £50.2 million to their wholesale water modelled base allowance. We provide the detailed calculation of our adjustments to base costs in our feeder model for base adjustments.

For wholesale wastewater models, we do not test a wide range of alternative model specifications as companies' concerns on these models (mainly related to bioresources cost drivers) were largely addressed at draft determinations. We test the inclusion of new connected properties as an additional cost driver and found the results were not intuitive (i.e. statistically insignificant and sometimes negative). We address company growth representations separately through the two-sided unit cost adjustments for growth costs and through deep dives, as discussed above. We also re-examined a number of wholesale wastewater models that we considered at our

¹⁰ Source: PwC – Funding approaches for leakage reduction, 2019. Funding approaches for leakage reduction. As suggested by PwC, we also include an interaction term with a Thames Water dummy variable given the outlier performance of the company.

¹¹ Ibid.

¹² We take an average of the two specifications with a leakage cost driver to ensure that we put an equal weight on each cost driver being tested (growth, energy requirements, level of maintenance activity / age of network, and leakage).

initial assessment of plans and found that no companies met both criteria outlined above.

Removing the enhancement opex implicit allowance

Our base models use historical data to derive the relationship between base costs and cost drivers, which we use to forecast future expenditure (see above). The historical data includes total opex, some of which relates to historical enhancement activities. Our forecast of future expenditure will therefore include an allowance for enhancement opex. Since we make totex allowances for enhancement activities, which include opex and capex, our allowance would be double counting the enhancement opex.

To ensure that customers do not pay twice for enhancement opex, once through our base allowance and once through our enhancement allowance, we estimate the implicit allowance in our base models and remove it from our base allowance.

3.1.14 Our final determination decision

We take a top down approach to calculating the enhancement opex implicit allowance. In April 2019, we issued a query to all companies requesting information on enhancement opex in their 2017-18 cost data, and the year they used as a reference for classifying any expenditure as enhancement. Six companies reported all relevant enhancement opex in 2017-18. We use the data from these six companies to estimate enhancement opex for all companies. Enhancement opex would typically increase year on year after the base year at the beginning of the period. We therefore consider it reasonable to use 2017-18 as an 'average' year for enhancement opex because it is half way through the 2015-20 period and therefore a reasonable proxy for the average in the period. We do not have data for actual expenditure on enhancement opex before 2017-18 as it has not been a part of our historical data collection, and any data for after 2017-18 is forecast rather than actual spend.

We calculate an implicit allowance separately for water and wastewater as follows:

1. we add the 2017-18 enhancement opex reported by the six companies for all categories of enhancement, except those that we consider as part of our base models. (This applied to five companies for wastewater rather than six because one company is a water only company);

2. we add the 2017-18 costs for the same six companies for all categories of totex that go into our base models;
3. we calculate the proportion of enhancement opex in 2017-18 out of modelled base costs for the six companies combined;
4. we calculate the enhancement opex implicit allowance by applying the proportion from step three to our 2020-25 base allowances; and
5. we remove our calculated implicit allowance for all companies from our base totex allowances. We make totex allowances for enhancement.

Table 8 shows the results of our calculation of enhancement opex implicit allowance.

Table 8: Enhancement opex implicit allowance (IA)

	Wholesale Water IA (£m)		Wholesale Wastewater IA (£m)	
	Draft Determination	Final determination	Draft Determination	Final determination
Anglian Water	12.9	9.1	5.8	4.7
Dŵr Cymru	10.2	7.3	3.2	2.9
Hafren Dyfrdwy	1.0	0.7	0.1	0.1
Northumbrian Water	11.5	8.3	2.4	2.2
Severn Trent Water	22.1	15.8	7.4	6.3
South West Water	6.4	4.8	2.1	1.8
Southern Water	6.7	4.9	4.4	3.8
Thames Water	31.3	23.4	11.1	9.0
United Utilities	19.6	13.9	6.0	5.0
Wessex Water	4.8	3.3	2.7	2.4
Yorkshire Water	13.5	9.8	4.5	3.8
Affinity Water	9.8	7.3		
Bristol Water	3.4	2.4		
Portsmouth Water	1.6	1.1		
South East Water	6.0	4.6		
South Staffs Water	3.9	3.0		
SES Water	1.6	1.3		

3.1.15 Changes from our draft determination

There are no changes to our draft determination approach.

3.1.16 Stakeholders' representations

We have representations on our draft determination approach from six companies, Anglian Water, Bristol Water, Dŵr Cymru, Southern Water, United Utilities, and Yorkshire Water. Anglian Water is supportive of our approach. The other five companies raise a number of points, which we summarise as below.

- The approach is not part of the methodology and may not be sufficiently robust. There is significant variation of enhancement opex proportions across companies, which leads to a highly sensitive model.
- Enhancement is lumpy. The companies suggest that the six companies' data we used had substantially higher enhancement capex in 2017-18 than the industry average.
- The approach takes away more enhancement opex for some companies than they have in their business plans.
- The approach is not accurate because there can be a lag between enhancement spend and additional opex requirements.
- The approach assumes enhancement opex ceases at end of 2015-2020 period, whereas in practice, some opex solutions will continue and need to remain in our base allowance.
- The approach assumes a pro-rata increase in base allowance due to historical enhancement opex but the increase could have had a different effect.

3.1.17 Our assessment and reasons

We acknowledge the lumpiness and the variation in proportion of enhancement opex across companies. We also acknowledge that some opex solutions may continue beyond the 2015-20. We consider alternative approaches to calculating the enhancement opex implicit allowance and conclude that our approach results in conservative estimates.

We consider our approach for final determinations in the light of an additional year of actual data reported to us (2018-19). We also consider the impact of using all company data in the calculation in response to some of the representations.

Table 9 shows that if we were to use 2018-19 to calculate the proportion of enhancement opex, we would have deducted a larger implicit allowance compared to using 2017-18 data. In response to a representation, we also confirm that the proportion of enhancement opex would be higher if were to use all eleven

wastewater companies' data (the proportion is 0.457% in 2017-18 and 0.755% in 2018-19).

Table 9: Proportion of enhancement opex in base costs used in models

	2017-18	2018-19
Water (6 companies)	1.027%	1.270%
Wastewater (5 companies)	0.281%	0.482%

Company query responses confirm our concerns regarding data comparability for some companies. For this reason, we conclude that we should be cautious and continue to use the data from the five or six companies with the same clear and comprehensive basis of completing the data tables.

Despite the representations that enhancement opex typically lags behind capex we still consider it appropriate to use 2017-18 as it is the mid-year of the five year period, rather than using 2018-19 or indeed any other calculation.

We consider calculating the implicit allowance based on an unweighted average of enhancement opex proportion across companies rather than a weighted average (ie the proportion of total enhancement opex across companies of total base costs) Using an unweighted average approach in water for example would increase the enhancement opex proportion from 1.027% to 1.189%.

We assess data from the June Returns (2005-06 to 2009-10) to consider the impact of moving to a totex regulatory framework on the proportion of enhancement opex in base costs. We find that wastewater enhancement opex made up approximately 4.2% of total wastewater opex reported in the industry over the period¹³. In the PR19 business plan proposals for 2020-25, opex is between 35% and 55% of base costs. Assuming that opex was a similar proportion of base costs over the period 2005-06 to 2009-10 (between 35% and 55%), we calculate that enhancement opex was between 1.5% and 2.3% of base costs over the period 2005-06 to 2009-10. This suggests a significantly higher proportion of enhancement opex in base costs between 2005-06 and 2009-10 than we see in AMP7 business plans. This suggests we are being proportionate or even conservative in using the 2017-18 proportions as a proxy for proportions across the model input data set of 2011-12 to 2018-19, which includes the time before moving to a totex regulatory framework.

One representation suggests we should cap the implicit allowance at the total enhancement opex in each company's plan. We do not agree with capping

¹³ Based on Table 36 of the June Returns.

enhancement opex to that in the plan. The enhancement opex implicit in our base allowance is based on historical data and is therefore unrelated to what companies are proposing in their business plans for 2020-25.

We cannot determine the effect of enhancement opex on the estimated cost function due to a lack of historical data. Therefore, with the data available, we consider the most appropriate and intuitive approach to removing the implicit allowance is by a proportional adjustment to our modelled base cost allowances.

Overall, we consider we have adopted an appropriate approach to calculating the enhancement opex implicit allowance given the data available, and protects consumers from the risk of double funding enhancement opex within the price control

3.2 Unmodelled base costs

We exclude a small number of base cost items from our econometric models. The costs that we exclude are:

- abstraction and discharge service charges (water service only);
- business rates;
- costs associated with the Traffic Management Act (TMA);
- wastewater Industrial Emissions Directive costs (wastewater service only);
- third party costs;
- pension deficit recovery payments; and
- non-section 185¹⁴ diversions costs

We set out below the approaches we take in coming to our view of efficient unmodelled costs.

¹⁴ Costs of diverting mains where the request is not made under section 185 of the Water Industry Act 1991. This will include works requested under the New Roads and Street Works Act 1991 and works in connection with large infrastructure projects such as High Speed 2 (HS2).

Abstraction charges and discharge consents

3.2.1 Our final determinations decision

The Environment Agency, Canal & River Trust and Natural Resources Wales impose abstraction charges on water companies to recover their costs of managing and regulating abstractions and discharge consents.

We exclude abstraction charges from our econometric models due to the lower degree of controllability and bespoke company and regional issues.

We assess each company's forecast of Environment Agency and Canal & River Trust service charges for the period 2020-25 and commentary separately. We seek clarifications from companies where there are significant variations between historical and forecast costs, and apply an efficiency challenge where we do not consider companies' explanations of material increases adequate.

An uncertainty mechanism for abstraction charges

We are aware that the Environment Agency is intending to consult on a change in how it calculates its abstraction licence charges. We therefore consider there is increased uncertainty around how much water companies will be charged in the period 2020-25. Due to the limited control companies have over the level of these charges we consider it appropriate to allow a further protection for companies and customers through a reconciliation mechanism at the end of the 2020-25 period, with special sharing arrangements for abstraction licence charges.

The reconciliation will allow a company to recover 75% of any costs in excess of its PR19 cost allowance, or allow customers to recover 75% of the amount by which its costs are lower than PR19 allowances. We will reconcile these adjustments alongside the totex sharing adjustments for the company and we will set out the approach to reconciliation adjustments in the PR19 Reconciliation Rulebook.

We consider that this mechanism provides companies with appropriate protection in respect of efficiently incurred costs while retaining some incentive for companies to fully engage with the Environment Agency over the change in abstraction licence charges. We will consider claims for additional adjustments by individual companies on a case by case basis at PR24 where they are able to demonstrate that a material change to charges, beyond prudent management control, has put them at a material disadvantage under the 75% sharing rate.

We set out in our PR19 final determination document for Bristol Water that we are including a Notified Item for uncertainty associated with charges payable to the Canal & River Trust for abstraction from the Gloucester and Sharpness Canal. The Notified Item is separate and distinct from the partial cost adjustment claim of £5.9 million we are making in respect of a Bristol Water's Canal & River Trust costs that we refer to elsewhere in this document.

3.2.2 Changes from our draft determinations

We introduce a cost sharing arrangement which will allow a company to recover 75% of any costs in excess of its PR19 cost allowance, or allow customers to recover 75% of the amount by which its costs are lower than PR19 allowances.

3.2.3 Stakeholders' representations

There are no representations on our approach to setting an allowance for Environment Agency and Canal & River Trust service charges for abstraction and discharge consent costs. Bristol Water makes representations on the cost it incurs from Canal & River Trust to receive water from the Gloucester and Sharpness Canal, which we consider separately as a cost adjustment claim.

Business rates

3.2.4 Our final determinations decision

For wholesale water, we calculate each company's expected 2017-18 business rates using the 2017 rateable values supplied by the Valuation Office Agency and the 2017 multiplier set by central government.

For wholesale wastewater, we calculate each company's expected 2017-18 business rates using the 2017 rateable values supplied by the companies and the 2017 multiplier set by central government.

We do not take the revaluations due in 2021 and 2024 into account in our allowances. We also do not take into account increases in business rates due to changes in wastewater asset stock in the period 2020-25.

Nonetheless, we recognise that companies have limited control over the level of business rates and the effect of revaluations. We therefore allow a further protection for companies and customers through a reconciliation mechanism at the end of the 2020-25 period, with special sharing arrangements for business rates.

The reconciliation will allow a company to recover 75% of any costs in excess of its PR19 cost allowance, or allow customers to recover 75% of the amount by which its costs are lower than PR19 allowances. We will reconcile these adjustments alongside the totex sharing adjustments for the company and we will set out the approach to reconciliation adjustments in the PR19 Reconciliation Rulebook.

We consider that this mechanism provides companies with appropriate protection in respect of business rates, recognising that some factors are outside of companies' control, while retaining some incentive for companies to fully engage with the Valuations Office Agency to minimise the change in business rates and to affect the factors that companies can influence. It also protects customers by ensuring they share benefits for companies where the Valuation Office Agency reduces the level of business rates.

3.2.5 Changes from our draft determinations

We introduce a cost sharing arrangement which will allow a company to recover 75% of any costs in excess of its PR19 cost allowance, or allow customers to recover 75% of the amount by which its costs are lower than PR19 allowances.

3.2.6 Stakeholders' representations

Seven companies provide representations on our approach to setting allowances for business rates. They all focus on the effect of revaluations in the period 2020-25 and the certainty that business rates will not be maintained at the current level.

Severn Trent Water highlights the range of impacts of the 2017 revaluation and that some companies were paying significantly more or less than that assumed at PR14, creating 'winners' and 'losers'.

Dŵr Cymru argues that transitional relief does not apply in Wales and therefore any revaluation effect will be immediately and wholly applied. It also argues that business rate increases due to asset additions can be reliably measured now and therefore should be included in the final determinations. Other companies agree and say that

we should allow for asset growth since it is part of their capital programmes and will be required to meet statutory obligations.

Three companies argue that while they have some degree of influence over some aspects of the revaluation process they have little overall control as much is pre-determined. Severn Trent Water also refers to a 2015 National Audit Office recommendation that Ofwat should “look to increase the pass-through to customers of costs or benefits which are outside companies’ control” and argues that other regulators treat business rates as a pass-through cost.

We also receive communication from a number of companies relaying information they obtained from the Valuation Office Agency (VOA) in November 2019 regarding draft rateable values for future years.

3.2.7 Our assessment and reasons

We consider companies representation on our approach to revaluations. We acknowledge that draft rateable values were available in November 2019. However, since they are still draft, and without knowing the overall revaluation landscape and the effect on the multiplier set by central government, we do not have enough information to make an accurate reflection in our final determinations. We note that while a few companies include increases in business rates due to the revaluations planned in 2021 and 2024 in their forecasts, other companies do not factor it in as there is too much uncertainty.

We also acknowledge that the varied effect of the 2017 revaluation has created ‘winners’ and ‘losers’ when compared to our PR14 allowances.

We therefore maintain our draft determinations approach for making an allowance in respect of business rates. Nonetheless, after considering the arguments presented in the representations, we consider it appropriate to allow for a reconciliation mechanism in respect of business rates with greater protection for companies and customers against the uncertain outcomes of the revaluations.

Traffic Management Act costs

The Traffic Management Act (TMA) 2004 places a duty on local authorities to make sure traffic moves freely and quickly on their roads and the roads of nearby authorities. Water companies who want to carry out street works must apply to the

highway authority for a permit. Companies incur costs relating to the permits themselves as well as the administration of the permit schemes.

At PR14, TMA costs were included in our econometric models. Given that these costs are incurred only by a subset of companies and are not well correlated with the cost drivers in our econometric models, we decided to exclude these costs from our models.

3.2.8 Our final determinations decision

We analyse companies' proposed costs against those that have been incurred historically. Our general approach is to challenge proposed costs using the company efficiency factor, namely, the same efficiency challenge as applied to the company's proposed base costs. Where there are significant increases, we carry out a company-specific review based on the evidence presented in business plans and challenge costs accordingly.

3.2.9 Changes from our draft determinations

No change in approach from draft determinations.

3.2.10 Stakeholders' representations

Yorkshire Water argues that the majority of TMA costs are outside of its control. Its representation states that our draft determination decision to reduce its costs by 50%, was disproportionate compared to cost challenges in other areas where we apply 20% reductions. It also provides some evidence to argue that the majority of cost drivers are outside of its control.

The company states that highway authorities are responsible for deciding whether to introduce permit schemes and the cost per permit within the scheme. It also states there are other cost drivers which the company has some degree of control. These include work volumes (which may be driven by external factors such as extreme weather) and permit related costs (which may be driven by permit stipulations such as additional costs due to out of hours working).

Northumbrian Water agrees with our draft determinations decision but proposes a notified item for the uncertain lane rental costs we disallowed in our draft determination.

3.2.11 Our assessment and reasons

We did not receive representations which significantly challenge the validity of our overall approach at draft determinations.

We accept that some elements of TMA costs, such as permit schemes and direct permit costs, are outside the control of companies and companies are given allowances to cover these expected additional costs where appropriate. However, companies do have control over work scheduling and how to manage any permit-related costs.

Regarding Northumbrian Water's proposal for a notified item to cover lane rental costs, we do not consider that the company provides sufficient evidence to demonstrate that new schemes are likely to be introduced in 2020-25. We consider that our cost allowances and our price control framework and the totex sharing mechanism provide adequate protection given the uncertainty of introducing new schemes in 2020-25 and the materiality of the costs.

Other costs

Pension deficit recovery contributions

In 2009, we set a pension deficit recovery period for each company. For those companies whose recovery period extends to 2020-25, we allow them to recover 50% of the remaining deficit. We do not make any allowances for those companies whose recovery periods end before 2020.

We follow the approach set out in our information notice '[IN 13/17: Treatment of companies' pension deficit repair costs at the 2014 price review](#)' (October 2013).

South East Water argues that it is inappropriate to apply further efficiency challenges as it has made all efficiencies that it can and that our calculation assumes a cumulative efficiency.

We do not consider that our efficiency challenge is cumulatively applied, instead we apply the same challenge to each year's allowance. This is consistent with the approach we set out in IN13/17 and that which we followed at PR14.

We maintain our approach at final determinations, other than to apply an updated forecast of inflation.

Third party costs

Third party costs are incurred by companies in providing services outside of their principal services. Such activities are set out in regulatory accounting guideline (RAG) 4 and include supplying non-potable water and bulk supplies, providing standpipes and water tanks, and fluoridation, amongst others.

We allow companies' third party costs included in their business plans. We challenge companies that report revenues less than their costs to ensure that customers are not disadvantaged. This is the same approach as at draft determinations.

Non-section 185 diversions costs

Requests to companies to move pipes are generally made under section 185 of the Water Industry Act 1991. We expect companies to recover reasonable costs of moving pipes to satisfy section 185 by charging developers. We have set out our approach in more detail in 'Our approach to regulating developer services'.

For final determinations we are moving two categories of diversions revenues out of the price control. These categories relate to diversions requested not under section 185 of the Water Industry Act 1991 (non-section 185 diversions). These are:

- diversions requested under the New Roads and Street Works Act 1991 (NRSWA - where legislation restricts the amount companies can charge to around 82% of the costs)
- other non-section 185 diversions, such as those required for High Speed 2. This means that water companies will bear the risk of any deviation from our view of diversions costs but they will be able to retain all of the revenue related to them

We added the remaining 18% of the NRSWA costs, which companies cannot recover from developers, to the amounts to be recovered from customers in general as an addition to our base allowance. For other non-section 185 diversions, we have assumed that companies should recover all of their costs from developers and so will not be recovering additional revenues from customers.

Wastewater Industrial Emissions Directive costs

Three companies include costs associated with the Industrial Emissions Directive. These costs are generally of low materiality. We analyse the forecast costs against historical trends and challenge where appropriate.

There are no representations on our approach to assessing Industrial Emissions Directive costs. We maintain our approach at final determinations.

4. Our assessment of enhancement costs

In this section we explain how we set efficient cost allowances for enhancement proposals.

Enhancement expenditure relates to investment for the purpose of enhancing the capacity or quality of service beyond a base level. It may be driven by a number of factors including new statutory obligations and strategic priorities companies develop in consultation with their customers.

Table 10: Overview of the contents of the enhancement costs chapter

Section	Section name
4.1	High level approach to enhancement
4.2	Our approach to enhancement costs where we have common performance commitments
4.3	Resilience
4.4	Supply-demand balance (drought resilience)
4.5	Metering (including supply-demand balance and metering joint assessment)
4.6	Environmental obligations under the Water Industry Environmental Programme (WINEP) in England, or National Environment programme (NEP) in Wales
4.7	Other enhancement areas (eg water quality, security)

We provide detail of our approach to strategic regional water resource development including the enhancement costs for this programme in the 'Strategic regional water resource solutions appendix'.

4.1 Our high level approach to enhancement assessment

4.1.1 Our final determination decision

Our enhancement assessment is done on a totex basis and we make totex allowances (that is, capex and opex) for efficient and well evidenced enhancement proposals.

Most enhancement activities are occurring within a single PR19 price control: water network plus, water resources, wastewater network plus or bioresources. Where activities cut across two controls within the water or wastewater service, we make

our assessment at the wholesale level. We apportion our efficient wholesale allowance based on each company business plan proportions of requested costs for the activity, unless our challenge relates to costs in a specific control, in which case we deviate from business plan proportions.

We generally assess enhancement expenditure separately for each enhancement category, as defined by the individual enhancement cost lines in company business plan tables. We assess multiple lines together where there is a potential for costs to be apportioned differently by companies and where there is some synergy between programmes.

Our preferred method of assessment is benchmarking analysis of forecast costs. Where the investment area does not lend itself to statistical modelling we rely more on the evidence provided by companies in their business plans. We follow a risk-based process of having a lighter touch ('shallow dive') assessment for low materiality costs and a more thorough assessment of the evidence ('deep dive') for high materiality costs.

Table 11: Our assessment methods for enhancement expenditure

Assessment method	Description of approach
Benchmarking analysis	For enhancement activities where most companies incur costs and we identify appropriate cost drivers we develop econometric or unit cost models. Our benchmarking analysis relies on forecast data from company business plans, except for 'first time sewage' in wastewater where we put some weight on historical data.
Deep dive	If the expenditure is above 0.5% of the company's water or wastewater wholesale totex, we carry out a deep dive assessment. The deep dive process follows our assessment of cost adjustment claims (see chapter 7). We assess the evidence provided by the company on the need for investment; options appraisal; robustness and efficiency of costs, and customer protection where appropriate. In very material cases we also look for evidence of affordability and board assurance in light of impact on customer bills. Where a compelling case is presented, that is well supported by a cost-benefit analysis of different intervention options, and a transparent breakdown of appropriate and efficient costs, we allow the expenditure in full.
Shallow dive	If the expenditure is below 0.5% of the company's water or wastewater wholesale totex, we carry out a shallow dive assessment. Our shallow dive is light touch and we allow the costs after applying a 'company-specific efficiency factor' (discussed below) where appropriate. At our discretion we may carry out a deep dive assessment for investments that are below but close to this threshold, particularly where we are assessing other companies' proposals through a deep dive. There are some enhancement activities where the costs proposed by each company, as well as by all companies combined, are of very low materiality and for these we allow the proposed costs in full.

Optioneering challenge in deep dive assessment

Solution options considered can range considerably in cost. Companies have provided evidence that options such as reinforcing a length of main and replacing the same main can have a difference in cost of 35%. Where we accept the need for the investment, but the company has not provided a thorough options appraisal that demonstrates it chooses the best option for customers, we challenge the proposed costs. We do that in two ways:

- If a company provides evidence that a lower cost option was available but gives no reasons as to why it was rejected, we use the lower cost option.

- Where a company does not provide evidence that the selected option is optimal, we protect customers from a potentially sub-optimal solution by applying a 20% challenge to proposed costs.

Cost efficiency challenge in deep and shallow dive assessments

We expect companies to provide robust, transparent and proportionate evidence on the efficiency of their cost proposals. Where there is not sufficient evidence that costs are efficient we apply an efficiency challenge to the proposed costs.

In deep dive assessments we typically do not rely on comparative assessment. In the absence of comparative evidence to use as an efficiency challenge, we use the company's base cost efficiency as evidence of the overall efficiency of the company's business plan cost proposals. To challenge proposed costs we use the 'company efficiency factor'. A company efficiency factor is the ratio of our view of efficient modelled base costs to the company view of modelled base costs over 2020-25.

We consider it is appropriate to use a measure of base cost efficiency to challenge enhancement costs because we expect companies to use consistent approaches to costing all elements of their plans.

In calculating the company-specific efficiency factor we remove enhancement opex from the company's view of modelled base costs. We also remove an enhancement opex implicit allowance from our view of base costs, and consider the impact of real price effects. We add any successful cost adjustment claims to a company's base costs, as well as any reallocation of costs from enhancement areas that we consider to be base or growth related proposals. We do these adjustments so that the company efficiency factor reflects the most appropriate and consistent view of the efficiency gap on base costs.

In deep dive assessments we apply the company efficiency factor only where there is insufficient evidence that the proposed costs are efficient. We cap the efficiency factors between a minimum of 5% and a maximum of 10%. That is, for companies with an efficiency factor less than 5% we apply the minimum challenge of 5%. We expect every company to provide evidence that its proposed costs are efficient. We recognise that the company-specific efficiency factor is an imperfect indicator of the inefficiency of proposed enhancement costs. We therefore cap the challenge at 10%. We accept that this may understate the efficiency challenge for an inefficient company, but consider that we need to set this against the risk of excessive disallowance of costs.

We also use the company-specific efficiency factor in our shallow dive assessments of low materiality costs. In shallow dive assessments we apply the company-specific efficiency factor as an automatic challenge to proposed costs. This approach is consistent with the view that base cost efficiency provides a good guide to overall business plan efficiency and with a light touch, proportionate approach for low materiality proposals.

In shallow dives we cap the company efficiency factor between a minimum of zero and a maximum of 10%. We do not use a five percent floor as in deep dives because in shallow dives we do not look for evidence that the cost is efficient, due to immateriality, so a five percent floor would risk overstating the efficiency challenge.

Table 12 provides the company efficiency factors per service (ie water and wastewater) for shallow and deep dive assessments at draft determinations (DD) and final determinations (FD).

Table 12: Company efficiency factor for deep and shallow dive assessments (%)

Company	Wastewater deep dive		Wastewater shallow dive		Water deep dive		Water shallow dive	
	FD	DD	FD	DD	FD	DD	FD	DD
Anglian Water	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Dŵr Cymru	5.0	5.0	4.4	3.1	5.0	5.0	0.0	0.0
Hafren Dyfrdwy	5.0	5.0	0.0	0.0	5.0	5.0	0.0	0.0
Northumbrian Water	6.1	6.8	6.1	6.8	5.0	5.0	0.4	0.0
Severn Trent Water	5.0	5.0	0.0	0.0	5.0	5.0	0.0	0.0
South West Water	5.0	5.6	3.0	5.6	5.0	5.0	0.0	0.0
Southern Water	5.0	5.0	1.3	4.3	8.3	7.1	8.3	7.1
Thames Water	5.0	5.0	4.0	4.4	6.2	9.3	6.2	9.3
United Utilities	5.0	5.0	4.7	4.7	5.0	5.0	0.0	0.0
Wessex Water	5.0	5.6	2.5	5.6	5.0	5.0	0.0	0.0
Yorkshire Water	10.0	10.0	10.0	10.0	5.0	5.0	0.0	0.0
Affinity Water					5.0	5.0	0.0	0.0
Bristol Water					10.0	10.0	10.0	10.0
Portsmouth Water					5.0	5.0	0.0	0.0
South East Water					10.0	5.0	10.0	2.7
South Staffs Water					5.0	5.1	4.6	5.1
SES Water					5.0	5.0	0.0	1.5

We do not apply the company-specific efficiency factor in our assessment of WINEP/NEP wastewater activities, where we determine an efficiency challenge for each company at a programme level rather than at the individual activity level. This is because there are interactions between many of the different categories of cost and we therefore take into account any cost allocation differences in companies' proposals.

In addition, for enhancement activities where the materiality was very low for individual companies and for the sector as a whole, we removed the efficiency challenge altogether.

Difference in assessment framework between base and enhancement costs

Unlike base costs, which are routine costs, enhancement costs are more irregular in nature, and could have many possible solutions to requirements, which are sometimes new. As a result, there is less opportunity to compare the cost of required enhancement solutions between companies. Due to this, our approach is different between the two.

- For base costs, we develop our independent view of efficient costs using econometric models. Since we have high confidence in our view of efficiency, we allow companies that submit the most efficient forecasts for the 2020-25 period to recover more cost than they requested. This helps to incentivise companies to submit their view of efficient costs in future price reviews.
- For enhancement costs, we do not have data to use the same approach as base costs to develop a robust and independent view of efficiency. We are more dependent on company forecast cost information and as a result we do not allow companies to recover more costs that requested in their business plans.

In addition, because of the uncertainty related to environmental requirements, and uncertainty on the need and the costs associated with material enhancement projects, our enhancement assessment framework makes greater use of bespoke mechanisms to protect customers against unrequired or undelivered investments. For example, we set out unit cost adjustment mechanisms for as yet unconfirmed environmental requirements which will allow us to adjust our cost allowance at the end of the period once the uncertainty has resolved. Similarly, we set customer protection for enhancement proposals in case the investment is delayed or not delivered. We achieve this through the outcomes delivery incentives framework.

How we use representation business plan cost forecasts

In August 2019, all companies submitted a subset of business plan tables which gave the opportunity for companies to revise their cost projections.

Some companies' costs remained unchanged but some companies responded to the efficiency assessment we had published in slow track draft determinations and reduced their costs compared to their April 2019 business plan.

We welcome companies' identifying further efficiencies and reducing their requested costs. We generally do not revise our cost benchmarking analysis using the new data, as this would tend to decrease allowances for all companies even those that accept our draft determination allowance. We considered the impact of the revised data for companies only where they provided specific representations that relate to it.

We use the revised data projections from August 2019 in our calculation of the totex sharing rates and in our split between capex and opex, as we explain in later sections of this report.

Reallocating enhancement costs

To ensure we assess companies fairly, we review company reporting of enhancement costs to improve consistency. Where we consider that the cost was not reported in the appropriate place we reallocate the costs.

Many companies included company-defined lines ('freeform' lines) to provide clarity. In most cases, we consider the company-defined lines were not required and the costs should have been included in one of the standard lines with appropriate commentary. We reallocate these costs to the appropriate standard line.

We also challenge companies' classification of costs as enhancement. Where we consider costs to be part of the normal running of the business, we disallow the costs as enhancement. We consider that such costs are included in our base cost allowance and make no further adjustment.

4.1.2 Changes from our draft determinations

- We assess enhancement activities and make efficient allowances at a totex level. This is consistent with slow track draft determinations but is a change from the fast track draft determinations where we made a capex allowance for the fast track companies.
- We update the calculation of the company-specific efficiency challenge:

- We update our view of efficient modelled base allowance (the numerator in the calculation of company efficiency factor) by including adjustments for successful cost claims related to base costs, and for real price effects;
- We update the company view of modelled base allowance for 2020-25 (the denominator in the calculation of company efficiency factor) by accounting for supply-demand balance and resilience activities which companies reported as enhancement but we consider to be base activities. We apply a conservative view of these reallocations to base.

4.1.3 Stakeholders' representations

Companies do not make representations on our methods of assessing enhancement costs using benchmarking, deep dive and shallow dive approaches. Some companies provide additional evidence on cost efficiency or optioneering, which we take into account for final determinations.

Anglian Water, Southern Water and Bristol Water make representations on the use of the company efficiency factor as a means to challenge cost efficiency of enhancement proposals. The companies argue that it is inappropriate to apply the same level of efficiency challenge to base costs and enhancement costs, given that efficiency in the two areas is driven by different factors.

Bristol Water also claims that the application of the base cost efficiency challenge on enhancement costs is double-counting the efficiency challenge on costs, and argues that this would create a perverse incentive for companies not to reveal their true efficiency position on enhancement.

United Utilities Water does not challenge the use of the company efficiency factor but points out that the calculation should account for successful cost claims when calculating the gap on modelled base costs, as well as real price effects in the application of the net frontier shift, to avoid overestimating a company's inefficiency.

4.1.4 Our assessment and reasons

We acknowledge that the company-specific efficiency factor is an imperfect indicator of the inefficiency of proposed enhancement costs. However, while some companies argue for the removal of the company-specific efficiency factor, they do not offer a suitable alternative. We consider it appropriate to challenge proposed enhancement costs, as part of our deep dive assessment, where there is no sufficient evidence

that costs are efficient. In the absence of comparative evidence to use as an efficiency challenge, we consider it is appropriate to use the company's base cost efficiency as evidence of the overall efficiency of the company's business plan cost proposals.

We reject the argument that the company-specific efficiency factor is double-counting the efficiency challenge because we consider base cost and enhancement costs separately. We remove enhancement opex from both our view and the company's view of base costs to ensure we are comparing the same scope of costs to calculate our efficiency factor.

We accept United Utilities' point about accounting for successful base cost adjustment claims in our view of the base cost allowance, and accounting for the impact of real price effects on net frontier shift when we calculate the efficiency factor. We accept this representation and amend our calculation of the company efficiency factor for final determination.

4.2 Our approach to enhancement costs where we have common performance commitments

As set out in our PR19 methodology, we challenged companies to adopt stretching performance targets as part of their business plans. We also said that customers should not pay extra for companies to deliver stretching but achievable targets. The delivery of stretching performance is to be funded from company base costs.

In exceptional circumstances, where companies consider they are not able to deliver performance commitments from base costs, for example due to unique operating circumstances, they can make the case for their performance commitment level to be adjusted or for a base cost adjustment claim as appropriate. This approach ensures consistency across totex and outcomes – outperformance on costs is rewarded by cost sharing and outperformance on outcomes is rewarded by outperformance payments, where these have customer support.

We provide further discussion of the historical evidence on cost efficiency and outcomes in the 'Overall stretch appendix' and find this shows that some companies currently achieve good performance on both outcomes and cost efficiency. We therefore do not conclude that good performance will necessarily drive higher costs and consider it is possible to achieve upper quartile performance in both, with efficient and well managed companies able to improve cost and outcomes.

4.2.1 Our final determination decision

Some companies request additional enhancement costs to improve performance in areas such as leakage, supply interruptions, pollution incidents and internal sewer flooding. In these areas, we have set performance commitment levels for each year of 2020-21 to 2024-25. Where companies go beyond these levels, they will receive outperformance payments through the outcomes delivery incentive framework.

We consider that our package of common performance commitments with stretching performance commitment levels, represents a base level of service. We expect an efficient company to be able to deliver our performance commitments levels through our base allowance.

An exception to this approach is leakage. In leakage we do not expect companies to achieve a common level of service by the end of the 2020-25 period. This is different to the other outcomes listed above where we expect companies to reach a common level of service (ie the common performance commitment) from their base allowance. For leakage, the performance commitment for leading companies is to a lower level of leakage than that for lagging companies. For a company with a performance commitment that goes beyond the upper quartile of companies' forecast 2024-25 performance level, we allow enhancement expenditure for the leakage reduction it forecasts in 2020-25 beyond the upper quartile threshold up to its performance commitment level. This is the same high level approach as at draft determinations and is described further in section 4.4.

We also make an allowance for Thames Water to significantly improve its unplanned outage performance. We expect Thames Water to deliver the current industry median performance level (2.34%) by 2025, with investment in improvements to resilience and asset health.

4.2.2 Changes from our draft determinations

We maintain our overall assessment approach as at draft determination. We revise the performance threshold for leakage enhancement funding, see section 4.4 for detail.

4.2.3 Stakeholders' representations

Some companies state that the upper quartile performance benchmarks are unrealistic to be achieved under the base expenditure. The companies are concerned that our approach is unfair and say that the differences in current

performance are a function, at least partially, of previous decisions we made and that the historical performance targets were based on customers' willingness to pay. Further, some companies state that historical improvements achieved under historical totex allowances do not suggest that future improvements can be achieved under future base allowances derived from historical base costs. The companies also state that expenditure to deliver service improvements in the past was classified as enhancement expenditure and therefore is not included within the base cost model input data and for this reason, the service improvement cannot be achieved under the base cost.

Ten companies make representations that the base model allowance is insufficient to achieve the leakage reductions they propose. The common issues they raise include that only limited reductions were achieved in the historical period from which the base model was derived and that significant enhancement expenditure contributed to this reduction but is not included within the model inputs. A number of companies also consider that frontier shift adequately captures continuously improving performance within base and including leakage stretch as well adds an additional efficiency challenge that is not justified. Companies that raise this point also consider that they factor in significant productivity and efficiency improvements to their cost forecasts, meaning further challenge is not appropriate.

4.2.4 Our assessment and reasons

In this price review we have challenged companies to set stretching performance commitments as part of their business plans. We also said that customers should not pay extra for companies to deliver stretching but achievable targets.

We maintain our position that the delivery of common performance commitments is to be funded from base costs. On the whole, most companies accepted the performance commitment levels in their business plans and in their representations on draft determinations. At final determination, we have carefully calibrated the challenge from performance commitments to take account of historical performance and performance improvements achieved in the current price review period. As with previous price reviews, we expect companies to improve performance within their base allowances. We also seek to ensure that customers do not pay twice, where companies' performance falls short in the current period. High performing companies are well placed to outperform the common performance commitments. Other companies are expected to achieve their performance commitments through efficiencies and innovation, this is similar to the challenge that to companies lag behind their peers on cost efficiency.

The sector as a whole has failed to reduce leakage since 1999-2000. The current level of leakage is about 21% of total water supplied by the industry, equivalent to about 53 litre per person per day¹⁵. This is a high profile and important issue for customers. High levels of leakage undermine efforts to encourage customers to use water wisely and is a waste of a precious resource. We consider it is vital that all companies address these challenges by making significant reduction in leakage at PR19. Given the sector's poor performance in this area over the last 15 years, we do not think that customers should be asked to fund the turnaround in sector performance.

In our PR19 methodology, we challenged them to consider reducing leakage by 15% in their business plans, at no additional cost to customers. Although we have not previously challenged companies to reduce leakage by this amount we consider that companies should be able to achieve this with their base allowance.

- The 15% reduction challenge was voluntarily accepted by all companies, they could have proposed alternative lower level of reduction within base funding, but choose not to do so.
- Some companies have committed to achieving a 15% reduction within base costs.
- We expect companies to reduce leakage beyond recent historical rates at lower costs due to the scale of technological change over recent years. Innovative and efficient approaches are necessary to drive long term leakage reductions to meet the challenges of increasing pressures from climate change, population growth, societal expectations and increasing environmental aspirations. We are reducing the frontier shift challenge from 1.5% to 1.1% per year in part to meet the leakage challenge.

We also note that in the decade following privatisation, when faced with significant public scrutiny following the 1995-96 drought, the sector achieved a greater than 30% reduction in leakage.

We do not consider that companies have demonstrated that the proposed reductions in 2020-25 are unachievable with base expenditure, with three companies proposing to achieve their leakage reductions from base expenditure, without additional enhancement costs.

¹⁵ Leakage, distribution input and population served data from company annual performance reports 2018-19

4.3 Resilience enhancement

Resilience is a key theme of the 2019 price review. The theme reflects the priorities set by the UK and Welsh Governments in their Strategic Policy Statements, as well as the additional duty for Ofwat to further the resilience objective, introduced by the Water Act 2014.

The Water Industry Act 1991 sets out general duties with respect to the water industry which requires water and sewerage undertakers to provide and maintain standards of performance for their water supply and sewerage systems. To support these duties, companies have invested, and will continue to invest, in resilient water and wastewater infrastructure through base cost allowances.

The PR19 methodology defines resilience as the ability to cope with, and recover from, disruption and anticipate trends and variability, in order to maintain services for people and protect the natural environment now and in the future. As a consequence, resilience is a broad concept that spans different base and enhancement activities. For example, our investments in the supply-demand balance enhancement area improve drought resilience, while those driven by the Security and Emergency Measures Direction (SEMD) enhance resilience of supplies in the event of an emergency situation. Our modelled base allowances are for companies' day-to-day activities, which maintain operational resilience. We also further the resilience through our initial assessment of business plans; subsequent resilience action plans; and our allowances for investment in resilience enhancement.

Our PR19 data tables allow companies to propose investment to enhance resilience. Under the resilience enhancement category, we accept proposals that improve service resilience in the face of low probability and high consequence events that are currently beyond management control, including expenditure to meet new, more onerous requirements arising from the National Flood Resilience Review.

Our resilience enhancement lines in business plan cost tables are not intended to cover all investment that contributes to furthering the resilience objective, it covers only a small part of it. Where the primary driver of a resilience investment addresses the need covered by another enhancement line we reallocate the expenditure accordingly to maintain consistency across the scopes of the different areas.

4.3.1 Our final determination decision

When assessing the need for investment proposals for resilience enhancement, we seek evidence of:

- the specific cause of service failures and associated probability of failure the investment is proposing to address;
- the consequence of failure to customer service; and
- how the failure and the consequence are currently beyond management control.

We also seek evidence that the proposed investments are not for activities we expect companies to fund from our base cost allowances, such as investments in capital maintenance or delivery of performance commitments.

Where we make a material allowance for a resilience enhancement investment, we assess whether bespoke performance commitments sufficiently protect, or are required to protect, customers against non-delivery of these investments. Such performance commitments require bespoke reporting, monitoring and reconciliation. Consequently, we take a proportionate approach and intervene to set a performance commitment when the value of an allowed investment is greater than 1% of the totex the company proposes in the relevant combined wholesale price controls.

Our final determination allowances reflect investments for sufficiently evidenced proposals that improve resilience for customers and the environment. Beyond PR19 we are supporting companies to work in collaboration with their stakeholders to enhance resilience.

Table 12 provides our draft and final determination allowances for investment in resilience for water and wastewater.

Table 12: Company requested costs and our allowed costs for resilience enhancement (£m, 2017-18 prices)

	Water		Wastewater	
	Company view in August 2019 (after reallocations)	Final determination	Company view in August 2019 (after reallocations)	Final determination
Anglian Water	29.7	19.0	15.0	13.2
Dŵr Cymru	37.1	18.7	46.3	3.9
Hafren Dyfrdwy	1.7	0.5	0.0	0.0
Northumbrian Water	95.1	63.7	50.8	39.9
Severn Trent Water	147.4	107.2	0.0	0.0
South West Water	54.5	38.8	4.8	3.7
Southern Water	0.0	0.0	0.0	0.0
Thames Water	89.2	17.0	19.4	13.2
United Utilities	107.9	78.6	0.0	0.0
Wessex Water	5.3	0.9	2.6	2.5
Yorkshire Water	0.0	0.0	0.0	0.0
Affinity Water	13.6	13.6		
Bristol Water	12.0	8.1		
Portsmouth Water	2.8	1.2		
South East Water	34.0	10.9		
South Staffs Water	4.1	1.9		
SES Water	8.9	6.4		
Total	544.1	386.5	138.9	76.4

In our final determinations we also make a conditional allowance of up to £180m for Thames Water to investigate and provide mitigations to resilience risks in the London water supply system. We provide more information in ‘Thames Water – cost efficiency final determination appendix’.

4.3.2 Changes from our draft determinations

No change in approach from our slow track draft determinations.

4.3.3 Stakeholders' representations

Companies generally accept our approach to resilience enhancements and welcome the clarity of our feedback in relation to specific investments. We received 25 representations on our draft determinations. Companies' representations can be broadly categorised within two main themes:

- providing new evidence to demonstrate the need for, or efficiency of, the investment; and
- challenging our assessment of investments that we consider should be classified as base costs or overlapping with other investments or enhancement areas.

Northumbrian Water states that our resilience allowances at draft determinations were inconsistent with our resilience duty and that we did not fully consider customer support for the company's proposed investments.

4.3.4 Our assessment and reasons

New evidence to demonstrate the need for or efficiency of the investment

Most representations include additional evidence to further demonstrate the need for investment and a small number provide new evidence to demonstrate cost efficiency. In addition to the evidence we received during formal submissions we have continued to engage with companies to obtain new information where we consider an investment might be eligible for funding as resilience but for which there remains insufficient evidence to establish the need.

We consider all of the evidence and consider it is sufficient to demonstrate the need for a small number of investments in addition to those funded at draft determination. Typically the company only demonstrates the need in part and we therefore make partial allowances where we have sufficient evidence to determine an appropriate value for the investment.

We discuss the evidence provided for specific investments in each company's summary document and in our water and wastewater resilience enhancement feeder models.

Investments that we reclassify as base cost

We received a small number of representations from companies that we make allowances for activities that at draft determinations we considered were included in our base cost allowances, for example telemetry and instrumentation, analytical tools, growth and reducing flood risk for properties. However in most cases, companies accepted our approach that base cost allowances provide for these activities.

We review the evidence provided by companies and consider that the requested expenditure is for ongoing activities such as to update or replace existing equipment; optimise service delivery; or mitigate the effects of severe weather on sewer flooding. We maintain our view that these costs are funded as part of companies' allowance for base costs and do not make any additional enhancement allowances. This helps ensure that all companies are treated on the same basis and that customers do not pay twice for maintaining service.

Our resilience duty and customer support for investment

We consider Northumbrian Water's representation on our assessment and its consistency with our resilience duty and customer support.

We further the resilience objective in many ways through PR19. Our final determinations make allowances for sufficiently evidenced proposals to enhance resilience and our allowances in other enhancement areas and base costs (as we note in our background subsection above) also contribute significantly to maintaining and enhancing resilience. High quality evidence we received from companies justifies £643m of investment in resilience enhancements alone across water and wastewater (£463m plus £180m as a conditional allowance for Thames Water) during the next price control period.

Furthermore, through our assessment of business plans and subsequent resilience actions plans we have challenged companies to:

- develop appropriate frameworks that integrate operational, financial and corporate aspects of resilience, including a systems-based approach that considers these elements “in-the-round”;
- implement such frameworks in practice into everyday activities and for the long term; demonstrate a clear line of sight between the risks to resilience identified by the company, the proposed mitigations presented in the plan to tackle these risks, and how these impact outcomes for customers and the environment; and
- plan for the timely delivery of improvements to resilience frameworks in the future, promoting this through stakeholder collaboration, seeking wider

partnerships to share and accelerate the implementation of resilience best practice.

Many companies fall short of our expectations in this area, particularly in identifying and mitigating risks to service resilience. Consequently, our assessment of resilience enhancement proposals seeks to establish that the company clearly understands the resilience risk that it is proposing to address, and the likelihood and consequences of failure if the risk is not addressed. This is where companies often struggle to make a clear and robust case and so we do not consider that customer support alone can justify the need for investment. We welcome company engagement with customers on their proposed resilience investment, however, this does not remove company responsibility for understanding and effectively mitigating risks to resilience.

4.4 Supply-demand balance enhancement

Water companies have a duty to maintain the security of their water supplies. Supply-demand balance enhancement includes expenditure incurred by companies to ensure the security of supply in drought conditions. Investment under this line includes supply-side enhancements (source and treatment) and demand-side enhancements (distribution and customer) to the supply-demand balance. The driver used for this investment is the benefit in megalitres per day (Ml/d) in dry year or critical period conditions. This investment is generally linked to the preferred options identified in the company's water resources management plan in order to maintain a resilient and secure supply in the drought conditions it plans for. This includes a wide range of options, for example:

- development of new source infrastructure, for example, river abstractions, storage reservoirs, ground water abstractions, water reuse and desalination;
- development of transfer infrastructure, to better use existing sources, such as to enable intra-regional optimisation or trading between regions and with third-parties;
- catchment management or alternative soft engineering solutions where the natural environment is incorporated to solve problems;
- water efficiency engagement and activities to reduce demand; and
- leakage management activities to reduce losses.

We accept the need to invest in new infrastructure and demand management activities to address the water resources management plan supply deficits. This is in accordance with the UK Government Strategic Policy Statement that expects us to recognise the need for investment to balance supply and demand and achieve the

level of service set out in the final water resources management plans. We expect companies to address their need to invest in a way that represents the best value-for-money for customers over the long term. We challenge their proposed solutions where evidence of value for money is not sufficiently convincing, also as required of us in the UK Government Strategic Policy Statement.

4.4.1 Our final determination decision

For our assessment we consider the totex expenditure for supply and demand solutions for both critical period and dry year annual average scenarios in a combined supply-demand balance enhancement assessment. For companies where the expenditure does not represent a material amount, we undertake a shallow dive assessment and apply the company-specific efficiency factor. Where the expenditure is material we complete a deep dive assessment using the information provided within the companies' submissions. For our deep dive assessment we disaggregate supply-demand balance enhancement proposals into five components which we assess separately:

2020-25 supply-demand balance enhancement

This component considers supply-side and customer demand-side (water efficiency) solutions delivering supply-demand balance benefits in the period 2020-25. We determine this allowance through a unit cost approach using the minimum of each company's proposed and industry efficient unit costs (£1.20million/MI/d) for 2020-25. Unit costs are expressed in units of pounds million per MI/d of benefit. The cost driver is our validated assessment of the companies' proposed benefits for solutions delivering in the 2020-25. The industry efficient unit cost is based on consideration of the industry median unit cost for this activity (after removing the costs of companies forecasting a 2024-25 surplus in their latest water resources management plan, WRMP19). As metering is assessed separately, we remove the supply-demand balance benefits associated with metering from our assessment. Where companies provided evidence demonstrating a scheme is materially different to others considered within this component, and this sufficiently justifies a different approach, we now introduce elements of the deep dive assessment approach for this component.

Long-term enhancement

We identify that some long-term drought resilience investment will not always deliver benefits to the supply-demand balance in 2020-25. This component considers solutions delivering benefits beyond 2025. We assess if there is a valid need for

these solutions based on the information companies provide. Where appropriate we challenge valid solutions against the average solution unit cost from industry-wide WRMP19 option analysis and consider whether the company provides evidence that the costs it presents are efficient. Note that we assess long-term multi-company strategic regional water resource solutions separately and set out our approach in the 'Strategic regional water resource solutions appendix'.

Leakage enhancement

This component considers companies request for enhancement expenditure to reduce leakage. We allow enhancement leakage expenditure only for companies that forecast leakage performance beyond our threshold. We calculate our enhancement threshold as follows:

- For each company we calculate the three-year average leakage forecasts for the period 2019-20 to 2024-25.
- For each company we calculate two normalised leakage measures, leakage per property per day (l/prop/d) and leakage per kilometre of mains per day (m³/km/d).
- For each company we calculate the geometric mean of the two standardised measures. The geometric mean is the average of the two normalised measures. However, it is not a simple average (ie not an arithmetic mean), but an average that is more suitable for metrics of different scale, or different numeric ranges.¹⁶ It is calculated as the square root of the product of the two normalised measures.
- Using the 17 geometric means, one for each company, we calculate the upper quartile level for 2024-25 and use this as our benchmark for leakage enhancement funding.

To calculate the allowance, we need to consider the volume of leakage enhancement eligible for enhancement funding, and the unit cost per unit of leakage reduction.

The volume of leakage enhancement for each company is based on its forecast leakage position in 2019-20, ie its starting point, relative to our threshold:

- If the starting point is beyond our threshold, we make an allowance based on assessing all of the leakage enhancement the company requests. This is the case for Anglian Water, Bristol Water and South East Water.

¹⁶ When two metrics have completely different scales, the arithmetic mean will be dominated by the metric with high values. The geometric mean will not have this bias and will weigh the two measure more appropriately to obtain a measure of average.

- If the starting point is not beyond our threshold, but the 2024-25 performance is, we make a partial allowance. We calculate the proportion of the company's proposed leakage enhancement that will take it beyond the threshold. This only applies to SES Water where approximately 55% of its improvement in leakage is beyond our threshold.

The unit cost (£m/Ml/d) we apply is based on the company's proposed unit cost. We apply the company-specific efficiency factor if the company's unit cost for leakage reduction is above the industry median and the company provides insufficient explanation to justify its higher costs. For SES Water we take into account the evidence the company submits within its mains replacement cost adjustment claim and determine a bespoke efficiency challenge.

Internal interconnections

We assess if there is a valid need for these solutions based on the information the company provides in its water resources management plan. We challenge the costs of valid solutions a company presents in three key areas:

- How a solution's size (capacity) is derived, by considering the water resources deficit it identifies, as well as any additional requirements and the forecast future use of the solution over the next 25 years.
- The evidence it provides to demonstrate a wide range of options were considered as part of its optioneering processes.
- The benchmarking evidence it provides to demonstrate that its costs are efficient.

Investigations and future planning

We consider that the activities companies identify in this component are an ongoing requirement and adequately funded through the base allowance. No company provides sufficient evidence to demonstrate any unique or company-specific circumstances that we consider justify making an additional enhancement allowance for this component. Our position is the same as at draft determination.

Table 13: Supply-demand balance enhancement for final determination (£million, 2017-18 prices)

Company	2020-25 enhancement		Long-term enhancement		Leakage enhancement		Internal inter-connections		Investigations and future planning	
	Draft determination	Final determination	Draft determination	Final determination	Draft determination	Final determination	Draft determination	Final determination	Draft determination	Final determination
Anglian Water ¹	40.7	56.3	2.9	4.3	69.2	71.4	241.8	304.9	-	-
Dŵr Cymru	21.1	34.2	6.2	7.6	-	-	5.5	5.5	-	-
Hafren Dyfrdwy	-	-	-	-	-	-	-	-	-	-
Northumbrian Water	-	-	-	-	-	-	-	-	-	-
Severn Trent Water	98.2	84.7	3.3	3.3	0.4	-	-	-	-	-
South West Water	3.9	3.9	-	-	-	-	-	-	-	-
Southern Water ²	53.2	53.2	69.5	68.5	-	-	52.6	51.9	-	-
Thames Water	74.3	74.3	4.9	4.9	-	-	-	14.4	-	-
United Utilities	-	-	-	-	-	-	10.0	9.5	-	-
Wessex Water	2.9	2.9	-	-	-	-	-	-	-	-
Yorkshire Water	-	-	-	-	-	-	-	-	-	-
Affinity Water	41.1	41.1	21.6	21.6	-	-	-	-	-	-
Bristol Water	-	-	-	-	2.4	4.8	-	-	-	-
Portsmouth Water ³	2.7	2.7	-	-	-	-	-	-	-	-
South East Water	37.8	37.8	4.3	4.1	4.6	26.6	2.2	2.1	-	-
South Staffs Water	5.9	5.8	-	-	-	-	-	-	-	-
SES Water	2.6	2.6	-	-	-	8.6	-	-	-	-
Total	370.7	399.3	112.7	114.3	76.3	111.5	311.6	388.3	0.0	0.0

1 We include the direct procurement for customers development allowance for the Elsham treatment and transfer solution. This excludes the delivery costs that the company requested in April 2019.

2 We include an additional £0.429 million in the long term enhancement component in addition to the companies requested £4.5 million for payment to Portsmouth Water for delivery of Havant Thicket reservoir. This £0.429 million is not included in the totals in this table.

3 Expenditure relating to the development of the Havant Thicket reservoir and associated transfer is included in a bespoke price control. For further details see 'Portsmouth Water – Cost efficiency draft determination appendix' and 'Havant Thicket appendix'.

4.4.2 Changes from draft determination

We describe changes in assessment from draft determination by component below:

2020-25 supply-demand balance enhancement

We introduce elements of the deep dive approach to assess specific schemes where companies provide sufficient evidence to justify an alternative assessment approach to the application of the unit cost within their representations.

Leakage enhancement

We amend our approach from draft determination. We replace the upper quartile threshold in both normalised leakage measures (per property and per kilometre of main), with the upper quartile geometric mean of both normalised measures.

Internal interconnections

We introduce an efficiency challenge of 5% where we assess that only 90-95% of the capacity the company proposes will be used under future planning scenarios over the next 25 years. Therefore, efficiency challenges are now applied for schemes with capacities used below a 95% threshold, a more onerous level than the 90% used at draft determination. We revise the threshold because we consider that our draft determination approach of allowing a margin of 10% underused capacity (forecast over 25 years) without applying an efficiency challenge does not represent best value to customers that may still be funding oversized assets.

Investigations and future planning

We make no change in approach but note that several companies including Anglian Water, Southern Water and Dŵr Cymru remove costs for this component in their representations.

4.4.3 Stakeholders' representations

We received the following representations in this area which we group by the relevant assessment component:

2020-25 supply-demand balance enhancement

Dŵr Cymru challenges the cost allowance made for the Tywyn Aberdyfi (raw water transfer) scheme and Project Cartref (water efficiency programme) stating that the volume benefits we used at draft determination were insufficient to maintain the supply-demand balance.

Anglian Water represents that its Pyewipe water reuse scheme should be assessed through a deep dive assessment. It references that the scheme will have a modular construction approach to ensure effective delivery of a complex treatment asset, with benefits both in the short and longer term.

Long-term enhancement

Dŵr Cymru makes a representation challenging our rejection of the need for investment in Tywyn Aberdyfi beyond the 2020-25 allowance. It considers that this is necessary to maintain a supply-demand balance in the long term.

Anglian Water challenges our reduction in allowance for this component which was made as we considered that all named schemes are unlikely to be needed in the long term and require funding in 2020-25. The company considers it is necessary to develop all of the proposed schemes to support future planning due to the uncertainty and scale of future water needs.

Southern Water challenges our use of the company-specific efficiency factor to the schemes it includes within its long term and internal interconnection components. Note we respond to the company's wider challenges regarding the use of the company-specific efficiency factor in section 4.1.

Leakage enhancement

We receive significant challenge relating to our draft determination approach to setting a leakage reduction enhancement allowance from 15 companies. We group the representations into the following areas of focus:

- insufficient base allowance for leakage reduction;
- use of alternative enhancement thresholds or normalisation approaches;
- leakage unit costs; and
- leakage - other.

Insufficient base allowance for leakage reduction

Ten companies make representations that the base model allowance is insufficient to achieve the leakage reductions they propose. While nine companies consider that leakage reduction should be classed as enhancement expenditure and be funded as such. These companies state that a 15% reduction in leakage for 2020-25 represents a step change from historical performance, the cost-service frontier is unrealistic and that not funding service improvement is inconsistent with the PR19 final methodology.

A number of companies reference a report by NERA, 'Assessing Ofwat's Funding and Incentive Targets for Leakage Reduction' that they previously submitted in response to the initial assessment of plans. The report supports the company representations across the areas of focus identified above. NERA states that the base model will not adequately fund the proposed level of leakage reduction, leakage costs will increase as leakage levels reduce and the Ofwat approach is inconsistent with that adopted at previous price reviews. This report also suggests that we could modify our base models to better account for the costs of reducing leakage. NERA propose an alternative modelling approach that provides a leakage allowance by incorporating a variable based on variance from companies' sustainable economic levels of leakage into the Ofwat base model specification. Based on this model the report identifies an increase of £647 million in total botex allowance across the industry for a 15% leakage reduction.

Use of alternative enhancement thresholds or normalisation approaches

Seven companies make representations relating to alternative thresholds or leakage normalisation approaches. Companies' responses question the consistency of leakage reporting across the industry, the limited control they may have over one of the normalisation metrics (leakage per property) and whether the analysis should be updated with the latest annual reporting figures. Some companies consider that leakage per property is a more appropriate measure than leakage per length of mains. Other companies propose that leakage is proportional to 'weak spots' in the network such as connections, joints and diversions. South West Water proposes an approach that assigns each company a performance status according to its performance against both measures and funds a proportion of leakage reduction based on this.

Leakage unit costs

Eight companies make representations relating to the costs of maintaining and reducing leakage levels as follows:

- The majority of these companies consider that the cost of achieving the historical reduction rate increases exponentially as they approach the background level of leakage, with new and innovative approaches being required to achieve the step change in performance. As such these costs will not be reflected in the historical data.
- One company proposes that we should apply the industry median to derive all company allowances and that using company-specific costs does not challenge companies to be efficient.
- Another company proposes that the unit rate assessment should be based on the overall cost of leakage reduction and not just the proportion classified as enhancement.

Leakage - other

Four companies comment that customers demonstrate they are willing to pay for leakage reductions. Other companies make representations regarding a regulatory precedent to fund changes in service and that the approach to leakage enhancement allowance undermines the water resources planning twin track approach and targets. Yorkshire Water proposes a reduction in its performance commitment level if no leakage reduction enhancement expenditure is allowed.

Internal interconnections

Anglian Water argues that our draft determination interventions on its supply-demand balance enhancement expenditure associated with the water resources management plan challenge the primacy of the statutory process in determining option selection and best value for customers and the environment. They state that this frustrates the established decision making process, which has included extensive and well-regarded consultation with customers, stakeholders and regulators, incorporating information regarding costs and value.

Anglian Water additionally makes detailed representations in relation to its large-scale internal interconnection programme within both its initial response to the draft determination and subsequent query responses. The responses are in the form of resubmitted and additional evidence in support of its proposals focussing on the areas of challenge at draft determination. The responses are presented in the context of the water resources management plan process that the proposed programme has been through.

Thames Water proposes that its Shalford to Netley Mill interconnector should be assessed as part of supply-demand balance enhancement because the company includes it within its latest water resources management plan to increase resilience

and maintain zonal integrity within its Guildford water resources zone. The company submitted this scheme within new development enhancement in its April 2019 business plan.

Investigations and future planning

South East Water considers that this is an enhancement activity and an allowance should be made for this component. The company reiterates its position from draft determination that it considers the water resources management plan process to be the optioneering and planning phase for additional schemes which have historically been treated as enhanced capital costs.

4.4.4 Our assessment and reasons

We include the outputs of our assessments in 'Our final determination decision' section above and here we provide responses to company representations.

2020-25 supply-demand balance enhancement

In response to Dŵr Cymru's representation regarding Project Cartref and Tywyn Aberdyfi we use the revised benefits the company provides within its representation to determine an appropriate allowance using the same criteria as in the draft determinations. We reallocate Project Cartref costs directly specified for leakage reduction to the leakage component and then update the overall unit cost for the 2020-25 component. We update our assessment and the company allowances based on the refined component reallocations.

In response to Anglian Water's representation we consider it appropriate to assess the company's Pyewipe water reuse scheme through a deep dive approach. We accept that the company has adopted a modular approach to delivery in order to enable it to deliver additional benefits beyond the 2020-25 period. We compare the scheme costs to those of similar reuse schemes presented in draft water resources management plans. We consider it appropriate to apply an efficiency challenge to the expenditure the company requests based on the evidence the company provides.

Long-term enhancement

We accept the evidence Dŵr Cymru provides to demonstrate a need for the investment in Tywyn Aberdyfi beyond the 2020-25 allowance. We accept the company's application of the industry level unit cost to the benefits it identifies for this

component, as it describes in its draft determination representation and query response. We consider this to be a sufficient scope and efficiency challenge.

We accept that Anglian Water may need to undertake some development activities for all of the schemes it identifies to support future planning. On this basis we make an allowance that we calculate in the same way as our funding to develop strategic regional water resource solutions and direct procurement for customers development management. We estimate a project cost based on the benefits of the schemes the company submits and allow 6% of this total project cost for development.

We still consider it is appropriate to apply an efficiency challenge to both the long-term and internal interconnection components of Southern Water's supply-demand balance enhancement expenditure because the company provides insufficient evidence that its costs are efficient, when compared to our efficient industry unit rate used for the short-term enhancement component. For internal interconnections we consider that the company needs to present evidence its costs are efficient considering the large size of the schemes, and we note that another company provides further specific costing detail for each of its interconnection schemes. We consider it is appropriate to use the company-specific efficiency factors at final determination and we provide further discussion on this point earlier in this document.

Leakage enhancement

We group the leakage enhancement representations by theme and address them in the individual sections below.

Insufficient base allowance for leakage reduction

We consider both historical performance and the potential gains from innovative and efficient approaches when setting an appropriate threshold level for enhancement expenditure allowances. We discuss this further in section 4.2 and as described in the 'Our final determination decision' section above, we make an allowance for high performing companies where we consider the leakage position is being enhanced beyond the level which we would expect an efficient company to deliver with base expenditure. We therefore consider that our approach is consistent with the final PR19 methodology and provides adequate funding for delivery of companies' leakage reductions.

We note there is significant variation across the companies' business plan submissions in terms of whether the costs for further leakage reduction are

requested in full as enhancement expenditure, and in the unit costs identified for this leakage reduction. In the draft determination representations, three companies, which are not outliers in terms of geometric mean performance, do not request any enhancement expenditure and commit to a 15% reduction in leakage in the period 2020-25. In the April 2019 business plans we observe a range of unit costs the companies submit for leakage reduction, from £0.3 million to £4.8 million per MI/d saving. We do not find a strong correlation between current leakage performance and the unit costs the companies propose for further reduction. We consider this may be partly attributed to companies considering that some reduction is achieved through base activities and expenditure, and inconsistency in reporting costs and benefits across the industry.

To investigate alternative approaches to incorporating leakage into our base models we commission an independent review of our existing base models including the potential for inclusion of specific explanatory variables relating to leakage¹⁷. The review identified a number of limitations with the lack of detailed and consistent data across the industry on leakage classification (eg background or burst driven) and the drivers of both leakage and the costs of leakage management. The review also highlighted that there was limited assessment of the historical cost and impact of leakage reduction initiatives. This lack of data reduces the effectiveness of, and explanatory power of, any leakage explanatory variables, and in the majority of cases, the impact of adding leakage variables to the models was not statistically significant. However, even with the caveats regarding data accuracy, the review identified leakage variables that improve the overall fit of the cost model and contribute to its explanatory power. But the inclusion of leakage variables in model specifications reduces the statistical significance of the other variables in explaining base costs.

In view of the concerns regarding the robustness and limitations of the data available, we do not consider it appropriate to replace our established base model with any of the alternative specifications. However, we include these models containing leakage variables within our assessment of the impact of different specifications on modelled base cost allowances (see section 3.1 for further details). This assessment reviews five alternative model specifications, two of which include leakage-specific explanatory variables, based around distance from the 2024-25 upper quartile (m³/km/day) and the squared distance from 2024-25 upper quartile (m³/km/day). We also investigated the use of variables based on leakage per property and the geometric mean of the two measures, but these were not found to be significant. We therefore consider that including these leakage-related models

¹⁷ PwC – Funding approaches for leakage reduction, 2019

within the alternative specifications evaluation enables us to determine whether we should provide a base maintenance uplift for any company. This assessment only identifies a material increase in cost allowance for Anglian Water.

The review of base models investigated the model specification based on sustainable economic level of leakage (SELL) that was included in the NERA report. However, we were unable to replicate the results, with our assessment resulting in lower cost allowances than our equivalent base model specification. In response to our further query, NERA highlights the potential impact of data changes since initial assessment of plans, and that rather than consider use of this model specification the key point it makes is the link between leakage, SELL and expenditure. NERA suggests that companies' bottom-up estimates would be an appropriate basis from which to make a leakage allowance. We note however, that SELL is also highly sensitive to the companies' water resource position and the next cheapest source of water, rather than actual leakage performance or comparative performance. Therefore, we do not incorporate SELL into our modelling approaches because this measure is influenced by companies' own determinations of costs and benefits and we instead focus on variables that are outside of management control.

Use of alternative enhancement thresholds or normalisation approaches

We consider that adopting a threshold based on the geometric mean of both normalisation measures is appropriate for setting a cost division between base and enhancement, one which the upper quartile companies have demonstrated they are able to deliver to using the base and enhancement allowances we make. We consider the revised threshold provides a more appropriate balance between the two normalised measures than the approach we adopted at draft determination and this results in us making an enhancement allowance to four companies rather than the three at draft determinations.

We recognise that there are a number of options we could use for normalising leakage levels but we continue the use of per property and per kilometre of mains because these are well understood metrics for which we have a long set of historical data. We also note that there is no industry consensus on the preferred normalisation metric to adopt.

Leakage unit costs

Beyond our cost threshold we make an enhancement allowance based upon the company-specific leakage unit cost which we consider will reflect a company's specific challenges in this area, its current level of leakage and its selected leakage

reduction strategy. We consider that comparing this unit cost to the industry median and reviewing the supporting information a company provides is sufficient to enable us to apply an appropriate cost challenge. Due to the limited information regarding individual company assumptions of leakage reduction expenditure considered to be base, we consider it appropriate to use unit costs based on enhancement costs.

Leakage - other

We consider that evidence that customers are willing to pay for enhancement does not mitigate our requirement to challenge companies to ensure that they are delivering suitably efficiently. We do not consider that the approach to leakage undermines the goals set in the water resources management plan because our leakage performance commitment (with common definition) incentivises delivery and we consider that challenging companies in this area is necessary to drive improvements that are essential for meeting longer-term supply demand balance targets. We respond to Yorkshire Water's proposal in the 'Yorkshire Water – Delivering outcomes for customers final decisions' document.

Internal interconnections

We accept the need to invest in new infrastructure and demand management activities to address the water resources management plan supply deficits. This is in accordance with the UK Government Strategic Policy Statement that expects us to recognise the need for investment to balance supply and demand and achieve the level of service set out in the final water resources management plans. However, we expect companies to address their need to invest in a way that represents the best value-for-money for customers over the long term. This is also in accordance with the UK Government Strategic Policy Statement that requires us to “continue to challenge companies to meet that need in a way that represents the best value for money over the long term, including through the price review”. We therefore challenge the companies' proposed solutions where evidence of value for money is not sufficiently convincing.

In the initial assessment and draft determinations, we made clear the areas of concern we had with each company's plan in this area and what we would expect to see to address these concerns. This was consistent with our consultation responses to the draft water resource management plans. However, we consider the additional evidence Anglian Water provides in response to our draft determination challenge and we update our assessment of the company's internal interconnection schemes accordingly. We explain the challenges on each particular scheme in the feeder model.

We accept the reallocation that Thames Water proposes for its Shalford to Netley Mill interconnector and assess the evidence the company submits within the internal interconnection component of our supply-demand balance enhancement assessment.

Investigations and future planning

Our approach to assessing South East Water's request in this area is unchanged from draft determination because we still consider that the activities identified by the company in this component are adequately funded through the base allowance. We do not consider that the company demonstrates any unique or company-specific circumstances that justify an additional enhancement allowance for this component.

4.5 Metering enhancement

Metering enhancement primarily considers investment to install meters at properties which currently do not have them. Meter replacements (meter installations at properties that already have them) are considered a base activity.

4.5.1 Our final determination decision

To assess investment proposals related to new metering installations, we combine the following reported costs into a single assessment:

- metering for optants (customers choosing to have a meter);
- selective meters (where companies introduce meters themselves without a customer's request); and
- meters for businesses.

Combining these lines mitigates inconsistent reporting of expenditure and cost drivers between these three expenditure lines in business plans.

We assess the combined metering costs using a regression model with data from 2018 to 2025. The model estimates the relationship between total expenditure and the total number meters installed (optant and selective). This model provides a cost allowance for new meter installations at properties which do not have an existing meter, the base model separately provides an allowance for the replacement of existing meters. We apply a frontier shift challenge to the output of our unit cost regression model and components related to this model that we assess within our

deep dive approach. Where the investment companies request is below our modelled allowance, we allow the company's requested amount.

Where companies identify significant metering costs outside of the enhancement line definitions, such as replacing existing basic meters with smart meters, we undertake a deep dive using the information companies provide. For the deep dives where possible we benchmark comparative costs. We assess the validity of any additional expenditure beyond the modelled allowance.

We note that smart meters should provide benefits to the company in areas such as per capita consumption (PCC), leakage reduction and customer engagement which will bring value to the company that a basic meter would not. This benefit could be considered a justification not to make an enhancement uplift for smart metering. However, we make an allowance for smart metering programmes as we recognise that at this early stage of the development of smart metering carrying out a large programme implementing a new technology involves delivery challenges relative to basic meter replacement programmes. We also expect that companies implementing large scale smart metering post-2025 will learn lessons from the experiences of companies that have rolled them out in 2020-25, and be able to deliver similar programmes more efficiently, with a better understanding of the challenges and benefits of smart metering.

As part of the final determination deep dives we allow the following uplifts for smart meters (either Automatic Meter Read or Advanced Meter Infrastructure) and in some cases the associated communications infrastructure for Anglian Water, Northumbrian Water, South West Water and Thames Water. These are calculated based on the evidence submitted and benchmarking of activities between companies where possible.

Table 14: Smart metering enhancement for final determination (£million, 2017-18 prices)

Company	Final determination
Anglian Water	89.1
Northumbrian Water	7.7
South West Water	1.9
Thames Water	17.8
Total smart meter replacement allowances	116.5

We define outcome delivery incentives that return appropriate smart meter funding to Anglian Water's, Northumbrian Water's and Thames Water's customers if the company does not meet its delivery targets.

Table 15: Metering enhancement, including smart metering for final determination (£million, 2017-18 prices)

Company	Draft determination	Final determination
Anglian Water	108.1	126.3
Dŵr Cymru	17.3	17.3
Hafren Dyfrdwy	0.8	0.8
Northumbrian Water	43.1	43.1
Severn Trent Water	66.6	66.6
South West Water	6.7	8.6
Southern Water	9.5	9.3
Thames Water	178.1	203.3
United Utilities	43.5	40.6
Wessex Water	10.1	9.9
Yorkshire Water	22.1	22.1
Affinity Water	58.9	57.3
Bristol Water	9.4	9.4
Portsmouth Water	5.2	5.2
South East Water	0.6	0.6
South Staffs Water	11.7	11.4
SES Water	19.5	19.0
Total	609.5	650.7

4.5.2 Changes from draft determination

- We apply a frontier shift efficiency challenge of 1.1% per year to the expenditure related to new meter installations (model outputs) and to Thames Water deep dive costs associated with new meter replacements.
- We amend the outcome delivery incentives relating to smart meter funding from draft determination in order to achieve consistency with our final determination allowances.

4.5.3 Stakeholders' representations

We consider all additional evidence provided by companies in support of their expenditure and revise our allowance where appropriate. We provide our decisions in each company's summary document and in our metering enhancement feeder model.

Anglian Water repeats the representation it made in response to initial assessment of plans by proposing that we consider the effect of including meter penetration in the unit cost model.

Thames Water states in its representation that we should evaluate its metering proposals through a deep dive approach rather than using a unit cost model and comparison with other companies. The company considers that metering programmes can differ significantly between companies as a result of factors such as differing objectives, operating area characteristics and how each company allocates costs. It considers that the unit cost model is too simplistic and tests alternative model specifications, including separating optant and selective metering costs, including a density variable and including a variable relating to meter technology. The company does not find its alternative modelling approaches to be robust enough to be used across the industry but considers an increase in its allowance resulting from these alternative model specifications supports the company's higher unit costs which are influenced by these variables.

Both Anglian Water and Thames Water provide further information in response to our deep dive assessment and the cost challenges we applied at draft determination to support the higher allowances that they continue to request. South West Water provides clarifying information, identifying expenditure associated with replacement of basic meters with smart meters. This expenditure was previously submitted at initial assessment of plans but was not clearly identified as being associated with this activity.

4.5.4 Our assessment and reasons

We consider it appropriate to apply a frontier shift to the expenditure related to new meter installations (model outputs) as this is a relatively common and repeatable activity that is well understood by the companies. We also apply the frontier shift to the Thames Water deep dive costs associated with new meter replacements as this is consistent with the approach taken in the base model which provides an allowance for these activities.

We do not modify the unit cost regression model in response to Anglian Water's representation to include meter penetration. We previously investigated including this variable at draft determination and found it had no significant impact on the model fit or outputs but rather added uncertainty in terms of data confidence.

In response to Thames Water's request for a deep dive, we assess the potential for applying a higher unit rate for meter installation and a greater uplift for replacing existing basic meters with smart meters through a deep dive. We consider the individual components of the unit cost that the company provides, and assess the areas highlighted as significant cost drivers in the company's alternative modelling approach. However, we consider that a comparison of costs with those presented by other companies is appropriate because many of the activity components are directly comparable with other companies. As we consider the comparable assessment to be appropriate, we therefore, expect the company to be able to present evidence explaining the factors that impact higher unit costs. This may include the cost impact of factors such as serving an area with a higher proportion of flats in comparison to other areas.

We review the additional information that Anglian Water, Thames Water and South West Water provide in support of their expenditure requests through a deep dive approach. We amend and increase our allowances for components where companies provide sufficient additional evidence to justify this. We decrease allowances for deep dive components where we consider the additional information no longer supports our draft determination allowance. Overall each of these companies receives an increase in allowance from draft determination.

Supply-demand balance and metering – a joint assessment

Water companies include expenditure relating to water efficiency activities both in the supply-demand balance enhancement and metering enhancement lines. In both areas we set our allowed costs at the lower of the expenditure the company requests or the output of our modelling.

We consider there may be common activities that companies record within either supply demand balance or metering expenditure requests. We therefore make a joint assessment to consider whether to adjust our allowances for the individual activities to safeguard against the risk of insufficient allowances due to allocation of costs between the two activities. Given the overlap, if a company appears efficient in one area but inefficient in the other, we adjust the combined allowance by the gap between the company's request and our modelled output for the efficient component.

We note that although the metering model output has frontier shift applied, the joint assessment uses the pre-frontier shift values.

When making the adjustment we review the difference between our allowance and the company's request for both components in turn. For example, assume a company requests £4 million less than our modelled amount for the 2020-25 supply-demand balance enhancement component but we apply an efficiency challenge of £1.1 million in its metering component. In this example we make an adjustment, increasing the overall combined allowance by £1.1 million. We apply this adjustment to our allowance where there is an efficiency allowance. In the example above we make the adjustment to our metering allowance.

Table 16: Joint assessment adjustments for final determination (£million, 2017-18 prices)

Company	Adjustment to supply-demand balance allowance	Adjustment to metering allowance
Dŵr Cymru	1.70	-
Severn Trent Water	7.50	-
Southern Water	-	1.14
Wessex Water	-	1.06
South Staffs Water	-	0.01
SES Water	-	0.13
Total	9.20	2.34

We made an adjustment of £10.5 million for Thames Water at draft determination but we no longer consider this valid at final determination because the company provides further detail of the activities associated with the costs it includes in both the supply-demand balance and metering enhancement lines, indicating that there is no overlap between the two categories.

4.6 Environmental obligations

Water companies have statutory obligations to deliver environmental improvements and help meet the environmental targets set out in legislation. For companies operating in England, the Environment Agency sets out these obligations in the

Water Industry National Environment Programme (WINEP), and for companies operating in Wales, Natural Resources Wales sets out the obligations in the National Environment Programme (NEP).

These obligations protect a range of environments including bathing waters, shellfish waters and other conservation areas and, in addition, cover issues relevant to water companies such as intermittent discharges of wastewater to rivers and coastal waters. The interventions that the water companies are expected to make to meet these obligations include treating wastewater discharges to a higher quality standard, better managing flows of wastewater and minimising the impacts of abstractions of water for drinking water production.

The investment requested by the industry to deliver the programme at PR19 is significantly larger than the investment required at PR14. We do not challenge the need of company proposals under WINEP and NEP given the statutory nature of the requirements. However, we challenge companies on the efficient delivery of the programme.

4.6.1 Our final determinations decision

As set out in section 4.1, we use benchmarking analysis, deep dive and shallow dive assessment to assess the efficiency of companies' environmental proposals. Our assessment is based on business forecast data for the period 2020-25.

Companies submitted business plans with their proposed costs to deliver WINEP/NEP for different area. These areas were defined to include relatively homogenous types of schemes to allow the development of benchmarking analysis. Table 17 provides a summary of each area and the method of assessment at final determinations.

Table 17: Method of assessment for each area of WINEP/NEP

Method of assessment	WINEP/NEP activities
Benchmarking analysis – wastewater	<ul style="list-style-type: none"> - Schemes to increase Flow to Full treatment - Storage at sewage treatment works. - Storage in the sewerage network - Chemical removal schemes - Phosphorus removal schemes - Event duration monitors - Flow monitors at sewage treatment works

Method of assessment	WINEP/NEP activities
Deep dive / Shallow dive – wastewater	<ul style="list-style-type: none"> - Schemes for reducing sanitary parameters - Schemes for conservation drivers - Eels Regulations schemes - Chemical investigations - Groundwater protection schemes - Wastewater investigations - Nitrogen removal - UV disinfection schemes - Other areas
Deep dive / Shallow dive - water	<ul style="list-style-type: none"> - Ecological improvements at abstractions - Eels Regulations schemes - Schemes for invasive non-native species - Drinking water protected areas - Water Framework Directive measures - Water investigations

Setting the efficiency challenge for wastewater obligations

We take a programme level approach to setting an efficient allowance for wastewater WINEP/NEP. Rather than develop our view of efficient cost within each enhancement area, we develop our view of efficient costs at a programme level. Following this process if a company is considered inefficient in one model and efficient in another, the outcomes will balance to a degree. We consider that this taking better account of the accuracy of individual models and potential differences in approaches to cost allocations companies may make.

To determine our allowance for wastewater WINEP/NEP we proceed as follows:

1. We sum the output of our assessment of all the individual lines. This is our view of costs before an efficiency adjustment.
2. We apply a 'catch up' challenge to our view of costs from step 1.
3. We apply a frontier shift challenge.
4. We set an allowance that is the minimum of our programme level view of efficient costs and the company requested costs.

Our overall efficiency challenge for wastewater WINEP/NEP is 9.58%. The catch-up component is 6.94%. It is the upper quartile efficiency for the WINEP programme across the industry (ie the proportion by which the 'upper quartile' company's requested costs is lower than our view of costs from step 1 above). We exclude Hafren Dyfrdwy from this calculation because its allowance is often not based on

cost benchmarking models due to its small size relative to the rest of the companies. We apply a frontier shift of 1.1% per year which is equivalent to adjustment of 2.64% over the period. We discuss our decision on frontier shift in section 5.

Table 18 summarises our final determinations for wastewater WINEP/NEP. Five of eleven companies receive a final allowance that is at least 95% of that requested. At an industry level our allowance is 89% of the total company's request compared to 88% at draft determination compared to the requested totex at April 2019. At the industry level our final determinations are £163 million higher than at the draft determination stage.

Table 18: Final determination allowances for the wastewater environmental programme (WINEP/NEP) (£m, 2017-18 prices)

Company	Requested investment (Apr 2019) ¹	Modelled Allowance	Modelled Allowance post-efficiency	Final Determination	Draft Determination
Anglian Water	797.1	761.3	688.4	688.4	673.6
Dŵr Cymru	207.1	216.6	195.9	195.9	195.9
Hafren Dyfrdwy	2.7	2.9	2.6	2.6	2.7
Northumbrian Water	173.9	152.5	137.9	137.9	144.7
Severn Trent Water	398.6	504.2	455.9	398.6	400.6
South West Water	145.2	181.3	163.9	145.2	145.2
Southern Water	612.2	593.5	536.7	536.7	532.9
Thames Water	381.1	362.8	328.1	328.1	306.8
United Utilities	647.1	701.8	634.5	634.5	625.1
Wessex Water	449.4	424.8	384.1	384.1	354.5
Yorkshire Water	891.6	802.7	725.8	725.8	632.4
Total	4706.1	4704.4	4253.7	4177.7	4014.4

¹ The requested investment has been revised to reflect data corrections and our reallocations

Below we set out the methodology for assessing individual area of enhancement covered by the wastewater programme in WINEP/NEP.

Benchmarking analysis – wastewater

Our benchmarking analysis is based on econometric models or a simple comparison of unit cost. Where feasible, we use cost drivers that are independent of any specific solution. This avoids treating certain solutions preferentially to others and allows for innovation in the area. We use forecast data for the period 2020-25 from the revised business plans of April 2019. We generally do not use the data submitted by companies in August 2019, in response to draft determinations, to re-estimate our models. As noted in section 4.1, the purpose of the data submission in August 2019 was for the determination of cost sharing rates, opex-capex split and for information.

However, where companies submit revised data with corrections to costs or cost drivers, we re-estimate our models and apply the revised results to our assessment. We consider that it is not appropriate to retain a model based on erroneous data. Data correction result in significant changes to model results in three areas: reducing sanitary parameters – where we decide not to use a benchmarking model due to the data changes, phosphorus removal and increasing flow to full treatment.

Where the revisions were due to an internal review of a company's costs and application of further efficiencies, we do not update our models, as discussed in section 4.1. For example, Dŵr Cymru revised its costs in line with our view of efficient costs at draft determination for WINEP/NEP overall. Anglian Water and Southern Water revised their costs in line with our view of costs for particular areas of WINEP. We do not use these revisions to rerun our models.

We recognise the limitations of cost models. We control for this in two ways. Firstly, we often triangulate results from multiple models to arrive at a more considered view of costs. Secondly, in wastewater only, we assess efficient costs considering all of the enhancement areas making up WINEP/NEP. We do not use this approach in wholesale water as we rely on deep dive or shallow dive assessments rather than benchmarking models.

Phosphorus removal: Phosphorus, along with nitrogen, is a constituent of wastewater and an essential nutrient for plant life. High levels of nutrients in receiving waters (eutrophication) leads to excessive plant growth and a corresponding depletion of oxygen and a loss of biodiversity. Limiting phosphorus discharges can be necessary for a watercourse to achieve good ecological status. Phosphorus is reduced in wastewater through enhanced biological or chemical treatment methods. The level of

intervention required is expected to be a function of the size of the sewage treatment works and the stringency of the consent.

We assess the investment for this line based on two econometric models, placing equal weight on each. Our model applied for the initial assessment of plans predicts the required totex using the number of sewage treatment works subject to a new or tightened consent and the population equivalent (a measure of works capacity) of these treatment works as the cost drivers. We consider population equivalent to be the primary driver of costs with the number of works providing a measure of the distribution of the size of works in the programme and thus economies of scale at this level. The second model uses the population equivalent and the number of enhanced works with a phosphorus consent less than or equal to 0.5 mg/L as the cost drivers. We base the models on information companies provide in business plan tables and in response to the queries we sent them. We use the consent limit of 0.5mg/L as companies provide evidence that costs increase significantly (ie non-linearly) after this threshold. Both models are linear regression models and these were chosen because they have a marginally better statistical performance in comparison with log models.

Chemicals removal schemes: The discharge of hazardous pollutants is controlled to safeguard the environment. In this area investment is required for schemes either to prevent breaching environmental quality standards through improvement schemes or to ensure no deterioration in river water quality.

We assess the investment for this area using a model that predicts the required totex using the population equivalent (a measure of works capacity) served by the sewage treatment works with an improvement driver and the average level of the consent for zinc as the cost drivers. The explanatory variables used have a clear engineering rationale and we consider the improvement schemes are a more significant driver of costs than no deterioration schemes, as these, in the main, lead to the commissioning of additional treatment technologies. All variables are in logs to allow for economies of scale and we correct for log transformation bias to ensure that the sum of predicted costs is equal to sum of model inputs (ie actual company cost estimates). The selected model appears statistically robust, although we are mindful of the limited sample size. Our programme level approach to efficiency challenge for WINEP and NEP helps mitigate the limitations of any individual model. Since draft determination we have increased the allowance for Thames Water based on its representation that the company is disproportionately impacted by the exclusion of the population equivalent served by no deterioration schemes in cost benchmarking.

Schemes to increase flow to full treatment: The flow of wastewater to sewage treatment plants increases in response to rainfall in the catchment, especially so in combined sewer catchments. As the treatment capacity of works is limited there is a point at which part of the flow is diverted to storm tanks. If the rainfall is intense and/or persistent these storage storm tanks will eventually fill and discharge untreated wastewater to the receiving watercourse. Increasing the hydraulic capacity of a works or 'flow to full treatment', e.g. by adding an additional treatment stream, reduces the likelihood of an untreated discharge. The costs of the intervention for an individual works is considered a function of this flow shortfall.

We assess costs for this area by taking the average from log and linear regression models that predicts totex using the number of schemes included in business plans and the shortfall in flow to treatment in litres per second as the cost drivers. Triangulating these models allows us to incorporate both outputs in our assessment. The linear model appears statistically better with a correlation coefficient (R^2) of 0.94, however, the log model may better account for economies of scale that we may expect with increasing the size of programme. We consider that the models with both factors perform better than with either single factor alone. Our log model does not predict realistic costs for Hafren Dyfrdwy, and we omit its data point from the model. For our determination of Hafren Dyfrdwy's costs we use the linear model alone. To avoid the log transformation bias we make an adjustment to the output from our log model so that the sum of predicted costs is equal to the sum of model inputs (ie actual company cost estimates). We revise our model since draft determination principally due to the representations from Wessex Water. Wessex Water contends that its Avonmouth STW scheme is significantly larger than any other in the industry and our cost benchmarking model at draft determination did not sufficiently account for this. We accept this and other argument relating to atypical costs and adjust the costs for Wessex Water we use for modelling. This ~~also~~ impacts our allowance for all companies. We subsequently make separate allowances for Avonmouth STW and an access bridge at Salford STW.

Storage schemes at STWs to increase storm tank capacity: As set out in the section above increasing the capacity of storm tanks should reduce the frequency of discharges of wastewater to receiving waters. We expected the cost of interventions to be a function of the increase in volume.

We assess the investment for this area based on two econometric models, placing equal weight on each. The first model predicts the required totex using the volume of storage to be commissioned and the second model includes the number of schemes as a second cost driver. All variables are in logs and we correct for log transformation bias to ensure that the sum of the model inputs is equal to the sum of

the industry predicted costs. Both models provide robust predictions based on the correlation coefficients, the sign of the coefficients etc. and were preferred to alternative linear models on comparison of these factors.

Storage schemes in the network to reduce spill frequency at combined sewer

overflows: A combined sewer overflow (CSO) is a part of the sewerage system intentionally designed to discharge wastewater to rivers during high rainfall to avoid the infrastructure that would be required for transporting and managing these flows at treatment works. However, frequent discharges from CSOs will impact water quality and the amenity value of receiving waters. Storage at the point of discharge will limit the volume spilling to the river. However, it is equally feasible to reduce this volume through stopping rainfall draining to the sewer at source. We allow for these interventions and other catchment management approaches within our methodology.

We assess the investment for this area by using a linear regression model which estimates expected totex based on the volume of storage each company is planning to construct or the effective storage. The use of effective storage volume of a scheme allows us to account for catchment management schemes and is the volume that would otherwise have been provided should a conventional CSO storage scheme have been constructed. This model has a better predictive power than alternatives, the coefficients appear logical and it fits the data well. We reviewed a range of linear and log models and further tested for the number of schemes as a cost driver. The model includes the costs and cost drivers for the Southern Water conservation driver schemes as they are of a similar nature. We make an adjustment to the allowance for Anglian Water based on its representation regarding the use of a log-log model and apply this to derive its cost allowance.

Wastewater benchmarking unit costs

WINEP/NEP includes requirements to monitor flows of wastewater at sewage treatment works to manage diversions and discharges to storm tanks and at intermittent discharges from combined sewer overflows. We do not identify robust regression cost models in these areas at a programme level due to the range of costs and cost drivers. On further scrutiny, the programme of work for individual companies varies significantly and it is appropriate to sub-divide requested investment further and create unit cost models at a more granular level where the scope of works is more homogenous.

Event duration monitoring at intermittent discharges: Our final determinations are based on separate analyses of costs for meter installations and permit applications. We understand these are distinct activities with a substantially different unit cost. We

estimate a unit cost for each of these areas and use this to determine the overall allowance. We use the median unit cost as this is less influenced by outliers than the mean. Our median costs increased from draft determinations as Thames Water provided corrected data.

Flow monitoring at sewage treatment works: Our final determinations are based on separate analyses of costs for new and upgraded meter installations and flow investigations based on the responses to our query from companies. We determine the allowances using the median unit costs as these are less influenced by outliers than the mean costs. Where a company's submission contains schemes necessitating a significant amount of civil engineering work, we separately assess these costs via a deep dive as they unduly impact our unit costs estimates. We combine the outcomes of any deep dives with the other elements to determine the overall allowance for a company.

Wastewater deep and shallow dive assessments

We assess the enhancement areas below using our deep dive and shallow dive approach rather than benchmarking models. This is typically because only few companies have material investments in the area, or because investment levels, and generally scheme numbers, are small, thus programme level costs more variable.

Conservation drivers: This enhancement area covers schemes whose primary driver is conservation (eg compliance with Habitat & Birds directives, Countryside and Rights of Way Act 2000) and are not reported elsewhere. Only Hafren Dyfrdwy, Southern Water and Wessex Water request material investment in this area. We assess Hafren Dyfrdwy and Wessex Water via deep dives using the information the companies provide in their business plan submissions. We are satisfied with the evidence provided and allowed the costs, subject to the WINEP/NEP programme level cost challenge. As Southern Water's preferred solutions are storage schemes, we benchmark its costs using our sewage treatment works and network storage benchmarking models as appropriate.

Eels (England and Wales) Regulations 2009 (Wastewater): This enhancement area covers schemes predominantly in the water service and are to ensure compliance with the Eels (England and Wales) Regulations 2009 to prevent the entrainment of eels and fish. After reallocations, only United Utilities requests investment in this area and based on the low materiality of the investment, costs are passed through and subject to the WINEP/NEP programme level cost challenge.

Groundwater schemes: This enhancement area covers schemes whose primary driver is to protect groundwater against pollution and deterioration in quality, in compliance with the EU Groundwater Directive. After reallocations Southern Water is the only company seeking investment in this area for the Thanet Groundwater Scheme. Southern Water has submitted a cost adjustment claim for this scheme and the investment is assessed through the cost adjustment claim process.

Wastewater general investigations and chemical monitoring and investigations: Wastewater investigations can cover a variety of types of study for diverse drivers such as the investigation of frequent spilling CSOs and bathing water quality, for example. We assess the investment for this area based on materiality, using deep dives, as appropriate. We carry out a deep dive using the information the companies provide in their business plan submissions. For our final determination we increase the allowance for Wessex Water as we are satisfied with the additional evidence it provides.

For the enhancement areas covering chemical monitoring and investigations, based on the low materiality of the investment, costs are passed through and subject to the WINEP/NEP programme level cost challenge.

Nitrogen removal: Nitrogen, along with phosphorus, is a nutrient linked to eutrophication. In order to comply with reductions in consent levels companies are typically required to treat wastewater through enhanced treatment methods. Only Wessex Water and Southern Water request investment in this area. Based on the low materiality of the investment, costs are passed through and subject to the WINEP/NEP programme level cost challenge.

Reduction of sanitary parameters: The level of organics (expressed as biochemical oxygen demand) and ammonia in wastewater are controlled principally as they deplete oxygen levels in receiving waters which is detrimental to wildlife. In order to comply with reductions in consent levels companies are typically required to optimise current operations and commission new assets as appropriate. Due to the variety of existing assets on a site, and variations across the industry in terms of current and the future consents imposed by WINEP/NEP, there is often a wide variety of interventions. As a result, we conclude that this programme does not lend itself to econometric modelling. For final determination we allow companies their requested costs in full in this area, subject to the WINEP programme level efficiency challenge, as appropriate.

UV disinfection: The primary driver for this work is to meet new or tightened consents for microbiological parameters to meet EU Shellfish or Bathing Water directives from

wastewater discharges. Only Anglian Water, United Utilities, Southern Water and Wessex Water request material investment in this area, and we assess these lines using deep dives based on the information the companies provide in their business plan submissions. For all companies we are satisfied with the evidence provided.

NEP discharge relocation: This area was designed to provide a place to which the costs of unfinished AMP5/6 schemes to relocate discharges to controlled waters were to be allocated. After reallocations, only Severn Trent Water requires investment in this area (to meet requirements set down in the WINEP for 2020-25). This is subject to a deep dive assessment in which we set out our concerns about the lack of evidence the company provides in support of its proposed investment. Whilst not disputing the environmental need for an intervention, in the absence of evidence and given the substantially higher cost by reference to comparators, we expect the company to meet this need through its overall allowances.

National phosphorus removal technology investigations: Only Anglian Water requests investment in this area and it relates to WINEP obligations for studies to achieve Common Standards Monitoring Guidance targets. Based on the low materiality of the investment, costs are passed through and subject to the WINEP programme level cost challenge.

Monitoring of pass forward flows at CSOs: The area relates to AMP5/6 schemes to monitor flow at CSOs. Only Severn Trent Water put costs against this area. As we do not expect expenditure in this area to continue into 2020-25 these costs are not allowed.

NEP - Flow 1 schemes: This area relates to AMP5 schemes where the primary driver is to prevent the deterioration of receiving waters as a result of increased volumes of discharges. Only Southern Water requests investment in this area and these costs are not allowed as there is no AMP7 driver.

WINEP/NEP relating to drinking water supply infrastructure

For final determination we do not change our method for assessing the water programme within WINEP/NEP. We assess all lines using deep and shallow dives based on the materiality of the totex requested. We do not challenge the need of the expenditure in this area provided the information submitted by companies reconciles with that in the WINEP and NEP provided by the Environment Agency and Natural Resources Wales respectively. We do not develop cost individual benchmarking models as we found that the individual areas of enhancement contained a range of

solutions, often with location specific cost drivers. Therefore, the enhancement areas are not set into relatively homogenous categories necessary for model development.

WINEP and NEP for water services consists of the following areas of enhancement,

- **Ecological improvements at abstractions** – schemes to limit the environmental impact at points of abstractions for drinking water production.
- **Eels Regulations** – schemes to ensure compliance with the Eels Regulations to prevent the entrainment of eels and fish.
- **Invasive non-native species** – schemes, activities and studies to limit the transfer of invasive non-native species, such as floating pennywort and zebra mussels
- **Water Framework Directive schemes** – schemes to improve, protect or ensure no deterioration of surface and groundwater under the water framework directive.
- **Drinking water protected areas** – schemes to either reduce current or avoid additional treatment of water for potable supply.
- **Water investigations** – as with the wastewater service this area covers studies and investigations that will frequently inform plans for future periodic reviews.

For the deep dive assessments, we consider the availability and quality of evidence the company provides. At draft determination we challenged companies' costs in our deep dives where there was a lack of evidence. For final determinations we adjust our allowance for Southern Water on the Bewl-Darwell INNS scheme, South Staffs Water for Eels Regulations schemes and Affinity Water for the Brett sustainability scheme based on their representations.

We apply our company-specific efficiency factor to any costs that we shallow dive. As a continuation of our approach set at the initial assessment of plans stage, we continue not to apply our company-specific efficiency factor for shallow dives in the Water Investigations as the costs are less material at an industry level. Since draft determinations we have continued to refine our modelling approach to determine efficient wholesale base costs. As a result, at final determination our shallow dive company-specific efficiency challenge in water has reduced for Thames Water, SES Water and South Staffs Water and increased for Northumbrian Water, Southern Water, South East Water. These changes have, alongside our evaluation of further representations, impacted our allowance for the water programme of WINEP/NEP. Table 19 below sets out the total cost allowance in final determinations in the water programme for WINEP/NEP.

Table 19: Total cost allowance in final determinations in water programme for WINEP/NEP investment (£m, 2017-18 prices) and a comparison to draft determinations.

Company	Requested investment after reallocations (April 2019)	Final Determination	Draft Determination
Anglian Water	61.7	55.7	55.7
Dŵr Cymru	19.6	15.7	15.7
Hafren Dyfrdwy	5.1	3.9	3.9
Northumbrian Water	14.5	14.4	14.5
Severn Trent Water	86.1	72.7	72.7
South West Water	12.6	11.2	11.2
Southern Water	17.7	17.1	13.6
Thames Water	173.6	145.9	141.2
United Utilities	28.7	28.7	28.7
Wessex Water	18.9	17.5	17.5
Yorkshire Water	47.8	46.2	46.2
Affinity Water	121.6	121.0	116.6
Bristol Water	4.9	4.5	4.5
Portsmouth Water	4.8	4.1	4.1
South East Water	69.0	63.7	65.6
South Staffs Water	9.2	8.8	6.5
SES Water	1.0	1.0	1.0
Total	696.9	632.1	619.0

Dealing with uncertainty in the programme

At the time of our final determination a significant proportion of WINEP and NEP requirements are yet to be confirmed. In 'Delivering Water 2020: Our final methodology for the 2019 price review' we introduced a mechanism to manage this uncertainty. We set our allowance based on the full extent of the programme a company anticipates being required by 2025. Companies were required to link their unconfirmed requirements to an outcome and a unit cost. We will use our view of the unit costs to make an adjustment at the end of the control period for schemes that are not confirmed as being required (or are confirmed but not delivered). The unit costs are specific to each company and set out in the 'Cost efficiency final determination appendix' for each company.

4.6.2 Changes from draft determination

- We revise our estimation of catch-up efficiency and frontier shift within the WINEP programme level adjustment for the wastewater programme.
- We revise the phosphorus removal model due to data changes.
- We change our method of assessing the allowance for the reduction of sanitary parameters programme. We no longer use a cost benchmarking model. Companies are allowed their requested totex.
- We revise the flow to full treatment model, excluding Wessex Water's Avonmouth scheme for a separate assessment due to its size.
- We increase the unit costs allowance for event duration monitors for all companies after Thames Water provided a correction to their data.

Further changes we made that are company-specific are set out in Annex 4.

4.6.3 Stakeholder representations

This section includes representations relating to our cost benchmark models that have broader implications across many companies. Company-specific representations are summarised in the following section alongside our assessment and decision.

WINEP – wastewater: Programme level adjustments

In general companies are supportive of assessing the investment in the wastewater elements of WINEP/NEP at programme level, as this results in a more balanced treatment of the outputs of our cost benchmarking models. Anglian Water, Northumbrian Water, Southern Water, Yorkshire Water, United Utilities and Wessex Water point out an error we made in our calculation of our programme level adjustment at draft determination. Further these companies do not consider it appropriate to include Hafren Dyfrdwy in our calculation of the upper quartile efficiency as our estimate of its efficient costs was significantly greater than the amount they requested, and this inappropriately affected the calculation.

Companies also consider that they had already made efficiency challenges to their costs in these areas of enhancement and that the application of a further adjustment was inappropriate. Anglian Water and Southern Water question why this further challenge is only applied to WINEP/NEP. Yorkshire Water and Southern Water made representations that for wastewater the small sample size, different approaches to opex and capex solutions and the use of restricted cost drivers meant that our models were not sufficiently accurate to determine efficient costs.

Wessex Water considers that the fact that Thames Water and Severn Trent Water had not included all of their uncertain (amber) schemes was biasing our assessment of efficient costs. They considered this was particularly so for costs in the phosphorus removal programme. Since our draft determinations a number of companies made us aware of corrections to their data on both costs and cost drivers in this area.

WINEP/NEP – wastewater: Phosphorus removal

Yorkshire Water considers that our cost benchmarking for phosphorus removal does not sufficiently account for the legislative driver nor the gap between the current and future consent. Anglian Water considers that our model variable used to account for the costs of more stringent consents should be set at $\leq 1.0\text{mg/l}$ and not $\leq 0.5\text{ mg/l}$. Further in its representation Northumbrian Water considers that South West Water should be treated as an outlier due to the size of their programme. It further considers that we do not fully account for the distribution of the size of sites and that its costs are high due to the need to up-date to radial flow settlement tanks.

Yorkshire Water makes a significant reallocation of investment it previously considered as base expenditure into this programme. Wessex Water corrected data in this area and is concerned that other companies were also not correctly reporting their data. We were already concerned with the data for cost drivers for Severn Trent and thus took this opportunity to ask all companies to confirm the population equivalent and number of sites in their phosphorus removal programmes.

WINEP/NEP – wastewater: Reducing sanitary parameters

Anglian Water, Southern Water, Thames Water and Wessex Water all make representations regarding the validity of our cost benchmarking model for the programme to deliver the tightening of consents for sanitary parameters. They are concerned with the model's weak predictive power, the quality of industry data, and that it did not represent the tightest permit level or how much tighter companies' permits will become. We asked companies to confirm their submitted data in this area and this has had implications on our approach for setting cost allowances.

4.6.4 Our assessment and reasons

This section sets our response to stakeholder representations in arriving at our final determinations.

WINEP – wastewater: Programme level adjustments

We have changed our approach to setting our programme level adjustment. For final determinations we separately estimate a catch-up efficiency and a frontier shift. We have corrected our error in the calculation of catch-up efficiency.

We consider our cost benchmarks to be robust and therefore an appropriate basis for determining catch-up efficiency. We use our programme level in-the-round approach to mitigate against estimation errors in individual models. Our methodology allows for companies to make representation against the models and companies can submit a cost adjustment claim where our models do not adequately account for local circumstances. We accept that there are limitations to the data available for modelling, we only use models that are statistically robust. We limit our models to two cost factors due to the small number of sewerage companies to improve their reliability. The cost factors we use all have an engineering logic behind them. Where we could not develop a reliable model or where the area was of lower materiality we undertook a deep or shallow dive, allowing requested costs in full for shallow dives. Our estimated modelled allowances show clear differences between our and company's view of efficient costs, providing evidence that lagging companies can make efficiency gains. South West Water and Severn Trent have requested costs less than our adjusted modelled allowance. Further after the application of our adjustments five of the eleven companies receive at least 95% of their requested investment. From this we conclude that these adjustments are reasonable and appropriate for lagging companies.

At our draft determinations we did not apply a separate adjustment for frontier-shift. The justification for this is set out in section 5. This adjustment is also applied to set efficient costs for metering. This is also an area where we expect there is be a greater scope of innovation.

In 'Delivering Water 2020: Our final methodology for the 2019 price review' we stated that our allowance would be based on the full extent of the programme a company anticipates being required by 2025. Therefore it was for companies, in co-operation with other stakeholders to set their programme. This means companies may leave out schemes that are not or only marginally cost-beneficial where they are not mandated by legislation. We consider that this approach is more reasonable than including schemes in our analysis that were not likely to go ahead.

WINEP/NEP wastewater – Phosphorus removal: As set out in the previous section we asked companies to confirm the details of their investment programme in this area and as a result nearly all companies provided changes to their data some of which were significant. We further confirmed this information with the Environment Agency. We updated our models with this new data and they continue to be robust and were used as the basis for our final determinations. In responding to representations we do not consider that South West Water should be treated as an outlier. Whilst its programme is smaller it is not significantly so. We continue to model Hafren Dyfrdwy and Severn Trent as a single company, mainly due to the Welshpool STW featuring the Severn Trent's investment plan.

Yorkshire Water considered that our cost benchmarking of the phosphorus removal programme did not sufficiently account for the legislative driver. The WINEP/NEP phosphorus removal programme has primarily two legislative drivers; the Water Framework Directive (WFD) and the Urban Wastewater Treatment Directive (UWWTD). WFD sets out to achieve good ecological status for rivers by 2027. This directive leads to schemes with Improvement or No Deterioration drivers. Schemes with a no deterioration driver are mandatory and the promotion of improvement schemes is dependent on a cost-benefit test. UWWTD drives phosphorus reduction where a works breaches a capacity threshold due to growth (mandatory) or discharges to sensitive waters (mandatory or uncertain if the waters are awaiting this designation). An important distinction is that the UWWTD stipulates tertiary treatment. The consent a sewage treatment works must achieve is typically more stringent under a WFD – improvement driver.

To evaluate the impact of the legislative driver we looked at how a company's costs varied with the proportion of its programme with a primary driver of WFD improvement, WFD no deterioration or UWWTD. The importance of setting a primary driver is that a single site may have multiple driver, e.g. both WFD and UWWTD driver, and thus the potential for double counting investment needs. In such cases the WFD improvement driver would typically have a more stringent consent and thus be considered the primary driver. Our analysis revealed that overall companies whose programme was driven more by WFD no deterioration drivers may appear more efficient. This supported the representation of Yorkshire Water in that it had a lower proportion of its programme in this area and thus may appear less efficient than other companies. We accept this point and have adjusted their allowance accordingly. We did this by triangulating our assessment with a third model that determines investment needs based on the proportion of the programme covered by sites with a WFD no deterioration driver. We do not make a symmetrical adjustment to the allowances for other companies for this factor as we are not fully confident in

the quality of the model. As explained previously we have a higher evidence bar for models we apply across the industry.

Yorkshire Water also considers that our cost benchmarking of the phosphorus removal programme does not sufficiently account for the gap between the current and future consent. Our analysis shows that the total number of enhanced sites is highly correlated to number of sites without a consent and the number within ≤ 1 mg/L and ≤ 0.5 mg/L stringency consent bands. Therefore we do not consider any company is substantially disadvantaged by the models we are applying for final determination. It is challenging to quantify the gap between current and future consents as many sites do not currently have a consent value. Yorkshire Water argues in its representations that they are an outlier for sites without consent. Yorkshire Water, Northumbrian Water and South West Water all have a similar level of sites in this enhancement programme without a consent and South West Water is considered highly efficient. Due to these facts we do not made an adjustment to Yorkshire Water's allowance based on their representations.

Anglian Water considers that our model variable used to account for the costs of more stringent consents should be set at 1.0mg/l and not 0.5 mg/l. We use the 0.5mg/L stringency level as companies told us that this is the point at which costs increase disproportionately to changes in consent. As set out above our analysis shows the total number of enhanced sites and those within ≤ 1 mg/L and ≤ 0.5 mg/L stringency consent bands for the industry are highly correlated. Therefore, we do not consider any company is substantially disadvantaged by the models we are applying for our final determination. Anglian Water has only slightly fewer sites than average in the consent ≤ 0.5 mg/L category and more than both South West Water and Wessex Water which are considered to be efficient. Due to these facts we do not make an adjustment to Anglian Water's allowance based on their representations.

We do not make an adjustment for Northumbrian Water allowance for phosphorus removal based on their representation that they need to up-date to radial flow settlement tanks on a number of wastewater treatment sites. Northumbrian Water does not justify why customers should bear the impact of the historical technology choices which are under management control. For example, it does not provide any evidence that these were legacy assets in use before privatisation.

WINEP/NEP wastewater – Sanitary parameters: We based our draft determination on two econometric models, placing equal weight on each. The first model predicted the required totex using the number of sewage treatment works with new or tightened sanitary parameter consents and the population equivalent (a measure of

capacity) of these works as the cost drivers. The second model used the same number of sewage treatment works and the change in the level of load at these works with an ammonia consent less than or equal to 3mg/L. All variables are in logs to allow for economies of scale and we corrected for log transformation bias to ensure that the sum of industry input costs is equal to industry output costs. Both models appeared to provide reasonably robust predictions.

After our draft determinations we became aware of inconsistencies in companies' data and clarified with companies their number of sites and schemes and further reconciled this data with WINEP/NEP. This led to a significant change in the value of costs drivers. When we re-evaluated our models with this corrected data, they no longer produced results that could be relied upon to derive efficient costs. We concluded that the variety of existing assets on a site and variations across the industry in terms of current and future consents imposed by WINEP/NEP means that there is often little homogeneity across interventions and that this programme does not lend itself to econometric modelling. As a result, for final determination we have allowed companies their costs in full in this area, subject to the programme level efficiency challenge as appropriate.

Annex 4 provides a summary of remaining stakeholder representations, our assessment and decision. The representations in the annex are more company-specific with less relevance to our wider approach.

Other enhancements activities – wholesale water

In this section we discuss our assessment approach for wholesale water enhancement activities not covered in previous sections. These activities include: improving taste odour colour; meeting lead standards; addressing raw water deterioration, improvements to river flows; and, Security and Emergency Measures Direction. Table 20 shows the companies' requested cost in their representations to the draft determinations and our final determination view of the allowances.

Our reporting tables allow companies to submit enhancement expenditure in freeform lines, where they consider that a specific expenditure does not fit the description of any of the standard lines. Our consideration and assessment of expenditure submitted in freeform lines is included in our freeform feeder models.

We assess freeform expenditure proposals either through a shallow dive or a deep dive process, depending on materiality. Where we consider it appropriate, we

reallocate expenditure submitted by a company in a freeform enhancement line to a standard enhancement line.

Table 20: allowed costs for other wholesale water enhancement areas (£m, prices of 2017-18)

	Improving Taste Odour Colour		Meeting lead standards		Addressing raw water deterioration		Improvements to river flows	
	Company (Aug 19)	Our view	Company (Aug 19)	Our view	Company (Aug 19)	Our view	Company (Aug 19)	Our view
Anglian Water	-	-	24.3	12.5	22.8	20.5	-	-
Dŵr Cymru	27.2	96.9	14.0	14.0	9.9	9.9	2.2	2.2
Hafren Dyfrdwy	1.8	1.3	2.9	2.9	0.2	0.2	-	-
Northumbrian Water	-	-	10.3	10.3	34.8	28.9	0.1	0.1
Severn Trent Water	22.4	11.3	16.8	6.3	60.8	37.1	15.2	15.2
South West Water	7.8	7.4	4.0	4.0	83.1	68.2	-	-
Southern Water	-	-	19.8	19.8	75.3	61.8	-	-
Thames Water	-	-	79.7	66.7	10.3	9.2	-	-
United Utilities	11.9	11.9	16.8	14.0	2.2	2.2	-	-
Wessex Water	-	-	11.3	11.3	12.1	11.3	-	-
Yorkshire Water	17.0	12.8	12.5	11.1	61.4	50.6	-	-
Affinity Water	-	-	8.4	8.4	3.0	3.0	0.5	0.5
Bristol Water	-	-	0.3	0.3	1.6	1.4	-	-
Portsmouth Water	-	-	0.3	0.2	5.8	5.5	-	-
South East Water	-	-	-	-	17.5	15.6	1.7	1.7
South Staffs Water	68.5	68.0	3.0	3.0	15.9	12.7	-	-
SES Water	-	-	1.7	1.7	-	-	-	-
Industry	156.6	209.6	226.0	186.5	416.8	338.7	19.7	19.7

Note: Our final determination view of company business plan figures include costs we have reallocated to the enhancement line from other areas of the business plan.

Improving taste odour and colour

4.6.5 Our final determination decision

Companies incur costs to improve the taste odour colour quality of water for customers.

We assess taste odour colour expenditure proposals through either deep dive or shallow dive assessment. To assess the need for the investment we look for Drinking Water Inspectorate support of individual schemes. Where we do not find this we consider evidence of customer support.

For schemes at treatment works we seek evidence as to size of works involved to quantify the scale of the enhancements and the processes required. We do not allow for operational costs related to new more complex treatment. These costs are captured in our modelled base allowance through the treatment complexity variable which is now based on companies' view of complexity in 2020-25.

In the water supply network we look for evidence of the extent and nature of the proposed remedial work. When we assess catchment management schemes we look for evidence that companies have considered the impact of the proposed metaldehyde ban on project costs. We do not allow for schemes to remove metaldehyde and provide a separate uncertainty mechanisms for identified costs should the ban not be reintroduced and these are explained in section 10¹⁸ and section 11.

4.6.6 Changes from our draft determinations

No change in approach from draft determinations.

¹⁸ We also explain in Section 10 that we are including Notified Items for Anglian Water and Affinity Water.

4.6.7 Stakeholders' representations

Dŵr Cymru, South West Water and South Staffs Water provided additional evidence to support individual schemes. Yorkshire Water made a representation for additional costs of operating more complex water treatment works.

Our assessment and reasons

For Yorkshire Water's representation we assess the impact on opex cost of changing treatment works complexity during the period 2020-25 in the modelling of base costs that we complete for final determination.

Meeting lead standards

Companies have an obligation to manage customer exposure to levels of lead below a statutory limit. To achieve that, companies replace lead communication pipes and may treat the drinking water to control plumbosolvency from lead pipes. More recently reducing lead exposure on the customer supply side pipework has attracted further attention for health benefits.

Our final determination decision

To assess companies' requested costs in this area, we benchmark the unit cost of replacing a lead pipe (for water quality) across companies. We use two methods of benchmarking: an econometric model and a simple unit cost benchmarking. Our assessment is based on companies' forecast costs from their April 2019 business plans.

For the econometric model, we use the 2020-25 forecasted number of lead communication pipes replaced for water quality in a log-linear model, as it captures economies of scale better than a linear model and provides more credible results for the very small and very large companies in our sample. The unit cost is calculated as the median across companies of the total costs of meeting lead standards per communication lead pipe replaced. The forecast median unit cost of £1,353 is credible as broadly in line with the historical median unit cost (£1,083), and provides a valid alternative result to that of the econometric model. Our estimate of an efficient expenditure is the average of both methods.

Our allowance is the minimum between our modelling result and the expenditure requested by the company.

For Dŵr Cymru and Hafren Dyfrdwy we make an additional allowance due to the expectation set by the Welsh Government to meet a lower lead target. Anglian Water and Thames Water make representations to undertake customer supply pipe replacement trials to minimise lead exposure at customers' taps. Both companies are engaging with the Drinking Water Inspectorate to take account of the proposals to revise the standard for lead for the proposed revision of the EU Drinking Water Directive (98/83/EC). We undertake a deep dive of Anglian Water's and Thames Water's proposals for the supply pipe element. Although companies operating wholly or mainly in England are not subject to the same lower lead target expected by the Welsh Government for companies operating wholly or mainly in Wales, we note the aspiration to minimise lead at customer taps. We make a separate partial allowance based on the efficient unit cost per replacement of customer pipe estimated for the Welsh companies.

4.6.8 Changes from our draft determinations

We make additional deep dives for Anglian Water and Thames Water for the supply pipe element.

4.6.9 Stakeholders' representations

We had two representations on our draft determination approach. Anglian Water acknowledges that the changes to the dependent and explanatory variable of the model from the initial assessment of plans represent an improvement and take on-board feedback from companies. However, the company notes that the average length of pipes it proposes to replace for the period 2020-25 is significantly higher than historical average, due to its proposal to replace both communication pipes and the customer owned side of the pipework. The company also provides additional evidence on its forecast costs for a treatment solution.

Thames Water represents on the provision of additional allowance for trials for reducing lead on customers supply pipe arrangements.

4.6.10 Our assessment and reasons

We do not receive representations which significantly challenge the validity of our approach at draft determination, which we retain for final determination. Both the

econometric and unit cost models are theoretically sound and provide credible results.

Following a deep dive assessment, we make a partial additional allowance for Anglian Water and Thames Water for work planned on replacing customer supply pipes, as the lead model allowance is based on communication pipe replacements only. This is in recognition of the companies' engagement with the Drinking Water Inspectorate and the aspiration to minimise lead at customer taps.

Addressing raw water deterioration

4.6.11 Our final determination decision

Companies incur costs to address raw water deterioration that result from the adverse impacts of changes in catchment characteristics and contaminant levels in raw water supplies.

We assess raw water deterioration expenditure proposals through either deep dive or shallow dive assessment depending on materiality. To assess the need for the investment in our assessment we look for Drinking Water Inspectorate support of individual schemes.

For treatment and raw water blending schemes we seek evidence as to the size of works involved to quantify the scale of the enhancements, the processes required and the extent of any pipeline works. We do not allow for operational costs related to new, more complex, treatment. These costs are captured in our modelled base allowance through the treatment complexity variable, which, for final determination, is based on companies' view of complexity in 2020-25. When we assess catchment management schemes that seek to prevent raw water deterioration we look for evidence that companies have considered the impact of the proposed metaldehyde ban on project costs. We do not allow for schemes to remove metaldehyde and provide separate uncertainty mechanisms for identified costs should the ban not be reintroduced¹⁹.

¹⁹ We also explain in Section 10 that we are including Notified Items for Anglian Water and Affinity Water.

4.6.12 Changes from our draft determinations

No change in approach from draft determinations.

4.6.13 Stakeholders' representations

A number of companies submitted additional evidence which we discuss in the relevant company document.

Southern Water and Yorkshire Water state that we should allow for additional costs to operate the enhanced treatment works. They argue that our forecast of treatment complexity, which we use to set base cost allowances for 2020-25, does not capture the increased treatment complexity they expect to deliver to address deterioration in raw water quality. At draft determinations, our forecast of treatment complexity was based on the level of complexity at recent years and remained constant for the period 2020-25.

4.6.14 Our assessment and reasons

Following the representations of Southern Water and Yorkshire Water we include in our assessment the impact on cost of changing treatment works complexity during the period 2020-25 in our modelling of base costs.

Improvements to river flows

4.6.15 Our final determination decision

Companies incur costs related to abstraction licences, to monitor river flows and address flow reductions.

Due to the low materiality of proposed costs in this area of enhancement, we allow the proposed costs in full.

4.6.16 Changes from our draft determinations

No change in approach from draft determinations

4.6.17 Stakeholders' representations

We did not receive any representations on our approach to setting allowances for improvements to river flows

Security & Emergency Measures Direction (SEMD) and non-SEMD costs for water

SEMD expenditure relates to schemes to protect key assets by complying with the Security and Emergency Measures Direction 1998. Non-SEMD expenditure relates to schemes driven by other security requirements (eg cyber security or enhancing the security of network and information systems).

4.6.18 Our final determination decision

For wholesale water, we combine SEMD and non-SEMD costs into one security assessment as these areas are both driven by the requirement to ensure the resilience of assets and the safety of water in an emergency situation.

To assess companies' proposals for the combined security costs, we first consider the proportion of their security costs over the period 2011-12 to 2024-25 (ie historical and forecast costs) as a proportion of the total base expenditure. We compare the company's proportion of security costs to the average proportion across all companies. If the proportion for the company is lower than the industry average, we allow the costs. If it is higher, we reduce the proposed costs. Where we consider company forecasts to be very immaterial, we disallow these costs as we do not consider these to be a significant enhancement to service. For companies whose PR19 costs are material as a proportion of base costs or whose costs changed substantially since September 2018, we carry out a deep dive using the information provided within the companies' submission.

4.6.19 Changes from our draft determinations

No change in approach since draft determination (although we change our allowance to some companies in light of further evidence).

4.6.20 Stakeholders' representations

We did not receive representations which significantly challenge our approach at draft determinations. A number of companies submitted further evidence in response to our assessment. We address these representations in the relevant company-specific documents.

Other enhancements activities – wholesale wastewater

In this section we discuss our assessment approach for wholesale wastewater enhancement activities not covered in previous sections. These activities include: first time sewerage; sludge enhancement (quality and growth), odour, Drainage and wastewater management plans; and Security and Emergency Measures Direction. Table 21 provides our expenditure allowance for each of these areas.

Table 21: allowed costs for other wholesale wastewater enhancement areas (£m, prices of 2017-18)

Company name	First time sewerage		Sludge enhancement (quality and growth)		Odour	
	Company (Aug 19)	Our view	Company (Aug 19)	Our view	Company (Aug 19)	Our view
Anglian Water	20.8	19.2	12.6	5.7	14.0	12.6
Dŵr Cymru	4.4	4.4	11.8	5.8	3.1	3.1
Hafren Dyfrdwy	-	-	-	-	-	-
Northumbrian Water	1.0	1.0	-	-	-	-
Severn Trent Water	17.4	12.7	29.3	-	0.7	-
South West Water	1.0	1.0	5.2	-	-	-
Southern Water	5.0	4.9	5.0	5.1	-	-
Thames Water	8.8	3.3	-	-	11.7	11.0
United Utilities	5.1	3.4	10.4	0.6	-	-
Wessex Water	5.3	3.9	-	4.1	-	-
Yorkshire Water	1.0	1.0	35.6	35.6	-	-
Industry	69.9	54.9	109.9	56.8	29.5	26.7

Note: Our final determination view figures include costs we have reallocated to the enhancement line from other areas of the business plan.

First time sewerage

Companies allocate expenditure for new and additional sewage treatment and sewerage assets for first time sewerage schemes to meet the duty under s101A of the Water Industry Act 1991.

4.6.21 Our final determination decision

We assess the investment for this line using a panel data model where the cost driver is the number of connectable properties served by s101A schemes. The model includes both a linear and a squared term of the driver. This captures the economies of scale and fits the data well. We triangulate our cost allowance across two models, one using historical data for the period 2011-12 to 2017-18 and other using forecast data for the period of 2020-21 to 2024-25. Our allowance is based on the average result of the two models, unless the company requested a lower expenditure than that predicted by the model, in which case we allow the company its requested costs.

4.6.22 Changes from our draft determinations

No change in approach from draft determinations.

4.6.23 Stakeholders' representations

Anglian Water and Thames Water request a separate deep dive for their first time sewerage programmes. Anglian Water argues that our model is skewed by the presence of two high-cost companies.

4.6.24 Our assessment and reasons

We retain our approach from the draft determination. We consider that our model is theoretically sound, it relies on a sample of 10 companies with planned activity in this area and therefore it provides a reasonable benchmark for the cost. Anglian Water and Thames Water's costs appear high based on our model, and this is cross-validated through our unit cost assessment. Neither representation provides evidence to suggest why the companies' cost appears high relative to our modelled costs.

Sludge enhancement (quality and growth)

4.6.25 Our final determination decision

Sludge enhancement for 2020-25 considers investments to provide additional sludge handling and treatment capacity to cater for the impact of population growth and the implementation of the 2020-25 WINEP programme for phosphorus removal.

We assess the proposals for costs of providing sludge treatment facilities to accommodate the increase in sludge production that results from population growth or the implementation of the 2020-25 WINEP programme for phosphorus removal. We allow expenditure where companies provide sufficient evidence of population growth and evaluate the impact of this and the environmental regulations on sludge production. We also assess how well the companies have engaged with the bio-resources market to provide a cost effective solution. For example, whether they have considered third party provision of additional treatment capacity, particularly when the additional capacity is not required immediately. Where companies do not

provide such evidence, we apply a cost challenge to their proposed expenditure and make a lower allowance.

4.6.26 Changes from our draft determinations

No change in approach from draft determinations.

4.6.27 Stakeholders' representations

There are two representations by Anglian Water and South West Water on the draft determination approach towards funding the provision of additional sludge treatment capacity in the period 2020-25.

Anglian Water provides persuasive evidence to support the need for the investment for the provision of additional sludge capacity. In addition, the company presents an improved evaluation of the options considered that involves third party suppliers or engagement in the bioresources market.

South West Water presents a revised proposal that includes the investment enabling projects to facilitate the bioresources market.

4.6.28 Our assessment and reasons

The allowance for Anglian Water is derived on the basis of the efficient cost of the contract with the bioresources market since the company's evaluation of the options considered is not satisfactory.

We disallow the proposed expenditure made by South West Water. The proposed investment does not qualify for enhancement adjustment since the company does not explicitly express or evaluate the need for tackling the sludge production growth.

Odour

4.6.29 Our final determination decision

Odour enhancement primarily considers the investment to install facilities to reduce the likelihood and frequency of odour complaints, for example physically covering wastewater and bioresources processes, and extracting and treating the air.

We assess the investment by following the shallow dive process since all the proposed expenditures are below the materiality threshold. We apply the companies' specific efficiency challenge to the proposed expenditure.

4.6.30 Changes from our draft determinations

No change in approach from draft determinations.

Drainage and Wastewater Management Plans (DWMPs)

Drainage and wastewater management plans are new plans prepared by the water and sewerage companies to provide a more consistent and comprehensive basis for long-term planning of drainage and wastewater services as recognised by the 21st Century Drainage Programme supported by Water UK, Defra and Environment Agency.

4.6.31 Our final determination decision

We make allowances for four companies that request additional enhancement costs for preparing drainage and wastewater management plans. We make our allowances using more detailed information that Dŵr Cymru provided in a query response about its wastewater catchment planning expenditure in the period 2011-12 to 2018-19. We calculate the annual historical expenditure and compare it to its proposed annual drainage and wastewater management plans expenditure. We find that 48% of what the company requests for drainage and wastewater management plans was spent historically. We therefore consider our base allowance already covers 48% of what the company requests. We make an enhancement allowance of the remaining 52% of the proposed drainage and wastewater management plans expenditure. We make enhancement drainage and wastewater management plans enhancement allowances for Northumbrian Water, Thames Water, Dŵr Cymru and Wessex Water.

4.6.32 Changes from our draft determinations

At draft determinations we did not make any enhancement allowances for drainage and wastewater management plans. We considered that wastewater planning activities are part of our base allowance. For final determinations we make partial allowances for four companies.

4.6.33 Stakeholders' representations

The representations are made by Northumbrian Water, Thames Water, Dŵr Cymru and Wessex Water. All four companies state that since drainage and wastewater management plans are a new requirement they are enhancement activities over and above our allowance for base activities,

4.6.34 Our assessment and reasons

The representations made by Northumbrian Water, Thames Water, Dŵr Cymru and Wessex Water provide convincing evidence that some additional investment is required to develop DWMPs to ensure a more consistent basis for long-term planning of drainage and wastewater services as recognised by the 21st Century Drainage Programme supported by Water UK, Defra and the EA. We recognise that there are activities related to the development of drainage and wastewater management plans are an increased requirement to previous wastewater planning processes that we consider are within our modelled base allowance. The proposed investments, therefore, is partially accepted to ensure the efficiency of the costs.

We assess the proposed expenditure by following the deep dive process and show detail of our assessment and allowance in each company's cost adjustment claim model.

Security & Emergency Measures Direction (SEMD) and non-SEMD costs for wastewater

Our final determination decision

SEMD expenditure relates to schemes to protect key assets by complying with the Security and Emergency Measures Direction 1998. Non-SEMD expenditure relates to schemes driven by other security requirements (eg cyber security or enhancing the security of network and information systems).

For wholesale wastewater, we combine the SEMD and non-SEMD costs into one security assessment. We welcome the proposals for companies to invest in this area and do not apply the company-specific efficiency factor to companies where wastewater security costs are not deemed material.

Where costs are material, we carry out a deep dive assessment. We assess these costs by determining the proportion of base totex spent on security for the period 2011-12 to 2024-25 and benchmarking companies against each other. Where a company spends above this benchmark, we reduce the company allowance to ensure the total costs for this period do not exceed the average of both the median and the average proportion of base costs spent on security for all wastewater companies.

4.6.35 Changes from our draft determinations

No change in approach from draft determinations.

5. Frontier shift and real price effects

5.1.1 Our final determination decision

Water companies are regulated monopolies. Our regulatory approach seeks to ensure that as far as possible customers obtain the benefits as if water companies were operating in a competitive market. Over time we expect the productivity of companies to improve as they adopt new technologies or new ways of working. These productivity improvements shift the efficiency frontier for the sector. These efficiency improvements are additional to any catch-up efficiency.

We consider that there will be frontier shift efficiency improvements in the water sector from two different sources:

- on-going efficiency improvements in the economy that the water sector should be able to emulate; and
- one-off efficiency improvements from water companies making greater use of the totex and outcomes framework at PR19.

Real price effects are a measure of how much we expect water company costs to change due to input price inflation, relative to the indexation we use in price controls. Key input prices for water are labour, energy and materials costs. In PR19 we will index wholesale controls to the Consumer Prices Index including owner occupiers' housing costs (CPIH) as a measure of inflation. Any real price effects for wholesale expenditure will be additional to the change in CPIH and are based on a comparison of the forecast growth of the relevant input price relative to CPIH.

Overall we consider that we should apply a frontier shift efficiency adjustment of 1.1% per year based on the combined effect of ongoing frontier shift efficiency and the impact of the totex and outcomes framework. This takes into account updated information on outperformance in the current control period and the stretch in outcomes, particularly on leakage. Overall we consider that a 1.1% frontier shift efficiency together with the stretch on outcomes provide a stretching but achievable challenge for companies.

We continue to apply a real price effect for labour costs. We continue to include a true up based on manufacturing wage costs as that will more accurately reflect underlying cost pressures in the water sector.

5.1.2 Changes from our draft determination

We reduce the frontier shift efficiency adjustment from 1.5% to 1.1% per year.

We will apply the frontier shift and real price effects to all wholesale base costs, rather than just modelled base costs, as frontier shift estimates are based on all costs, including costs that are outside our modelled base costs such as business rates.

We will also apply frontier shift and real price effects to metering and WINEP enhancement costs as our frontier shift efficiency estimate is based on all costs in comparator industries, not just base or on-going costs. We consider that applying frontier shift efficiency to these costs is most relevant as the potential gains from productivity improvements are likely to be more significant as both encompass large, relatively homogenous, programmes of work that are more common across companies.

We will apply the frontier shift and real price effects to costs from 2019-20 rather than 2020-21. Base cost inputs, and cost forecasts, used in our cost models only take into account data and therefore on-going efficiency improvements and real price effects up until 2018-19. We therefore consider it appropriate to add in frontier shift and real price effects for the additional year.

We continue not to apply frontier shift to retail costs as these are partly based on forward-looking costs, and reflect significant efficiency improvements from historic expenditure.

Based on updated evidence from companies, we have revised the proportion of costs that are labour costs from 35% to 39%.

5.1.3 Stakeholders' representations

We received responses on frontier shift efficiency and real price effects from 11 water companies. We set out the company responses and our detailed assessment in annex 3.

5.1.4 Our assessment and reasons

To understand the potential scale of these efficiency improvements we commissioned two consultants' reports:

- 'Frontier shift efficiency and real price effects', by Europe Economics, which was updated for final determinations; and
- 'Innovation and efficiency gains from the totex and outcomes framework', by KPMG and Aqua consultants, which was published at the initial assessment.

Following consideration of responses to the draft determinations, Europe Economics revised its assessment of real price effects and frontier shift efficiency. We outline the updated findings in annex 3. We also set out our response to points raised by companies and their consultants on frontier shift and real price effects. This includes further responses to the 'Innovation and efficiency gains from the totex and outcomes framework' report by KPMG and Aqua consultants. We also discuss the scope of the application of frontier shift and our approach to the true up for labour costs. Finally, we set out our revised assessment of the scope for frontier shift efficiency and real price effects for the 2020-25 period.

While we continue to apply a real price effect to labour costs, we do not make an adjustment for other costs, such as energy, materials and chemicals costs. For these costs we do not consider that there is sufficient evidence that there will be a significant wedge between these costs and CPIH over the price control period, there is some level of management control over these costs and some elements of the cost increase will be captured within increases in CPIH.

For frontier shift efficiency, taking into account the findings of the two reports, responses and updated evidence on the outperformance of the totex and outcomes controls in water and energy and the stretch in company outcome performance commitments, particularly in leakage, we have revised the ongoing efficiency adjustment from 1.5% to 1.1% per year.

Table 22 sets out our frontier shift assumptions, together with our real wage growth rate assumptions (taken from the Office for Budgetary Responsibility) and the real price adjustment based on an assumed 38.6% labour cost share in expenditure.

Table 22: Real price effect and frontier shift assumptions

Year	Real wage rate growth per hour	Real price effect adjustment	Frontier shift
2019-20	1.00%	0.37%	-1.10%

2020-21	1.10%	0.44%	-1.10%
2021-22	1.10%	0.43%	-1.10%
2022-23	1.20%	0.45%	-1.10%
2023-24	1.30%	0.50%	-1.10%
2024-25	1.40%	0.54%	-1.10%

6. Pulling the pieces together: setting efficient allowances for wholesale controls

In previous sections we explain our assessment approach to the three building blocks of wholesale costs – modelled base costs, unmodelled base costs and enhancement expenditure. Our assessment is often done at service levels that do not necessarily correspond to the PR19 controls of water resources, water network plus, wastewater network plus, and bioresources.

In this chapter we explain how we apportion the result of our assessments to set efficient cost allowances for each of the PR19 controls.

6.1 Modelled base costs

For modelled base costs, we use our suite of econometric models to estimate efficient costs at the wholesale service level. Figures A2.1 and A2.2 in Annex 2 describe how we triangulate the results from the different models to come to a view of efficient wholesale costs.

We apportion to each price control our view of efficient wholesale costs based on the proportion of business plan costs companies allocated in each control.

6.2 Enhancement and unmodelled base costs

In the areas of enhancement and unmodelled costs, most activities fall naturally within a single price control.

In cases where activities cut across two controls, we make the assessment at the wholesale level. We apportion the result of our assessment to price controls based on the proportion of costs in the company business plan in each price control for the activity in question.

An exception is third party services costs, where we do the assessment at price control level so no apportioning is required.

There may be cases where it is appropriate to make the apportionment differently to the above, directly related to the specific disallowances we have made.

7. Residential retail

Since we introduced separate retail controls at PR14, we have seen evidence that companies are increasingly more focussed on outcomes and efficiency in delivering retail services. This trend is continuing in the PR19 business plans. Projected costs for 2020-25 in residential retail are generally decreasing relative to current levels of expenditure.

7.1.1 Our final determinations decision

Econometric modelling

We use econometric models, with data over six years (2013-14 to 2018-19), to estimate an average cost for retail services as a function of relevant drivers of costs. We derive efficient costs, based on efficient companies over the sample period and efficient business plan forecasts for the 2020-25 period.

We use different models to estimate different costs:

- models to benchmark bad debt and debt management costs;
- models to benchmark other retail costs (ie total residential retail costs except for bad debt and debt management costs, such as customer service and meter reading costs); and
- models to benchmark total retail costs.

We add the results of the bad debt and debt management models with the results of the other retail costs models to obtain our “bottom up” view of total retail costs. We triangulate our bottom up view of costs with the results of the total retail costs models (top down models) to obtain our triangulated view of costs. Using the results of the different models ensures we do not rely on any one model but on a suite of models. Given the relatively wide spread of efficiency scores (ie residuals) in bad debt models compared with the total retail costs models, we give our bottom up view of costs a weight of 25%, with a higher weight of 75% to our top down view of costs.

We refer to our initial assessment of plans document [Supplementary technical appendix: Econometric approach](#) for an explanation of our levels of aggregation, model selection criteria, rationale for selected models and triangulation approach. Annex 2 of this report provides a description of the models’ specifications.

As in wholesale, our models exclude pension deficit recovery costs and third party services costs. We set out our approach for these excluded items in section 3.3.

Forecast of cost drivers

We develop forecasts for cost drivers to set cost allowances for the period 2020-25. For final determinations, we adopt newly available data where possible.

Table 23: Our forecast approach of explanatory factors in our residential retail econometric model

Variable	Forecast method
Total households connected*	Our total cost allowance in residential retail is based on each company's forecast of connected households for the period 2020-25. Since the residential retail control is an average not a total revenue control, by its nature, we do not challenge companies on the number of customers projected. Consistent with this form control, we will make an adjustment at the end of the period to reconcile our allowance to the actual number of connected households in each year in 2020-25.
Real average bill size*	We use company forecasts of average bill. This is calculated as the ratio of companies' forecasts of revenue and number of connected households.
Proportion of dual service households	The variable is forecasted rolling forward the most recent year of available data (2018-19). We discarded the linear trend method because it is not intuitive for the forecast of the proportion of dual service connections.
Proportion of metered households*	We use company forecasts of the proportion of metered households. This is calculated as the ratio of the number of metered households and total households.
Proportion of households with default (variable procured directly from Equifax) (proxy for probability of default)	The variable is forecasted rolling forward the most recent year of available data (2018-19). We discarded the linear trend method because it is not intuitive for the forecast of the proportion of households with default.
Proportion of households income deprived (income score of Index of Multiple Deprivation) (proxy for probability of default)	The variable is forecasted rolling forward the most recent year of available data (note that this is based on 2013-14 actuals for English companies and 2016-17 actuals for Welsh companies. The difference in years is due to differences in the frequency of data published between England and Wales). We discarded the linear trend method because it is not intuitive for the forecast of the proportion of households that are income deprived.
Total migration (transience variable)	The variable is forecasted rolling forward the most recent year of available data (2017-18). We discarded the linear trend method because it is not intuitive for the forecast of the proportion of transient households.

* We model Severn Trent Water and Dee Valley Water into 2020-25, combine their costs and then apportion them based on the newly formed companies' business plans to produce modelled costs for Severn Trent Water and Hafren Dyfrdwy. As a result, we use time trend forecasts for total households connected and average bill drivers and constructed WRMP data for the proportion of metered households for the 2020-25 period where company forecasts are not available.

Efficiency challenge

We calculate the upper quartile efficient level of cost performance, which corresponds to the level of costs that the top 25% of companies achieve. We apply the average of the historical and forward-looking upper quartile efficiency challenges to companies' modelled costs to set allowances for 2020-25.

Our approach to applying the efficiency challenge for residential retail differs to that in wholesale. In retail, we apply the average of the historical catch-up and the forward-looking upper quartile efficiency challenges to companies' modelled costs over 2020-25 to calculate PR19 allowances. We consider that using business plans to inform the efficiency challenge is appropriate, particularly for retail services. The retail control has started as recently as 2015 and retail services can transform more quickly than wholesale services (eg due to lack of long-lived infrastructure assets). The fact that the majority of companies submitted forecasts that are significantly more efficient than historical expenditure is evidence of the pace at which this service is transforming. It is important that customers share the benefits. We consider that the upper quartile benchmark, which is determined by the fifth most efficient business plan, provides a credible challenge for the sector.

We do not apply a further frontier shift challenge or input price pressure adjustment in residential retail. Efficient business plans may have accounted for these in their cost forecasts, which feed into our forward-looking efficiency challenge, and thereby are reflected in our efficient allowances.

Setting cost allowances

As outlined in the previous section, we use our efficient cost benchmark, based on our econometric models adjusted to efficient companies, to set cost allowances. Our overall approach rewards efficient business plans, which means that some efficient companies may receive more in allowances than requested in their business plans. These companies help set the efficiency challenge for the sector as a whole.

As in wholesale, we have an adjustment process to allow companies to make claims that models do not effectively allow for their costs. Our cost assessment framework allows companies to submit cost adjustment claims where they consider they are subject to exceptional circumstances. We consider that companies have not

provided sufficient and convincing evidence to demonstrate exceptional circumstances in residential retail and we therefore do not accept any of the cost adjustment claims submitted by companies in residential retail. The only adjustment we make to our modelling results is of £1.9 million for Dŵr Cymru to correct for a discrepancy in 'income score' reporting between England and Wales.

As set out in our PR19 methodology, we do not index the residential retail controls to a general inflation measure. We set cost allowances at 2017-18 prices which are the nominal allowances for 2020-21 to 2024-25.

Our total cost allowance in residential retail is based on each company's forecast of connected households for the period 2020-25. Consistent with the form of the residential retail control, we will make an adjustment at the end of the period to reconcile our allowance to the actual number of connected households in each year in 2020-25.

7.1.2 Changes from our draft determinations

- At final determinations we make a number of updates to our cost and cost-driver data:
 - we adopt newly reported 2018-19 data on companies' actual expenditure;
 - we source the 2017-18 data from the annual performance reports instead of company business plans;
 - we adopt newly released 2017-18 data for total migration; and
 - we procure data on the propensity to default directly from Equifax.
- We reduce the weight placed on results from our bottom-up models from 50% to 25% and increase the weight on results from our top-down models to 75%; and
- We apply an adjustment of £1.9 million for Dŵr Cymru over 2020-25 related to the income score variable.

7.1.3 Stakeholders' representations

Eight companies make no representations on the draft determinations for residential retail.

Northumbrian Water and South West Water recommend that we adopt the newly submitted data from the annual performance reports (APRs) on 2018-19 actual expenditure into our econometric models.

Six companies comment on our continued use of the forward-looking efficiency challenge, five of them expressing concerns over the deliverability of proposed cost reductions in some companies' business plans. These companies suggest we remain consistent with modelling in wholesale and set the efficiency challenge fully based on historical cost performance. United Utilities and Dŵr Cymru suggest we loosen the efficiency challenge to the industry average and Affinity Water recommends removing outliers from its calculation.

A number of companies comment on the validity of our econometric models in retail:

- Affinity Water critiques the significant change in rankings between the historic and the forward-looking period, claiming only Yorkshire Water appears as an upper-quartile performer in both.
- Dŵr Cymru and SES Water comment on the wide range of efficiency scores in residential retail. SES Water suggests residuals may not reflect inefficiency but rather omitted factors or data errors. It argues that the coefficient of variation (ratio of the standard deviation to the mean) of modelled unit costs in the bad debt models is higher than that of the standalone growth models from the initial assessment of plans, which – partly due to the wide variation – we moved away from and adopted the 'base plus' approach to wholesale modelling.
- SES Water also critiques the low R-squared of the other retail cost models,
- Wessex Water recommends we bring back two models that include council tax collection rates that were excluded at draft determinations, whereas United Utilities supports our decision to exclude them. Dŵr Cymru claims companies account for void properties and therefore bad debt related costs inconsistently, which impacts our assessment of relative company efficiency.
- Thames Water also claims the magnitude of the coefficient for the proportion of metered customers is too large.

Dŵr Cymru claims that the wider availability of income score data for Wales relative to England disadvantages the company (see Dŵr Cymru final determination summary document for more information).

A number of companies make representations advocating the use of nominal values, rather than real values, to differing extents:

- Thames Water suggests running all our models in nominal terms;
- Wessex Water suggests modelling average bill size in nominal terms; and
- United Utilities suggests using nominal average bill forecasts only.

Thames Water argues that our models still do not fully account for costs associated with transience. On the other hand, United Utilities sees limited value in including transience as a cost driver in our models but admits that the current metric is the most appropriate available.

7.1.4 Our assessment and reasons

We consider it appropriate to adopt new data, where available. Using the additional year of data makes the sample size larger and ensures we use the most recent historical information available. We therefore incorporate the 2018-19 data in our econometric models, increasing the sample size from five to six years of historical data.

We maintain our view that it is appropriate to calculate the efficiency challenge as the average of the historical catch-up and the forward-looking efficiency challenges. We consider that setting a catch up challenge which puts 50% weight on historical cost performance and 50% on business plan performance strikes an appropriate balance of evidence in the more dynamic retail sector.

Furthermore, our analysis reveals that our cost challenge at PR19 is planned to be achieved or exceeded by seven companies. Our analysis shows that some companies have already achieved this level of performance in recent years, while for others, the expenditure path shows a clear trend towards our allowances. There is evidence that companies have been transforming their retail business and unlocking efficiencies relatively quickly. However, for a small number of companies our cost challenge in residential retail remains significant. This is the case for SES Water, Wessex Water, Dŵr Cymru, Northumbrian Water and Thames Water. We expect these companies to catch up to efficient companies in the sector. SES Water, Wessex Water and Northumbrian Water were among the least ambitious in terms of the cost reductions they proposed in their PR19 business plans relative to actual historical spend. SES Water, Dŵr Cymru and Thames Water are underperforming on their PR14 retail allowances in the current regulatory period (2015-2020) more than other companies, despite the glide path to catch up with the rest of the industry we allowed at PR14. We consider that these companies had sufficient time to catch up with efficient retailers in the sector and therefore maintain our view that our allowances provide an appropriate basis for setting cost allowances for the industry.

With regards to representations made on the models' validity, we have undertaken further analysis. We find that adding the additional year of data for 2018-19 makes the ranking profiles of the historic and the forward-looking periods converge. Of the

five upper quartile companies (Yorkshire Water, Southern Water, South East Water, Hafren Dyfrdwy and Severn Trent Water) in the 2020-25 period, three (Yorkshire Water, South East Water and Severn Trent Water) are now also upper quartile companies on a historic basis. In addition, the number of companies that have not moved by more than two rankings between the two periods has increased from five to eight from draft to final determinations. Changes to the models since initial assessment of plans have also significantly reduced the spread of efficiency scores on both a historical and a forward-looking basis.

In response to Dŵr Cymru and SES Water's representations on the wide spread of efficiency scores, we consider that the spread of efficiency scores of the 'other costs' and total costs retail models is reasonable and similar to the spread of efficiency scores of our wholesale models. The spread of our retail models, including our bad debt models, is significantly lower than the spread of our standalone growth models from the initial assessment of plans. We acknowledge the wider spread of efficiency scores in bad debt cost models relative to the rest of our retail models. Consequently, we reduce the weight of the bottom-up models and instead put more weight on our top down models when calculating allowed residential retail costs.

We also test a variety of alternative model specifications for retail models.

- Using a total cost specification produces R-squared that is over 0.96 for all levels of aggregation, including other retail cost models, and the magnitude of the scale coefficient is algebraically equivalent to that in unit cost specifications. This shows that the low R-squared of the other cost model is a cosmetic issue due to the specification of the dependent variable as 'unit costs' rather than 'total costs' thereby removing the bulk of cost variation that could otherwise be explained through variation in customer numbers.
- Adding the number or proportion of void properties and adding back council tax collection rates (with the addition of recently released data for 2018-19) as cost drivers results in coefficients that are statistically insignificant, unstable and which deteriorate the statistical performance of other variables in the models. For the council tax variable, this may be the result of its significantly lower extent of data variation across companies relative to that of other proxies we use for the probability to default on bills. We also find no correlation between companies' number or proportion of void properties and efficiency scores.

We therefore consider it appropriate to retain our draft determinations model specifications. In relation to Thames Water's representation on the metering coefficient, we are not concerned by the value of the coefficient. We consider that it

is within a plausible range and the precise value of the coefficient depends on the other variables included in the model.

We consider that Dŵr Cymru's argument in relation to its representation regarding the discrepancies in Welsh and English income scores is convincing. We therefore apply an off-model adjustment for Dŵr Cymru of £1.9 million (see Dŵr Cymru final determination summary document for more information). The impact on Hafren Dyfrdwy – the only other company operating in Wales – is immaterial, and our allowed costs are consistent with what the company requested, so we make no adjustment to the company's allowance.

We maintain our view that to ensure consistency of price base with the costs in the dependent variable, average bill size should remain in real terms both in modelling and for forecasting.

We maintain our view that including a transience driver with a positive sign in a bad debt cost model and adding total migration as a driver to one total retail cost model – changes made at draft determinations – sufficiently captures transience costs.

8. Business retail

In PR19, we set an average revenue control for a five year period for water companies that expect to have business retail customers on 1 April 2020. This means Dŵr Cymru and Hafren Dyfrdwy, because full business retail competition is not extended in Wales.

Yorkshire Water exited the business retail market on 1 October 2019 and therefore will not be subject to the business retail price controls. Instead, former customers of Yorkshire Water will be protected in relation to the charges they pay by the Retail Exit Code and, where relevant, competition law.

Consistent with the approach adopted at PR16, the average revenue control takes the form of default tariff caps based on allowed average cost per customer and net/gross margins. In this section, we provide our decision on the allowed average cost per customer for each customer type in the non-contestable segments of the business retail market in Wales. The non-contestable segment is of customers using less than 50 megalitres of water a year and all wastewater customers.

The details of how the efficient cost per customer allowance is used along with application of the different margin caps (net/gross²⁰) to estimate total allowed revenue for each customer type is explained in our 'Allowed return on capital technical appendix' document.

8.1.1 Our final determination decision

We consider the evidence in companies' business plans and challenge it using comparative information on historical levels of business retail costs.

At draft determinations we allowed the requested cost for Dŵr Cymru based on evidence of efficiency. The company's revised cost per business customer is lower than its PR14 and PR16 levels.

²⁰ The application of the different margin caps depends upon the contestability of the market and customer type.

For Hafren Dyfrdwy we applied a challenge for its tariff proposals for small business customers (ie customers that use less than five megalitres per year of water and wastewater).

For final determinations we accept Dŵr Cymru and Hafren Dyfrdwy's cost proposals. The proposals are for tariff caps for customers using 50 megalitres of water per year or less and all wastewater customers.

8.1.2 Changes from draft determinations

We accept Hafren Dyfrdwy's proposed tariffs, which provides the company with an additional £0.8 million relative to draft determinations, bringing up the company's total business retail allowance from £1.3 million to £2.1 million.

8.1.3 Stakeholders' representations

Hafren Dyfrdwy provides further evidence to justify its tariffs. It provides evidence of higher bad debt costs among business customers, and of trade effluent costs, which are not considered for residential customers. The company also provides comparative analysis showing that Hafren Dyfrdwy's proposed costs are well within the range of our PR16 cost allowance for the industry.

8.1.4 Our assessment and reasons

We confirm Hafren Dyfrdwy's comparative analysis. We find that Hafren Dyfrdwy proposed tariffs for small (ie consumption less than five megalitres per year) water and wastewater customers are close to the industry average. Based on this evidence we consider the company's requested costs as appropriate, and allow the costs in full.

For PR24 we expect to have more information from the English business retail market. We expect Welsh companies to use this information to challenge themselves and submit evidence on the efficiency of their proposals in light of such evidence.

9. Cost adjustment claims

Our cost assessment framework allows companies to submit cost adjustment claims in their business plans. Cost adjustment claims are mechanisms for a company to present evidence of unique operating circumstances, legal requirements or atypical expenditure which drive higher efficient costs for the company relative to its peers. We refer to our [Technical Appendix 2: Securing cost efficiency](#) published in January 2019 for an explanation of how we assess whether the companies' cost adjustment claims are well evidenced and appropriate.

As stated in Appendix 11 of our PR19 methodology we set a high evidential bar for accepting cost adjustment claims and expect them to be submitted with supportive evidence against the relevant assessment gates. The most important gate is the 'need for adjustment'. We expect companies to clearly explain why our benchmarking analysis does not adequately capture their unique circumstances. Where this gate is failed, we reject the cost claim. We also expect companies to follow a robust decision making process, with proper options assessment, and present robust evidence of cost efficiency.

Companies submitted 36 cost claims in their August representations, 10 of which are new claims. They withdrew 40 cost claims since the initial assessment of plans.

Annex 5 provides a summary of the submitted cost adjustment claims and our assessment. We reject 43 claims and accept or partially accept the remaining 19.

We provide further detail on the rationale for our assessment of each cost claim in the company-specific cost assessment final determination appendix. We publish our assessment by company in a separate excel spreadsheet (called FM_CAC) as part of suite of cost assessment models.

10. Cost Sharing

In a price control we set cost and revenue allowances five years in advance. There are always uncertainties about the future, and therefore a risk that we have set an allowance that will turn out to be either too low or too high. Cost sharing is an important mechanism by which this risk is shared between customers and shareholders. Cost sharing enables us to rely less on other uncertainty mechanisms such as interim determinations and pass through costs, which means that our price control has stronger incentives on companies and a lower regulatory burden.

As a risk sharing mechanism, cost sharing works as follows: when a company over or underspends its cost allowance during the price control period, it will share the over or underspend with customers.

At PR19 we amend the mechanism to not only provide a risk sharing arrangement, but also provide an incentive for companies to submit efficient cost proposals in business plans. The mechanism therefore does two things:

1. It provides an incentive for companies to submit business plans that are efficient, by providing more favourable cost sharing rates for efficient plans.
2. It provides a risk sharing mechanism between customers and shareholders through the sharing of any over or underspend.

Cost sharing rates are the proportion of cost savings that investors get to keep, or the proportion of any cost overrun that investors will have to bear. Cost sharing ensures that customers get a share of the benefits when companies outperform their cost allowance, and that customers and companies are protected when companies overrun their allowance. We will take companies' cost performance against our allowance into account in the PR19 reconciliation for the next price control period.

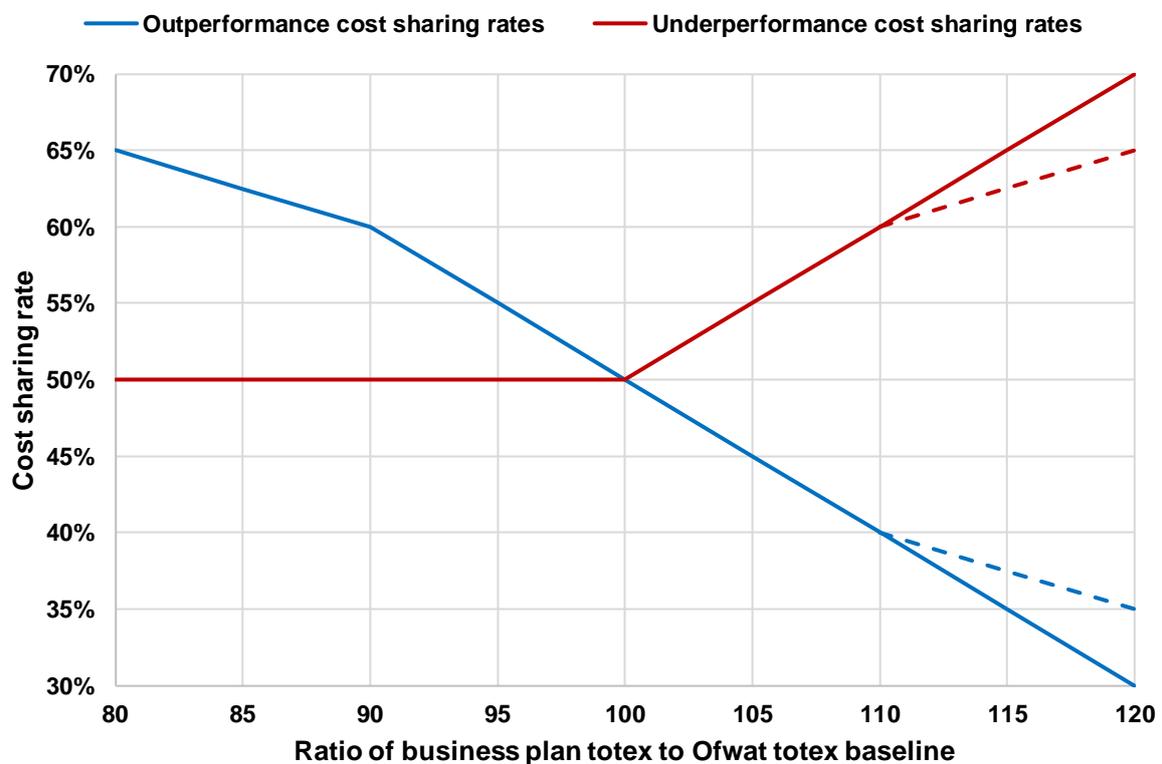
10.1 Our final determination decision

Calculation of cost sharing rates

Cost sharing rates are determined by the ratio of a company's view of totex to our view of efficient totex. The company's view of totex is the average of its September 2018 business plan totex and the revised view submitted in August 2019. Our view of totex is as at final determinations.

Each company has two cost sharing rates, one for outperformance, and another for underperformance. Figure 4 illustrates how we determine the sharing rates based on the ratio of business plan totex to our allowed totex. The slopes of the lines provide an incentive for companies to submit efficient plans, as a low ratio of business plan totex to our totex allowance provides more favourable cost sharing rates than a high ratio. The dotted lines show the part of the line where the sharing rates schedule was different at draft determinations.

Figure 4: Determination of cost sharing rates at PR19



We publish the cost sharing feeder model for each company with details of the calculation of the cost sharing rates.

For the fast track companies, Severn Trent Water, South West Water and United Utilities, we continue to use 50% cost sharing rates as these companies accepted our view of costs at the initial assessment stage.

The cost sharing mechanism applies to total revenue controls only, namely for water resources, water network plus and wastewater network plus. For the water resources and water network plus controls, we set the same cost sharing rates. The sharing

rates are determined on the basis of the ratio of the combined totex of the water resources and water network plus controls between companies and us.

We do not apply cost sharing in the residential retail and bioresources controls. These are average revenue controls, which means that we adjust the allowed revenue at the end of the regulatory period if the number of customers (in retail) or the volume of sludge produced²¹ (in bioresources) turns out different to our estimate at final determinations. Any deviation from our allowed expenditure in these controls, other than due to outturn volumes of customers (retail) or sludge produced (bioresources), will be incurred fully by the company.

Table 24 sets out the cost sharing rates for final determinations.

²¹ When we set companies' allowed bioresources revenue we take account of their sludge production forecasts. We adjust the allowed revenue if companies' actual production deviates from their forecasts. Separate to this, we have introduced a forecasting incentive which could give rise to a penalty if a company's forecast turns out to be too inaccurate. We would apply any penalty at PR24.

Table 24: Cost sharing rates for 2020-25 (%)

Company	Water resources and water network plus		Wastewater network plus	
	Out-performance	Under-performance	Out-performance	Under-performance
Anglian Water	31.89	68.11	34.96	65.04
Dŵr Cymru	42.66	57.34	41.51	58.49
Hafren Dyfrdwy	53.96	50.00	59.11	50.00
Northumbrian Water	46.19	53.81	34.40	65.60
Severn Trent Water*	50.00	50.00	50.00	50.00
South West Water*	50.00	50.00	50.00	50.00
Southern Water	36.45	63.55	36.08	63.92
Thames Water**	32.27	75.00	44.22	75.00
United Utilities*	50.00	50.00	50.00	50.00
Wessex Water	43.86	56.14	41.33	58.67
Yorkshire Water	38.06	61.94	33.21	66.79
Affinity Water	46.51	53.49		
Bristol Water	39.76	60.24		
Portsmouth Water	60.08	50.00		
South East Water	38.09	61.91		
South Staffs Water	45.06	54.94		
SES Water	44.63	55.37		

* For fast track companies we apply cost sharing rates of 50% as they accepted our view of costs at the initial assessment of plans.

** Thames Water's cost sharing rate for underperformance is based on a reduced rate of 75%, due to its business plan classified as significant scrutiny and lack of appropriate engagement after the Initial Assessment of Plans. Further detail in 'Significant scrutiny companies – Application of lower cost sharing rates and outcome delivery incentive cap'.

Definition of Totex for the calculation of cost sharing rates

For the purpose of calculating cost sharing rates we use gross totex (ie before deducting grants and contributions income from developers) and remove certain cost items from totex:

- pension deficit recovery costs;
- third party costs;
- non-section 185 diversions costs;

- strategic regional water resources development scheme costs; and
- for Thames Water, our conditional allowances London resilience (£180 million) and for the water network performance improvement (£300 million).

These cost items are excluded because different cost sharing arrangements are in place. For example, pension deficit repair costs are subject to a 50% recovery as set out in IN13/17 with no provision for over or underspend. Strategic regional development costs and Thames Water's conditional allowances are subject to cost sharing arrangements specified in a bespoke gated process. Non-section 185 diversions costs would be recovered outside the price control.

Adjustment to companies' view of totex in September 2018

In a few cases, we adjust companies' view of totex in their September 2018 business plans. These adjustments are for:

- costs that were included in September 2018 business plans and later excluded to be directed to a delivery via Direct Procurement for Customers schemes (DPC);
- costs that were included in September 2018 business plans related to delivery of performance commitments beyond the stretching level we have set, which the company later withdrew; and
- costs that were included in September 2018 business plans related to removing or preventing the metaldehyde in drinking water.

We make these adjustments because we consider that these costs do not reflect inefficient proposals in September 2018 plans, and companies' cost sharing rates should not be adversely affected.

We make the adjustments in respect of business plan costs diverted to delivery by DPC because these costs do not necessarily represent inefficient proposals, rather a change in method of delivery, from in-house to a third party. Our motivation for making these adjustment is also because PR19 is the first price control with the DPC provisions. At PR24 we expect companies to have a better understanding of the DPC provisions and use them efficiently. At PR24 it may therefore be appropriate not to make these adjustments, and let the cost sharing rates reflect costs that are proposed for in-house delivery instead of via the DPC route as inefficient proposals.

We make the adjustments for costs related to performance commitments beyond the level that we set after September 2018 (eg at the Initial Assessment of Plans or the slow track draft determinations), which were later withdrawn, as we welcome the stretch in the company business plan and to ensure companies are incentivised to

submit stretching targets in the future. We make this adjustment only for Wessex Water in respect to withdrawn costs related to pollution incidents and sewer flooding.

Upfront payment to reduce the size of reconciliation at PR24

As part of the PR19 methodology we set out that we would provide companies with an upfront payment. This payment was proposed to be based on the expected outturn if the company spent in line with its business plan, and therefore received cost sharing for the overspend (or underspend) compared to our efficient cost baseline. The aim of this payment was to reduce the scale of reconciliation between outturn and actual costs required in PR24.

For PR19 we retain the upfront payment for companies whose business plan totex is below our view of efficient costs. However, we remove it for companies whose business plan totex is above our view of efficient costs. This is consistent with our draft determinations proposals.

We consider that the upfront payment is not appropriate as companies tend to outperform their business plan submissions, and the upfront payment could lead to an even greater negative adjustments at PR24 than without it. The upfront payment also means that customers are likely to pay more for the 2020-25 period and above the level of efficient costs.

For companies below our efficient cost baseline we retain an adjustment so that company in period revenues more closely reflect their business plan request. We calculate the adjustment by multiplying the outperformance cost sharing rate by the difference between our efficient cost baseline and the company's forecast costs. This does not affect fast track companies as they accepted our view of costs and so get a 50% sharing rate with no upfront adjustments.

10.2 Changes from draft determinations

- To calculate cost sharing rates, we put 50% weight on the company's view of totex in August 2019, with the other 50% on its view in its September 2018 business plan. At draft determination we placed 100% weight on company view of totex in its September 2018 business plan.
- We change the cost sharing rates for ratios in the 110% to 120% bracket. At draft determinations we used the cost sharing rates that we set out in our PR19 methodology.

- We amend the company view of costs at September 2018 business plans to take out costs which are transferred to direct procurement for customers schemes, costs associated with going beyond our performance commitment levels, and costs related to removing or preventing metaldehyde in drinking water.

10.3 Stakeholder representations

Two companies provide representations on removing the costs associated with scope reduction from each company's view of costs.

Anglian Water highlights that the scope adjustment that was made for Direct Procurement for Customers (DPC) schemes at draft determination was two-sided but that it was less clear whether adjustments for other scope changes would be one- or two-sided. It argues that at previous price reviews scope changes were removed from both the company and Ofwat view of costs and it expects adjustments to be reflected in the same way in the final determinations.

Wessex Water highlights that it had removed costs that were not the result of inefficient scope or costs, rather the costs were related to proposing levels of service improvements beyond the common performance level that we have set. These costs relate to the performance commitments on pollution incidents and sewer flooding. It argues that costs associated with proposing these higher levels of stretching performance should be removed from its September 2018 business plan totex for the purposes of calculating cost sharing rates as these costs do not represent inefficiency. Not adjusting for this would imply that companies would be penalised for proposing ambitious improvements in initial business plans.

SES Water disagrees with our proposed change to cost sharing rates and argues that we should retain the cost sharing rates that were in our PR19 methodology as we were not clear on our rationale for the change.

Anglian Water, Wessex Water and Bristol Water raise objections to our change in approach on the upfront payment.

- It goes against the approach in PR09 and PR14 where we gave companies 25% of their view of costs, and removes some of the protection in the uncertainty in cost efficiency.
- Companies have not in general outperformed their cost allowances – while some companies outperformed their cost allowances, 11 companies underperformed their allowances in the last year.

- Over 2006-2018, 9 of 16 companies outperformed the industry cost of capital, whereas 7 companies underperformed.
- The PR14 baselines are likely to be more stretching due to the 'step change' in cost efficiency and outcome performance and so past performance not a good guide to the future, and the need for the mechanism is even greater in this review.
- This change reduces cash flows and equity buffer should there be errors in the final determinations.
- This is a late change to the methodology, which should have been properly consulted on in the methodology.

10.4 Our assessment and reasons

Calculation of cost sharing rates

For final determinations we continue to use the cost sharing rates that we proposed at draft determinations. The revised rates were proposed to incentivise companies to focus on the most important issues and ensure that their plans were efficient. At that stage, most companies were in the 110% to 120% bracket, where the slope of the cost sharing curve was flattest, and therefore the incentives to drive further efficiencies in business plans was the weakest. In response to SES Water's representation, we consider that our rationale for our proposed change was clear at draft determination and, given that companies have altered their plans subsequently, the incentive mechanism has worked.

Adjustment to companies' view of totex in September 2018

We discuss our decision and rationale for adjusting companies September 2018 business plan totex above. Anglian Water and Dŵr Cymru include costs in their September 2018 business plans that we assessed as being suitable for delivery via a Direct Procurement for Customers scheme. We have therefore removed the costs of these schemes, less the allowance we include for the administration and management of the schemes, from their view of totex in their September 2018 business plan. This adjustment makes the company view comparable with our allowance. We do not make other scope adjustments. The scope of companies' proposals is part of our efficiency assessment of companies' business plans. For companies to remain incentivised to submit efficient scope of work, it is appropriate that it should affect their cost sharing rates.

We consider that it is appropriate to make an adjustment to companies' view of totex in their September 2018 business plans for costs related to delivering performance commitments beyond the level we have set after this date. These costs in the September 2018 business plans do not represent inefficiency and therefore should not adversely impact companies' cost sharing rates.

In view of that we make an adjustment to remove £14.5 million from Wessex Water's totex of September 2018. This cost is associated with additional stretch, over and above the common performance commitment that we have subsequently set, related to performance on pollution incidents and sewer flooding.

There are other companies that proposed performance commitments in their September 2018 business plan that are beyond the levels that we have subsequently set, and have adjusted their proposals to match ours in their revised plans.²² However, these companies either do not provide cost information that is directly related to delivering these stretching performance commitments, or they do not justify their cost reduction since the September 2018 as related to the reduced level of stretch. We therefore do not make adjustments for these companies' view of September 2018 totex for calculating cost sharing rates.

We make adjustments for metaldehyde related costs, because on the information that companies had at the time, it was appropriate to include costs to remove metaldehyde in business plans. Subsequent to September 2018 it was announced that the use of metaldehyde was to be banned. This allowed companies to remove these costs from their revised plans, and although the ban has been overturned again (but is still likely to be introduced), we do not include an allowance for metaldehyde costs in our totex but rather treat them through an uncertainty mechanism. We consider that because of the information that companies had at the time, we should remove metaldehyde related costs from their business plan view of totex so as not to affect the cost sharing rates.

Upfront payment to reduce the size of reconciliation at PR24

Overall we continue to consider that we should remove the upfront payment from companies above our efficient cost baseline. We consider this payment is not appropriate as companies tended to outperform their business plan submissions. This is more likely given that some of the difference between our and company views

²² Anglian Water, Bristol Water, Hafren Dyfrdwy, Northumbrian Water, SES Water and Yorkshire Water have reduced the level of stretch for one or more performance commitment levels to match our requirements.

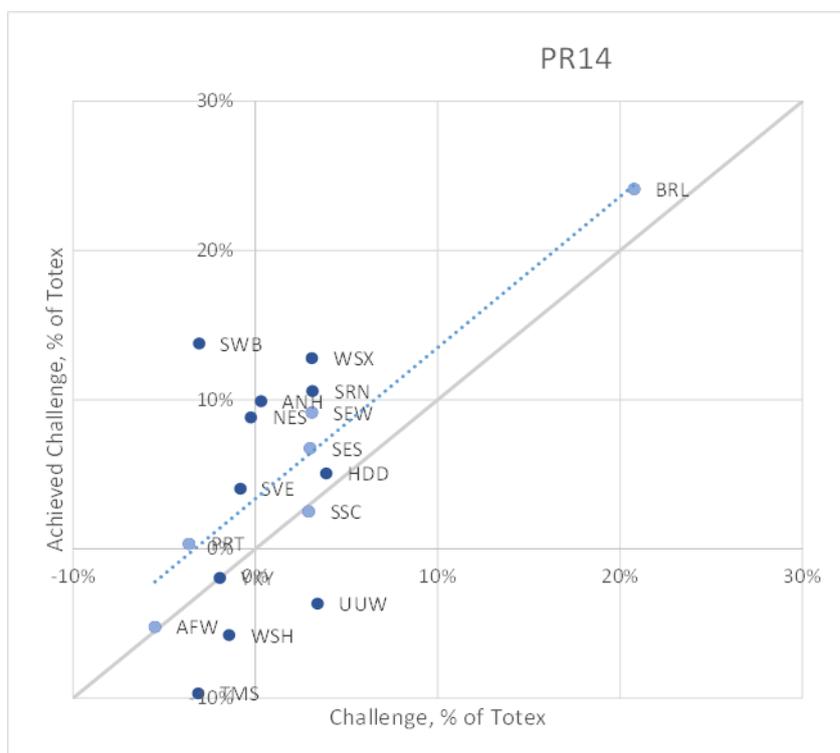
of costs was due to scope reductions. If companies underspent against our PR19 allowances then an upfront payment could lead to an even greater negative adjustments to its revenue in PR24. The upfront payment also means that customers are likely to pay more for the 2020-25 period and above the level of efficient costs.

We respond to each of the specific objections raised by Anglian Water, Wessex Water and Bristol Water below.

- Including an upfront payment would not be consistent with the approach used in PR09 and PR14. Whilst we gave companies a cost baseline based on 25% of their view and 75% of our view of costs, this did not affect overall company revenues as a countervailing income adjustment was made as part of the incentive. Indeed the overall effect might have been to reduce in period revenues as the income adjustment was made to revenues and some proportion of costs is accrued to the RCV. This is consistent with the view of the Competition and Markets Authority when describing Ofwat's PR14 menu scheme in its determination for Bristol Water²³.
- We consider that company business plans are not a good guide to outturn expenditure. As set out in the [service delivery report](#), on average companies have outperformed their cost baselines, with 13 companies spending less than their wholesale allowance between 2015 and 2019 and four companies spending more than their allowance. Companies' outturn expenditure is much closer to our view of costs, irrespective of the level of intervention we make in company plans. Figure 5 shows that for PR14 most companies achieved a level of outturn below their plan at the same level or beyond the challenge provided with our cost allowance.

²³ Source:

https://assets.publishing.service.gov.uk/media/5627995aed915d101e000001/Appendices_1.1_-_4.3.pdf

Figure 5: PR14 outturn versus allowance and company plan

- We do not consider it relevant whether companies outperform our cost of capital, as the return on regulatory equity will be affected by a range of issues including outcomes and financing performance, and so is not relevant to the assessment of cost performance.
- We consider the PR19 baselines on costs and outcomes to be stretching but achievable. As explained above in section 6, after reviewing the overall stretch we are moderating the stretch on costs, through reducing frontier shift from 1.5% to 1.1% per year, and on outcomes, in particular through reducing the stretch on water supply interruptions and making some amendments to incentive rates and collars. We therefore do not consider that the need for any adjustment is greater than previous price controls.
- We agree with companies that removing the upfront payment will reduce cash flows in this period but increase revenues in future periods. However companies will continue to have sufficient revenues to be financeable with the notional capital structure. Companies benefit from a number of protections such as cost sharing and interim determinations if there are factors that increase costs. We do not consider that this additional cash flow is required as an equity buffer for errors in our cost assessment. As set out above, companies tend to perform in line, or outperform our cost allowance. In addition the cost of capital already includes an

equity buffer for risk in totex, and companies have tended to outperform rather than underperform their return on regulatory equity.

- The upfront payment would mean that customers are likely to pay above the level of efficient costs and more for the 2020-25 period. We do not consider that this is in customers interests.
- Finally we acknowledge that this is a change to the PR19 methodology. However we consulted on this change at draft determinations, this has given the companies opportunity to respond and us the opportunity to consider those responses before finalising our policy. Considering the responses in the round, we continue to consider that this amendment is consistent with our statutory duties, in particular protecting customers' interests.

11. Additional details of our cost assessment

11.1 A transition programme

In our PR19 methodology we allow companies to propose to bring forward some of their investment programmes from 2020-25 to 2019-20.

The purpose of the transition programme is to make efficient use of resources and minimise whole life costs, where it is efficient to bring forward an investment, and to enable statutory deadlines early in the next regulatory period to be met. It may allow companies to respond efficiently to new information related to the next price control period. Although the expenditure would be incurred in 2019-20, for the purpose of cost performance incentives it is considered as expenditure incurred in 2020-25.

11.1.1 Our final determinations decision

Where companies propose transition expenditure, we expect them to make the case for why it is efficient to bring the investment forward, and why it was not part of its outcomes and long-term planning from PR14. Our criteria for accepting expenditure under the transition programme are:

- the company provided evidence to justify the early start; and
- the investment has early statutory deadlines in the next regulatory period; or
- the expenditure relates to early design and planning of large, non-routine investments.

We consider that under our regulatory framework of totex and outcomes, companies have flexibility to defer or bring forward investment as appropriate and efficient. In contrast to PR09, cost allowances are not linked to specific schemes and companies are able to bring forward investment, if it is more efficient to do so, regardless of the regulatory cycle. Where we reject expenditure proposals under the transition programme, we still expect companies to bring forward the investment if it is efficient to do so.

We are allowing £128.9 million for nine companies that propose investments under the transition programme. The costs that we allow under the transition programme are notional. They do not represent the result of our efficiency assessment but only an acceptance that companies are allowed to spend a part of their totex allowance – up to a specified amount and for the specified purpose – under the transition

programme. The efficiency of transition expenditure is assessed as part of our overall totex assessment and as such these costs are subject to the same scrutiny and challenge as all other costs.

We did not receive representations on our framework to assess transition expenditure. Where companies amend, or request new transition expenditure in their representations to the draft determination, we assess it consistently with our approach at the draft determination. We provide detail of the schemes requested under the transition programme, our decision and rationale in the relevant company-specific final determination cost assessment appendix.

11.2 Operating leases

We make an adjustment to reflect a change in the accounting treatment of leases. We remove the forecast annual cash cost of existing leases from our allowances for companies where Regulatory Capital Value (RCV) adjustments are made. In doing so, we have followed the approach set out in [IN 18/09 Guidance for reporting operating leases in PR19 business plans](#). We have used the adjustment proposed in the company business plan.

We did not receive any draft determinations representations on the adjustments to take account of operating leases, therefore we have not made any changes at final determinations.

Table 25: Operating leases adjustment by wholesale price control for 2020-25, £m 2017-18 prices

	Water resources	Water network plus	Wastewater network plus	Bioresources	Thames Tideway	Total
Anglian Water	-0.44	-4.28	-6.44	-2.60	0.00	-13.75
Dŵr Cymru	0.00	0.00	0.00	0.00	0.00	0.00
Hafren Dyfrdwy	0.00	0.00	0.00	0.00	0.00	0.00
Northumbrian Water	-0.17	-1.09	-2.70	-0.14	0.00	-4.09
Severn Trent Water	-0.15	-1.25	-0.10	0.00	0.00	-1.51
South West Water	0.00	-3.33	-3.31	0.00	0.00	-6.64
Southern Water	0.00	0.00	-7.72	0.00	0.00	-7.72
Thames Water	-2.43	-9.67	-11.29	-0.81	-5.78	-29.98
United Utilities	0.00	-0.14	-1.05	-0.03	0.00	-1.23
Wessex Water	0.00	-0.31	-0.23	0.00	0.00	-0.54
Yorkshire Water	-0.35	-6.59	-5.88	-1.71	0.00	-14.54
Affinity Water	0.00	-11.96				-11.96
Bristol Water	0.00	0.00				0.00
Portsmouth Water	0.00	0.00				0.00
South East Water	-0.17	-0.73				-0.90
South Staffs Water	0.00	0.00				0.00
SES Water	0.00	0.00				0.00
Industry	-3.71	-39.35	-38.72	-5.30	-5.78	-92.85

11.3 Grants and contributions

11.3.1 Our final determinations decision

Companies receive grants and contributions from developers towards company expenditure to:

- reinforce the network as a consequence of new properties being connected;
- connect a new property (eg the meter and connection pipe);
- provide new water mains or public sewers (ie requisitions); and
- move an existing main or sewer or other apparatus at the request of a third-party (ie diversions).

11.3.2 Grants and contributions (price control)

For final determinations, our calculation of net totex for cost sharing and the developer services reconciliation are both based on 'gross' grants and contributions revenue (i.e., before deduction of income offset allowances), as explained in 'Our approach to regulating developer services'. This approach ensures alignment between our developer services reconciliation and calculation of net totex for cost sharing by using consistent developer services data. For English companies, it also addresses concerns with our calculation of net totex since this approach eliminates the need to estimate a recovery rate for companies.

For avoidance of doubt, we expect that companies will recover less than the 'gross' grants and contributions figures from developers used in our final determinations as the income offset is funded by existing customers.

For final determinations, 'gross' grants and contributions (price control) are calculated using the following approach.

1. **Calculate company view of 'gross' income from developer services** (i.e. before deduction of income offset allowances). This is the sum of:
 - Connection charges (wholesale water)
 - Diversions under section 185 of the Water Industry Act 1991 (section 185 diversions) income
 - Infrastructure charge receipts (net of income offset allowances for English companies)
 - Requisitioned mains / sewers (net of income offset allowances for Welsh companies)
 - Total value of income offset allowances
 - Grants and contributions other contributions (price control)
2. **Apply base cost efficiency challenge**. This is a direct application of our base cost econometric modelling results, which includes a scope challenge in cases where Ofwat's forecast cost drivers differ from companies' forecast cost drivers. This approach ensures alignment between grants and contributions and our base cost challenge. We set the efficiency challenge to zero for those companies whose base cost allowance is greater than business plan requested costs. Companies must set cost reflective charges so this will ensure that the developer services market is not distorted.
3. **Split between price controls, and between opex and capex**, based on company business plan proportions.

We provide an illustrative example of the 'gross' grants and contributions calculation for United Utilities below.

Table 26: Calculation of 'gross' grants and contributions (price control) for United Utilities (wholesale water)

Step 1: Calculate company view of 'gross' income from developer services	
Connection charges	£34.24 million
Section 185 diversions	£7.32 million
Infrastructure charge receipts (net of income offset allowances for English companies)	-£88.26 million
Requisitioned mains (net of income offset allowances for Welsh companies)	£52.29 million
Total value of income offset allowances	£125.56 million
Grants and contributions other contributions (price control)	£16.19 million
Total 'gross' grants and contributions (price control)	£147.34 million
Step 2: Application of base cost efficiency challenge	
'Gross' grants and contributions (price control)	£147.34 million
Wholesale water base cost efficiency challenge	0%
'Gross' grants and contributions (price control) after efficiency challenge	£147.34 million x (1 - 0%) = £147.34 million
Step 3: Split 'gross' grants and contributions between price controls, and between opex and capex	
Water network plus - opex	£49.58 million
Water network plus - capex	£97.76 million
Water resources - opex	£0 million
Water resources - capex	£0 million

Table 27: Calculation of 'gross' grants and contributions (price control) for United Utilities (wholesale wastewater)

Step 1: Calculate company view of 'gross' income from developer services	
Section 185 diversions	£1.84 million
Infrastructure charge receipts (net of income offset allowances for English companies)	£32.25 million
Requisitioned sewers (net of income offset allowances for Welsh companies)	£1.84 million
Total value of income offset allowances	£0.00 million
Grants and contributions other contributions (price control)	£15.26 million
Total 'gross' grants and contributions (price control)	£51.19 million
Step 2: Application of base cost efficiency challenge	
'Net' grants and contributions (price control)	£51.19 million
Wholesale water base cost efficiency challenge	4.71%
'Net' grants and contributions (price control) after efficiency challenge	£51.19 million x (1 - 4.71%) = £48.78 million
Step 3: Split 'gross' grants and contributions between price controls, and between opex and capex	
Wastewater network plus - opex	£1.75 million
Wastewater network plus - capex	£47.03 million
Bioresources - opex	£0 million
Bioresources - capex	£0 million

Grants and contributions after the deduction of income offset allowances (ie 'net' grants and contributions) are used to calculate net totex for use in the financial modelling. This ensures that income offset allowances, that are funded by existing customers rather than developers, are captured within net totex that is used to calculate pay-as-you-go revenue and RCV additions.

We provide an illustrative example of the 'net' grants and contributions (price control) calculation for United Utilities below.

Table 28: Calculation of 'net' grants and contributions (price control) for United Utilities (Wholesale Water)

Step 1: Calculate company view of 'gross' income from developer services	
Connection charges	£34.24 million
Section 185 diversions	£7.32 million
Infrastructure charge receipts (net of income offset allowances for English companies)	£88.26 million
Requisitioned mains (net of income offset allowances for Welsh companies)	£52.29 million
Total value of income offset allowances	£125.56 million
Grants and contributions other contributions (price control)	£16.19 million
Total 'gross' grants and contributions (price control)	£147.34 million
Step 2: Subtract total value of income offset allowances	
Total 'gross' grants and contributions (price control)	£147.34 million
Total value of income offset allowances	£125.56 million
'Net' grants and contributions (price control)	£21.78 million
Step 3: Application of base cost efficiency challenge	
'Net' grants and contributions (price control)	£21.78 million
Wholesale water base cost efficiency challenge	0%
'Net' grants and contributions (price control) after efficiency challenge	£21.78 million x (1 - 0%) = £21.78 million
Step 4: Split 'net' grants and contributions between price controls, and between opex and capex	
Water network plus - opex	£7.32 million
Water network plus - capex	£14.46 million
Water resources - opex	£0 million
Water resources - capex	£0 million

Table 29: Calculation of ‘net’ grants and contributions (price control) for United Utilities (Wholesale Wastewater)

Step 1: Calculate company view of ‘gross’ income from developer services	
Section 185 diversions	£1.84 million
Infrastructure charge receipts (net of income offset allowances for English companies)	£32.25 million
Requisitioned sewers (net of income offset allowances for Welsh companies)	£1.84 million
Total value of income offset allowances	£0.00 million
Grants and contributions other contributions (price control)	£15.26 million
Total ‘gross’ grants and contributions (price control)	£51.19 million
Step 2: Subtract total value of income offset allowances	
Total ‘gross’ grants and contributions (price control)	£51.19 million
Total value of income offset allowances	£0.00 million
‘Net’ grants and contributions (price control)	£51.19 million
Step 3: Application of base cost efficiency challenge	
‘Net’ grants and contributions (price control)	£51.19 million
Wholesale water base cost efficiency challenge	4.71%
‘Net’ grants and contributions (price control) after efficiency challenge	£51.19 million x (1 – 4.71%) = £48.78 million
Step 4: Split ‘net’ grants and contributions between price controls, and between opex and capex	
Wastewater network plus - opex	£1.75 million
Wastewater network plus - capex	£47.03 million
Bioresources - opex	£0 million
Bioresources - capex	£0 million

11.3.3 Grants and contributions (non-price control)

For final determinations, we set non-section 185 diversions income outside of the price control. Diversions other than those requested under section 185 of the Water Industry Act 1991 (e.g. due to High Speed 2) can lead to step charges in diversions expenditure that may not be fully captured in our base econometric cost models that use historical costs. Non-section 185 diversions can also be relatively unpredictable. For these reasons, non-section 185 diversion receipts are considered to be an ‘excluded charge’ and water companies will bear the risk of any deviation from our view of diversions costs but would also retain all revenue related to them.

Legislation limits the amount of revenue that companies can recover from the customer regarding non-section 185 diversions. Therefore, we have made a minor adjustment to companies allowed revenue to ensure they can recover this shortfall from other customers. In calculating this, we have assumed companies can recover at least 82% of their costs from the customer for non-section 185 diversions associated with the New Roads and Street Works Act (NRSWA). For other non-section 185 diversions, we have assumed that companies can recover 100% of their costs. We illustrate this below for United Utilities.

Table 30: Calculation of grants and contributions (non-price control) for United Utilities (wholesale water)

NRSWA diversions expenditure and income	
Ofwat view of NRSWA diversions income	£16.92 million
United Utilities view of NRSWA diversions expenditure	£20.44 million
Ofwat recovery rate (average over AMP7)	83%
Unrecovered NRSWA diversions expenditure	
Ofwat view of unrecovered NRSWA diversions expenditure	£20.44 million - £16.92 million = £3.52 million
Other non-section 185 diversions expenditure and income	
Ofwat view of other non-section 185 diversions income	£40.44 million
United Utilities view of other non-section 185 diversions expenditure	£40.44 million
Ofwat recovery rate (average over AMP7)	100%
Total non-price control diversions income	
Ofwat view of NRSWA diversions income	£16.92 million
Ofwat view of other non-section 185 diversions income	£40.44 million
Ofwat view of total non-price control diversions income	£57.37 million

Table 30: Calculation of grants and contributions (non-price control) for United Utilities (wholesale wastewater)

NRSWA diversions expenditure and income	
Ofwat view of NRSWA diversions income	£18.43 million
United Utilities view of NRSWA diversions expenditure	£21.80 million
Ofwat recovery rate (average over AMP7)	85%
Unrecovered NRSWA diversions expenditure	
Ofwat view of unrecovered NRSWA diversions expenditure	£21.80 million - £18.43 million = £3.37 million
Other non-section 185 diversions expenditure and income	
Ofwat view of other non-section 185 diversions income	£19.76 million
United Utilities view of other non-section 185 diversions expenditure	£19.76 million
Ofwat recovery rate (average over AMP7)	100%
Total non-price control diversions income	
Ofwat view of NRSWA diversions income	£18.43 million
Ofwat view of other non-section 185 diversions income	£19.76 million
Ofwat view of total non-price control diversions income	£38.19 million

11.3.4 Changes from our draft determinations

- The calculation of net totex for cost sharing and the developer services reconciliation are both based on 'gross' grants and contributions revenue to ensure consistency. This approach eliminates the need to estimate a recovery rate for companies.
- The efficiency challenge we apply to grants and contributions (price control) is a direct application of our base cost econometric modelling results. This ensures alignment between grants and contributions and our modelled base cost challenge. We set the efficiency challenge to zero for those companies whose base cost allowance is greater than business plan requested costs.
- We set non-section 185 diversions income outside of the price control. However, legislation limits the amount of revenue that companies can recover from the customer regarding non-section 185 diversions. Therefore, we have made a minor adjustment to companies allowed revenue to ensure they can recover this shortfall from other customers.

11.4 Allocating costs between capex and opex

11.4.1 Our final determinations decision

In their business plans companies propose pay as you go rates based initially on their underlying split of opex and capex before any adjustments for financeability. To maintain companies' approaches to cost recovery we need a similar split of totex to work out pay as you go rates based on our totex allowance.

For final determinations we calculate companies' proportions of opex and capex on base and enhancement separately. We use company proportions of opex and capex for base and enhancement expenditure, and apply this to our forecast base and enhancement expenditure. We make adjustments for specific costs that are either outside our initial base or enhancement expenditure allowances or are specifically opex or capex such as third party costs, strategic regional water resource development schemes or non-section 185 diversions.

11.4.2 Changes from draft determinations

At draft determinations we calculated companies' proportions of opex and capex on total costs with minor adjustments for specific items such as strategic regional water resource development schemes.

We revise our approach for final determinations and calculate companies' proportions of opex and capex on base and enhancement costs separately and apply them to our base and enhancement allowances. We make specific adjustments to allowances for cost items that are more easily identifiable as opex or capex.

11.4.3 Stakeholders' representations

We received a range of responses on our draft determinations approach in companies' representations as well as in queries to the draft determinations and in company meetings.

The main argument against our approach is that it did not sufficiently reflect our cost challenge on enhancement expenditure relative to base expenditure. Enhancement expenditure has a greater proportion of capex than base costs. Our draft

determination approach could therefore lead to our challenge being more evenly split between opex and capex than the companies' expenditure profiles would suggest it should be.

We shared our revised approach of applying company splits of opex and capex separately to our base and enhancement allowances with the companies. Overall the companies are generally supportive of our revised approach and several companies state that it addresses the concerns they had raised previously.

Anglian Water and Wessex Water raise concerns over the impact of the revised approach of including growth costs within the base cost models on the split of opex and capex. The companies argue that the challenge on growth costs is primarily capex and by using the same challenge on base and growth costs, the impact on opex may be understated. The companies propose that we either calculate the split of opex and capex on base, growth and enhancement separately or make an adjustment from capex to opex to account for it.

Some companies provide comments on how infrastructure renewals expenditure is treated within pay as you go rates. This is something that is considered within "Aligning risk and return technical appendix".

11.4.4 Our assessment and reasoning

We consider that our revised approach of applying opex and capex proportions to base and enhancement separately gives a level of opex more in line with companies' own expenditure profiles. It more accurately reflects our challenge on enhancement costs that is more heavily weighted towards capex.

We do not agree that we should consider base and growth separately for the purpose of calculating the split of opex and capex. We model base and growth costs together as both types of expenditure have similar cost drivers and to minimise cost allocation inconsistencies between them. We do not separately challenge base and growth costs, rather we have a single challenge for both costs. We have changed aspects of our approach to modelling base and growth costs, such as making an additional allowance for high growth companies. This may narrow the challenge on growth costs from the draft determinations. But as we do not set separate allowances we do not consider it to be appropriate or feasible to attempt to split the allowance for base and growth costs to separately calculate the split of opex and capex.

We have considered all other comments. We have made changes where errors have been identified either within the model's calculations or with specific data.

11.5 WINEP unit cost adjustment mechanism

In our PR19 Methodology we committed to making financial provision for the anticipated programme, as long as companies proposed an appropriate cost adjustment mechanism to account for a potential discrepancy between the scale of the assumed and confirmed programmes. Companies were required to link expenditure for unconfirmed requirements, known as 'Amber' schemes, to a measure and a unit cost. We will use our view of the unit cost to make an adjustment at the end of the control period, based on the volume of work that is eventually confirmed as required and delivered by the company. In some cases no suitable measure has been identified; in such cases the unit cost will simply be the assumed allowance for the scheme.

We need to undertake a reconciliation to totex to ensure companies' totex in the PR19 control period:

- does not include Amber schemes that did not proceed; and
- does include Amber schemes that were delivered but which weren't costed in our final determinations.

11.5.1 Our approach at draft determination

At draft determination for each company we set out in each company's cost efficiency appendix a table listing all Amber WINEP schemes and the unit cost or cost (or the formula we would use to calculate it) that we would recover for customers should the requirement for the scheme not be confirmed by ministers in or by 2021. Two companies (Severn Trent Water and Thames Water) did not include all Amber WINEP schemes in their business plans. For these companies we also tabulated the costs / unit costs we would take account of at the next price review should any of these schemes, unfunded at PR19, be confirmed as required.

In setting the costs and unit costs the principle we adopted was that should an Amber scheme not be confirmed we would only recover the same proportion of the company's business plan forecast totex for the scheme for which we had made an allowance in our draft determination.

11.5.2 Stakeholder's representations

We received few representations on the WINEP cost adjustment mechanism. The only substantive representation we received was from United Utilities in respect of enhancement schemes at a large sewage treatment works which had been coded 'Red' and had therefore been omitted from the version of WINEP released in March 2019 but the need for which had recently been confirmed by the Environment Agency. United Utilities requests that at final determination this scheme be treated in the same way as the 'Amber' schemes that Severn Trent Water and Thames Water had omitted from their business plans but for which they had nevertheless provided cost estimates and measures of the benefits these schemes would deliver should they be required.

11.5.3 Our approach at final determinations

Our approach at final determination is largely unchanged from that at draft determinations though evidence provided in companies' representations including new information on costs as well as amendments to a number of our cost models has resulted in changes to some of the costs, unit costs and formulae in our uncertainty mechanism tables in the updated Cost Efficiency appendix.

For three companies we make provision for the costs associated with product substitution that would arise should the appealed ban on metaldehyde currently in abeyance not go ahead.

We accept United Utilities' representation and include costs and unit costs for two ex-'Red' coded schemes at Bolton STW in what is now a two-way adjustment mechanism for this company.

11.6 Approach to costs related to metaldehyde

Water companies must ensure that metaldehyde concentrations are below European and UK standards for pesticides in drinking water set at 0.1ug/l.

Some companies included costs in their September 2018 business plans to remove or prevent metaldehyde from drinking water. It was subsequently announced that the use of metaldehyde was to be banned and some companies removed these costs from their revised business plan in April 2019. A ban of metaldehyde would provide water companies with a reduced level of risk in catchments and avoid enhancement

expenditure such as product substitution payments to farmers, costly treatment solutions at water treatment works and blending schemes in the water distribution system.

In July 2019 the ban has been overturned by the High Court following a judicial review. As a result, some companies reintroduced metaldehyde costs to their view of total in August 2019 representations, and some suggested an uncertainty mechanism.

As the government has indicated that it will retake a decision on the metaldehyde ban, taking account of the procedural points raised, we do not make an allowance for these costs. Rather, we address possible costs related to the removal of metaldehyde through suitable adjustment/uncertainty mechanisms.

For three companies we make provision through the WINEP unit cost adjustment mechanism for the costs associated with metaldehyde removal if the ban is delayed or not reintroduced. For Anglian Water and Affinity Water, due to the higher materiality, we make provision through Notified Items for the costs associated with treatment solutions at water treatment works and blending schemes in the water distribution system (see section 4.4 in the Risk and Return appendix).

We are adjusting the deadband on the Compliance Risk Index of 2.00 throughout the period reducing the risk of underperformance payments in the last three years of the 2020-25 period. This allows more flexibility in performance to take into account the uncertainty created by the overturning of the ban by the High Court in July 2019.

Annex 1: Cost tables

The annex provides three summary tables. All costs are in £m of 2017-18. Company view of costs is based on August 2019 representations to our draft determinations. Our view of costs is our final determinations allowance. The efficiency challenge is the percentage by which our allowance is lower than company requested costs.

The tables exclude the following costs:

- Pension deficit recovery payments
- Third party services and other cash items
- Business retail (Dŵr Cymru and Hafren Dyfrdwy only)
- Strategic scheme development
- Non-section 185 diversions costs
- The conditional allowances for the performance improvement and London resilience (Thames Water only).

Table A1.1: Totex (£m)

Company	Wholesale water			Wholesale wastewater			Residential retail			Total		
	Company view	Our view	% Efficiency challenge	Company view	Our view	% Efficiency challenge	Company view	Our view	% Efficiency challenge	Company view	Our view	% Efficiency challenge
Anglian Water	2,586	2,241	13.3%	3,293	2,909	11.7%	407	403	0.9%	6,286	5,553	11.7%
Dŵr Cymru	1,534	1,453	5.3%	1,499	1,419	5.3%	230	205	11.0%	3,264	3,077	5.7%
Hafren Dyfrdwy	119	124	-3.7%	25	28	-9.3%	14	14	-6.7%	158	166	-4.9%
Northumbrian Water	1,665	1,629	2.1%	1,168	1,054	9.7%	280	250	10.5%	3,112	2,933	5.7%
Severn Trent Water	3,091	2,875	7.0%	2,942	3,096	-5.2%	462	492	-6.6%	6,496	6,463	0.5%
South West Water	925	928	-0.3%	983	925	5.9%	160	141	11.7%	2,068	1,994	3.6%
Southern Water	1,169	1,042	10.8%	2,300	2,197	4.5%	235	262	-11.3%	3,704	3,501	5.5%
Thames Water	4,711	4,328	8.1%	4,314	4,358	-1.0%	820	754	8.0%	9,844	9,440	4.1%
United Utilities	2,458	2,492	-1.4%	3,022	2,847	5.8%	508	475	6.5%	5,988	5,814	2.9%
Wessex Water	646	615	4.8%	1,550	1,440	7.1%	164	143	12.8%	2,360	2,198	6.8%
Yorkshire Water	1,733	1,696	2.1%	2,740	2,424	11.5%	273	322	-17.8%	4,746	4,442	6.4%
Affinity Water	1,367	1,358	0.7%				145	142	2.2%	1,512	1,500	0.8%
Bristol Water ²⁴	444	411	7.4%				50	51	-1.7%	494	462	6.5%
Portsmouth Water	166	182	-10.0%				23	21	9.1%	189	204	-7.6%
South East Water	1,005	899	10.6%				82	88	-7.8%	1,086	987	9.2%
South Staffs Water	564	553	1.8%				59	62	-4.7%	623	616	1.2%

²⁴ Figures in this row have been amended for company view and % efficiency challenge in the wholesale water and total columns

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SES Water	256	244	4.8%				35	28	21.4%	291	271	6.8%
Industry²⁵	24,438	23,071	5.6%	23,837	22,699	4.8%	3,946	3,854	2.4%	52,222	49,623	5.0%

²⁵ Figures in this row have been amended for company view in the wholesale water and total columns

Table A1.2: Base costs (£m)

Company name	Wholesale water base			Wholesale wastewater base			Residential retail			Total base		
	Company view	Our view	% Efficiency challenge	Company view	Our view	% Efficiency challenge	Company view	Our view	% Efficiency challenge	Company view	Our view	% Efficiency challenge
Anglian Water	1,753	1,556	11.2%	2,482	2,169	12.6%	407	403	0.9%	4,641	4,129	11.0%
Dŵr Cymru	1,088	1,123	-3.2%	1,190	1,165	2.1%	230	205	11.0%	2,508	2,493	0.6%
Hafren Dyfrdwy	101	111	-9.2%	23	25	-10.8%	14	14	-6.7%	138	150	-9.2%
Northumbrian Water	1,454	1,459	-0.4%	938	872	7.1%	280	250	10.5%	2,672	2,581	3.4%
Severn Trent Water	2,456	2,463	-0.3%	2,408	2,644	-9.8%	462	492	-6.6%	5,325	5,599	-5.1%
South West Water	699	774	-10.7%	791	767	3.0%	160	141	11.7%	1,650	1,682	-1.9%
Southern Water	816	754	7.6%	1,654	1,630	1.5%	235	262	-11.3%	2,705	2,646	2.2%
Thames Water	3,428	3,700	-7.9%	3,816	3,997	-4.7%	820	754	8.0%	8,064	8,451	-4.8%
United Utilities	2,198	2,307	-4.9%	2,332	2,196	5.8%	508	475	6.5%	5,038	4,977	1.2%
Wessex Water	531	547	-3.1%	1,022	999	2.2%	164	143	12.8%	1,717	1,689	1.6%
Yorkshire Water	1,571	1,553	1.1%	1,783	1,661	6.8%	273	322	-17.8%	3,627	3,537	2.5%
Affinity Water	1,100	1,091	0.8%				145	142	2.2%	1,245	1,233	1.0%
Bristol Water	409	381	6.9%				50	51	-1.7%	459	432	5.9%
Portsmouth Water	143	164	-14.6%				23	21	9.1%	166	185	-11.2%
South East Water	743	736	1.0%				82	88	-7.8%	825	824	0.1%
South Staffs Water	435	442	-1.5%				59	62	-4.7%	495	504	-1.9%
SES Water	203	204	-0.5%				35	28	21.4%	238	232	2.8%
Industry	19,129	19,366	-1.2%	18,439	18,126	1.7%	3,946	3,854	2.4%	41,515	41,345	0.4%

Table A1.3: Enhancement costs (£m)

	Environmental programme (WINEP / NEP)		Supply-Demand balance and metering		Resilience enhancement		Other enhancement activities		Total enhancement	
	Company view	Our view	Company view	Our view	Company view	Our view	Company view ²⁶	Our view	Company view ²⁷	Our view
Anglian Water	809	744	678	563	45	32	112	85	1,644	1,425
Dŵr Cymru	212	212	106	66	83	23	354	284	755	584
Hafren Dyfrdwy	8	7	1	1	2	1	10	8	21	16
Northumbrian Water	190	152	43	43	146	104	62	53	440	352
Severn Trent Water	514	471	218	162	147	107	291	123	1,170	864
South West Water	158	156	27	13	59	42	174	101	418	312
Southern Water	622	554	230	184	0	0	147	118	999	855
Thames Water	563	474	605	297	109	31	503	188	1,780	989
United Utilities	680	663	104	50	108	79	58	45	951	837
Wessex Water	430	402	39	14	8	3	166	90	643	509
Yorkshire Water	941	772	22	22	29	0	127	111	1,119	905
Affinity Water	117	121	134	120	14	14	2	12	267	267
Bristol Water	5	4	14	14	12	8	3	3	35	30
Portsmouth Water	5	4	9	8	3	1	6	6	23	19
South East Water	69	64	135	71	34	11	23	17	261	162
South Staffs Water	9	9	28	17	4	2	87	84	129	112
SES Water	1	1	41	30	9	6	2	2	53	40
Industry	5,332	4,810	2,436	1,676	811	463	2,129	1,329	10,707	8,278

²⁶ Figures in this column amended for Anglian Water, Northumbrian Water, South West Water, Southern Water, Thames Water, United Utilities, Wessex Water, Yorkshire Water, Affinity Water, Bristol Water and Industry

²⁷ Figures in this column amended for Anglian Water, Northumbrian Water, South West Water, Southern Water, Thames Water, United Utilities, Wessex Water, Yorkshire Water, Affinity Water and Industry

Annex 2: Our econometric models – specifications

In this annex we provide a description of the econometric models we use for final determinations. We use the same modelling approach and model selection criteria as described in our [Supplementary Econometric Technical Appendix](#) published earlier this year. We present a brief description below.

Selection of costs drivers

Our approach to model development and assessment is as follows:

1. We use engineering, operational and economic understanding to specify an econometric model, and form expectations about the relationship between cost and cost drivers in the model.
2. We assess whether the estimated coefficients are of the right sign and of plausible magnitude.
3. We consider if the estimated coefficients are robust. For example, are they stable and consistent across different specifications? Are the estimated coefficients statistically significant?
4. We assess the consequences of cost drivers under management controls, in particular, the risk of any perverse incentive.
5. We consider the statistical validity of the model more widely – does the model perform well in terms of statistical tests and diagnostics?
6. We consider the appropriate estimation method.

In terms of estimation method, we use random effects models. Random effects model are appropriate for a panel data set (data with a cross section and a time dimension). The models also perform better statistically than under the ordinary least squares (OLS) method and the Breusch Pagan test consistently supports using random effects over the OLS.

Levels of aggregation

We keep the levels of aggregation we use in our initial assessment of plans.

- In wholesale water we use models to benchmark costs at water resources plus, treated water distribution and wholesale water levels. “Water resources plus” is our term for water resources, raw water distribution and water treatment combined.

- In wastewater, we use models to benchmark costs at sewage collection, sewage treatment, bioresources and bioresources plus levels. Bioresources plus is our term for bioresources and sewage treatment combined).
- In residential retail we use model total retail costs, bad debt and debt management costs, and other retail costs (total residential retail costs except for bad debt and debt management costs)

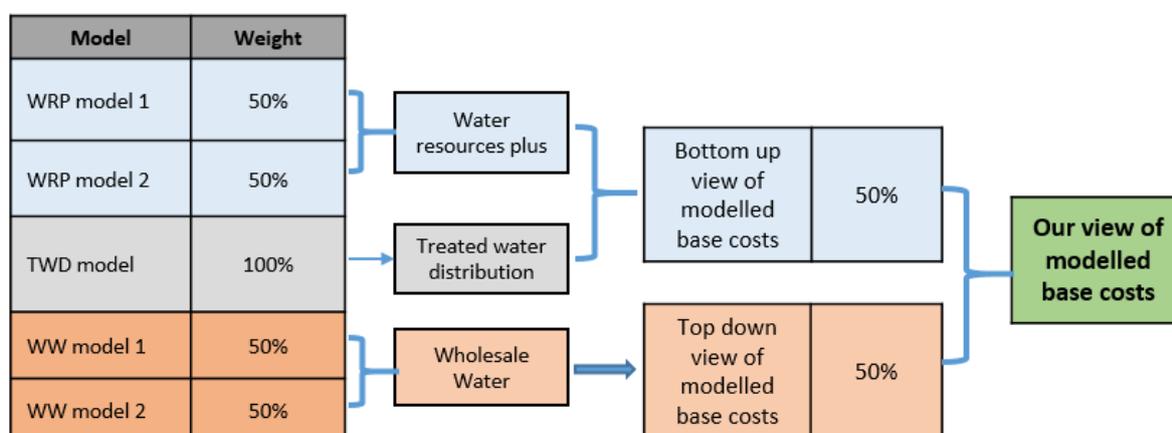
We use a 'triangulation' process to combine different models in order to arrive at our view of costs at different levels of aggregation. Figures 3, 4 and 5 below explains the triangulation method we use for wholesale water, wholesale wastewater and residential activities respectively.

Our final determinations models, whose results are presented in tables A2.1, A2.2 and A2.3 below, were chosen using the modelling approach and selection criteria described above. Our models can be replicated using the published feeder model 1 and Stata do files.

A2.1 Cost models for wholesale water activities

Table A2.1 Econometric models for wholesale water activities

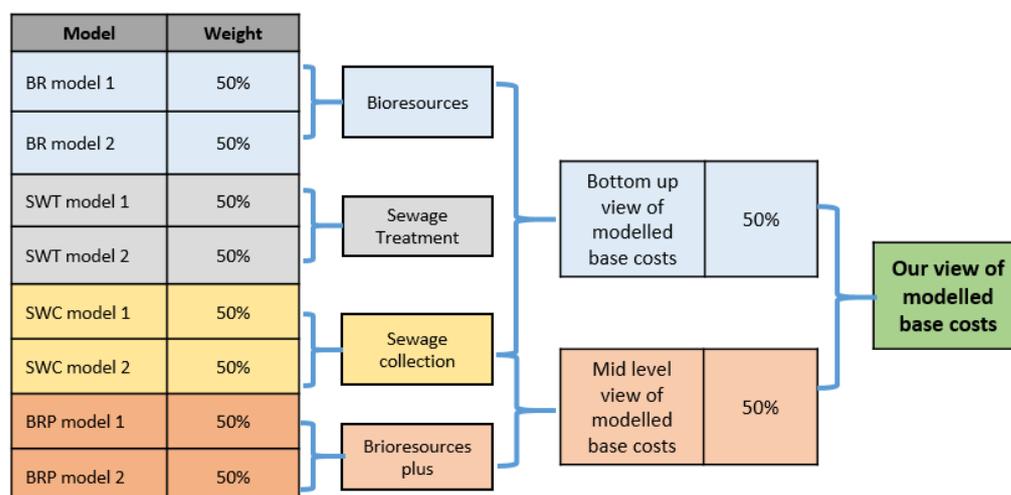
Model name	WRP1	WRP2	TWD1	WW1	WW2
Dependent variable (log)	Water resources + Raw water distribution + Water treatment		Treated water distribution	Wholesale water total	
Connected properties (log)	1.007***	1.007***		1.034***	1.020***
Lengths of main (log)			1.049***		
Water treated at works of complexity levels 3 to 6 (%)	0.008***			0.005***	
Weighted average treatment complexity (log)		0.486***			0.568***
Number of booster pumping stations per lengths of main (log)			0.455***	0.231**	0.256***
Weighted average density (log)	-1.647***	-0.981**	-3.120***	-2.220***	-1.789***
Squared term of log of weighted average density	0.103***	0.056 (0.120)	0.248***	0.156***	0.125***
Constant term	-4.274**	-6.607***	5.686***	-1.106 (0.483)	-2.725**
Overall R-Squared	0.93	0.92	0.97	0.98	0.98
Number of observations	141	141	141	141	141

Figure A2.1: Triangulation of wholesale water econometric models


A2.2 Cost models for wholesale wastewater activities

Table A2.2: Econometric models for wholesale wastewater activities

Model name	SWC1	SWC2	SWT1	SWT2	BR1	BR2	BRP1	BRP2
Dependent variable (log)	Sewage collection		Sewage treatment		Bioresources		Bioresources + Sewage treatment	
Sewer length (log)	0.839***	0.896***						
Load (log)			0.779***	0.773***			0.765***	0.762***
Sludge produced (log)					1.274***	1.265**		
Load treated in size bands 1-3 (%)			0.045***		0.057**		0.038*	
Load treated in size band 6 (%)				-0.013**				-0.011**
Pumping capacity per sewer length (log)	0.317*	0.606***						
Load with ammonia consent below 3mg/l (%)			0.004***	0.004***			0.005***	0.005***
Number of properties per sewer length (log)	0.998**							
Weighted average density (log)		0.178 (0.146)			-0.295**			
Sewage treatment works per number of properties (log)						0.397*		
Constant term	-8.124***	-6.416***	-5.228***	-3.988***	-0.389 (0.648)	0.994*	-4.753***	-3.709***
Overall R-Squared	0.93	0.88	0.88	0.87	0.82	0.79	0.92	0.92
Number of observations	80	80	80	80	80	80	80	80

Figure A2.2: Triangulation of wholesale wastewater econometric models


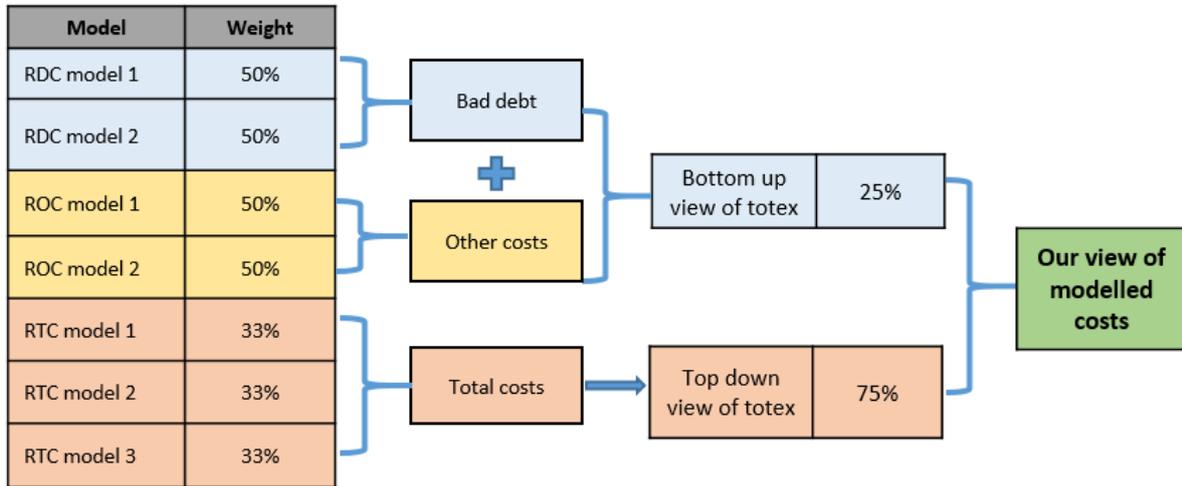
A2.3 Cost models for residential retail activities

Table A2.3: Econometric models for residential retail

Model name	RDC1	RDC2	ROC1	ROC2	RTC1	RTC2	RTC3
Dependent variable (log)	Bad debt and bad debt management costs per household		Other retail costs per household		Total retail costs per household		
Average bill size (log)	1.190***	1.158***			0.458***	0.526***	0.603***
Proportion of households with default (Equifax variable) (%)	0.067***				0.024 {0.106}	0.030**	
Proportion of households income deprived (income score of IMD) (%)		0.076***					0.059***
Total migration (% of population)		0.035**					0.037**
Proportion of dual service households (%)			0.002*	0.002**			
Proportion of metered households (%)			0.007***	0.007***	0.004 {0.321}	0.004 {0.206}	0.002 {0.436}
Number of households connections (log)				-0.039 {0.394}		-0.059*	-0.116**
Constant term	-6.032***	-5.680***	2.400***	2.909***	-0.014 (0.980)	0.226 (0.653)	0.200 (0.564)
Overall R-Squared	0.77	0.78	0.13	0.15	0.67	0.70	0.71
Number of observations	105	105	105	105	105	105	105

* Other retail costs include customer service, other operating costs, meter reading, recharges and depreciation.

Figure A2.3: Triangulation of residential retail econometric models



Annex 3: Frontier shift and real price effects

This annex considers the scope for frontier shift efficiency and real price effects for wholesale controls. This annex has been updated following company responses to our draft determinations. We consider each issue in turn.

A3.1 Frontier shift

Frontier shift refers to a shift in the efficiency frontier for the sector. We consider there is scope for frontier shift efficiency improvements in the water sector from two sources:

- on-going efficiency improvements in the economy that the water sector should be able to emulate; and
- one-off efficiency improvements from water companies making greater use of the totex and outcomes framework at PR19.

To understand the potential scale of these efficiency improvements, we commissioned two consultant reports:

- 'Frontier shift efficiency and real price effects', by Europe Economics²⁶; and
- 'Innovation and efficiency gains from the totex and outcomes framework', by KPMG and Aqua consultants.

Following the receipt of responses to our draft determinations from companies and their consultants, 'Frontier shift efficiency and real price effects' has been finalised by Europe Economics.

In this section we first present our final determination assessment of frontier shift, then summarise changes since our draft determination, followed by stakeholder representations regarding our draft determination. Finally we outline our assessment and reasons, including responses to stakeholder representation.

²⁶ Supplementary technical appendix: Europe Economics Frontier shift and real price effects – updated at Final Determination. This report was also revised at our draft determinations

11.6.1 Our final determination decision

Overall, we consider that the combined effect of ongoing frontier shift efficiency and the impact of the totex and outcomes framework is an overall frontier shift of 1.1% per year based on a range of factors identified at the initial assessment, draft determination and final determination stages including:

- The frontier shift efficiency range of 0.6% to 1.2% per year for total expenditure identified by Europe Economics, before allowing for impacts of totex and outcomes. As the frontier shift efficiency challenge will be applied to base costs (modelled and unmodelled) and some enhancement costs, we do not use Europe Economics' range of 0.6% to 1.4% per year, which only applies to base expenditure.
- Europe Economics suggests we use a number towards the top end of the 0.6% to 1.2% per year range as some weight should be placed on valued-added measures and to account for embodied technological change (input quality effects). We note that the value-added measure of frontier shift efficiency tends to be higher than the gross output measure we use as the main basis for our frontier shift efficiency estimate. For example in the post financial crisis period, the value-added measure is 1.3% per year compared to 0.6% per year for the gross output measure, indicating much higher values if weight is placed on the value-added measure. We also note the scope for higher estimates, by up to 60%, if input quality effects are taken into account.
- We are including a real price effect adjustment for real wage growth to reflect improvements in labour productivity. Labour productivity improvements reflect the impact of improved labour quality (for example better skills) as well as a result of technological progress and better use of capital. As total factor productivity estimates remove the impact of improvements in labour quality, then we could be allowing for the additional costs of improved labour quality without allowing for the additional benefits in terms of increased productivity. We consider this provides us with an additional reason to use a total factor productivity estimate towards the upper end of the 0.6% to 1.2% per year range suggested by Europe Economics.
- The impact of on-going improvements in company outcome performance commitments on efficiency, in particular the 15% leakage reduction challenge.
- The KPMG study indicates a range of 0.2% to 1.2% per year from the additional impact of the totex and outcomes framework. Recent data suggests that the impact from the impact of the totex and outcomes framework could be lower than we previously estimated.
- There are some factors that would indicate using a number towards the lower end of the range identified by KPMG. For example, not all outperformance in this period can be attributed to the totex and outcomes framework.

- There are also some factors that could indicate a figure towards the upper end of their range. For example, KPMG applies diminishing marginal returns to the totex and outcomes framework, however, evidence on diminishing returns from regulatory and structural changes in other sectors is mixed.
- The 48 case studies by KPMG indicate a 35% improvement from the impact of totex and outcomes and cover 3.8% of total expenditure. While some of these case studies are not easily replicable, even just considering these 48 case studies gives an efficiency improvement of 1.3% of totex, equivalent to around a 0.5% efficiency improvement per year.
- Frontier Economics for Water UK (2017) found a quality adjusted total factor productivity of 2.1% between 1994 and 2017, showing the scope for efficiency gains in the water sector in the past, as well as the lack of recent productivity growth.
- An all-in efficiency figure of 1.1% per year is consistent with using a frontier shift efficiency number towards the upper end of the 0.6% to 1.2% per year range identified by Europe Economics.
- An efficiency figure of 1.1% per year is towards the lower end of the range of 0.6% to 2.5% per year indicated by KPMG for the combined effect of frontier shift efficiency and the impact of the totex and outcomes framework.

We apply the frontier shift to base costs (modelled and unmodelled) and metering as well as wastewater WINEP enhancement costs from 2019-20.

We do not to apply frontier shift to retail costs as these are based, in part, on forward-looking costs, and reflect significant efficiency improvements on historical expenditure

Overall we consider that a 1.1% per year frontier shift efficiency, together with the improvements from outcome performance commitments, provides a stretching but achievable challenge for water companies.

11.6.2 Changes from our draft determination

We have reduced the frontier shift estimate from 1.5% to 1.1% per year.

We apply the frontier shift to unmodelled base costs (with the exception of pension deficit recovery costs and a broader range of enhancement costs) as our frontier shift estimate of 1.1% is based on all costs in comparator industries.

We will apply the frontier shift and real price effects to costs from 2019-20, instead of 2020-21, as these costs only take into account on-going efficiency improvements and real price effects up until 2018-19.

11.6.3 Stakeholders' representation

In their response documents to our draft determinations, several companies and their consultants submitted reports regarding Europe Economics assessment of frontier shift. These reports included:

- **Responding to Ofwat's draft determination of South East Water's wholesale and growth enhancement cost allowance - Prepared for South East Water Ltd**, Oxera, 28 August 2019
- **Response to Ofwat's Draft Determination on Real Price Effects and Frontier Shift - Prepared for Bristol Water**, NERA Economic Consulting, 23 August 2019
- **Financeability of the notionally efficient firm: top-down analysis - A PR19 representations report for Anglian Water, Northumbrian Water, Dŵr Cymru and Yorkshire Water**, Economic Insight, August 2019
- **Frontier Shift – A brief response to the new points raised by Europe Economics and Ofwat** (for Yorkshire Water), Economic Insight, August 2019

The key points raised by companies in their draft determination representations, and their consultants in the reports listed above are summarised below.

1. Choice of comparator sectors – companies argue that we should be considering the average of all comparator sectors for our upper bound, and that we should allow for differences in cost structure, innovation and maturity across sectors.
2. Choice of time period – companies argue we have excluded “full business cycles” or particular years without sufficient reason to do so.
3. Weight placed on value added total factor productivity measures – companies argue we continue to attach weight to the value added measure of total factor productivity growth without providing convincing evidence to support this.
4. Consistency of frontier shift analysis with other parts of the price control – companies argue that we shouldn't be trueing-up for real price effects without also having a true-up for the frontier shift, and that it is inconsistent to have a high frontier shift but only a labour real price effect. They also argue there remains inconsistency between the 1.5% frontier shift and the lower economy-wide productivity growth for the WACC. A further comment is raised that our frontier shift framework fails to connect costs and outcomes.

5. Allegation of “grossly disproportionate” change in efficiency challenge - several companies made representations regarding the required step change on cost efficiency, including suggesting this was unprecedented.
6. Application of frontier shift to enhancement costs – Anglian Water commented that it is unclear why the frontier shift should be imposed on costs for specific projects.
7. Addition for impact of totex and outcomes framework - Economic Insight raises concerns regarding the potential for double counting efficiency improvements when adding an uplift for shift to a totex and outcomes framework, and disagree with Europe Economics’ argument regarding additional industry catch-up following the introduction of the framework.
8. Performance in previous periods - Economic Insight, on behalf of Anglian Water, Dŵr Cymru and Yorkshire Water, argue that there have not been previous periods of outperformance that need to be reset, and therefore there is no rationale for requiring a step change in performance.

Further detail on these points and our responses are provided in the section below.

11.6.4 Our assessment and reasons

Our assessment of frontier shift is informed by two external consultant reports prepared by Europe Economics and a joint report from KPMG and Aqua Consultants. A summary of these reports is provided below.

Europe Economics final assessment of frontier shift

This work identifies the scope for frontier shift and whether there is evidence of real price effects that will impact water company costs going forwards. As part of this work Europe Economics considered the evidence put forward by water companies in their responses to Europe Economics revised assessment.

Consistent with the approach used by water company consultants, Europe Economics forecasts the scope for frontier shift efficiency based on total factor productivity analysis of comparative sectors using historical EU KLEMS data of UK productivity. Europe Economics’ conclusions on frontier shift analysis at final determination stage are substantially the same as those in their revised assessment report published at the draft determinations.

Europe Economics forecasts a frontier shift of 0.6% to 1.2% per year for total expenditure. The bottom end of this range is based on productivity growth in the

most recent post financial crisis period. The top end of this range is based on the growth of better performing sectors in the pre and post-crisis period.

Table A3.1: Europe Economics final recommendations of frontier shift efficiency

	Frontier shift range
Wholesale total expenditure	0.6% – 1.2% per year

Europe Economics recommends using a number towards the upper end of these ranges for the following reasons:

- It is appropriate to place some weight on the value-added measure, which is somewhat higher than the gross output measure as it excludes intermediate inputs.
- The estimates exclude embodied technological change, which are the quality improvements in inputs. Europe Economics cites a study which indicates that taking into account quality improvements could lead to as much as 60% increase in productivity. This could suggest a range of 1% to 2.2% per year. While evidence on this is limited, this could result in somewhat higher productivity growth.

Efficiency gains from the totex and outcomes framework – KPMG assessment

This study²⁷ was prepared during our initial assessment to consider the potential efficiency improvements from the totex and outcomes framework, although the study also provided estimates for the on-going frontier shift efficiency improvement. The study identifies that introducing the totex and outcomes framework in the 2014 price review removed a regulatory barrier to companies achieving greater efficiency.

The study provides an estimate of frontier shift, based on total factor productivity, of 0.4% to 1.5% per year based on analysis of EU KLEMS data. KPMG estimates the overall scope for ongoing efficiency improvement over the next control period by

²⁷ Supplementary technical appendix: KPMG totex and outcomes report

combining the impact of the totex and outcomes framework, with their estimate of frontier shift.

Table A3.2: KPMG estimates of the ranges of frontier shift efficiency for on-going efficiency target setting

	Total factor productivity	Totex and outcomes	Combined effect
Annual incremental gain (% per year)	0.4 – 1.3%	0.2 – 1.2%	0.6 – 2.5%
Total efficiency gain over the control period (%)	1.2 – 3.8%	0.6 – 3.7%	1.8 – 7.4%

Our assessment and reasons

Below we summarise the points made by companies and their consultants in their draft determination representations in relation to the reports prepared by Europe Economics and KPMG and Aqua consultants, along with responses to those points. In cases where we consider that points are not persuasive, we explain why we have not made any changes. We also identify any changes that we have made.

We discuss the points made by respondents under the following headings:

1. Choice of comparator sectors.
2. Choice of time period.
3. Weight placed on value added total factor productivity measures.
4. Consistency of frontier shift analysis with other parts of the price control.
5. Allegation of grossly disproportionate change in efficiency challenge.
6. Application of frontier shift to enhancement costs.
7. Addition for impact of totex and outcomes framework.
8. Performance in previous periods.

The remainder of this section provides a summary of the points listed above made by companies and their consultants, the responses provided by Europe Economics and our overall assessment. Europe Economics addresses in detail these comments in the supplementary technical appendix to their report.

Productivity growth in comparator sectors that perform similar activities is relevant to forecasting productivity in the water sector

Oxera and NERA argue that the upper bound of the range for frontier shift should be based on an average of comparator sectors rather than the most strongly performing sectors. Thames Water argues that it is wrong to consider productivity growth in other sectors without allowing for differences in cost structure, innovation and maturity. Oxera also argues Europe Economics' upper bound is based exclusively on the chemicals sector which exhibited low productivity 2010-14.

Europe Economics considers that averages of comparator sectors would not provide an appropriate upper bound as historical performance indicates many sectors can perform more strongly than the average. In terms of the weight of the comparator sectors, Europe Economics states that sectors are included in frontier shift analysis because they are similar in terms of the nature of activity carried out, not because the water sector purchases inputs from that sector. For example, the chemicals sector is included as its activities are similar to the water sector.

Europe Economics state that the upper bound is based on both the pre and post crisis period and a range of comparator sectors including "machinery and equipment nec", "other manufacturing; repair and installation of machinery and equipment", "professional, scientific, technical, administrative and support service activities" and "transport and storage". Europe Economics state that the use of comparator sectors is widely used for productivity forecasts for the utility sectors, including by all water company consultants, and is accepted to provide an indication of potential productivity gains. Europe Economics also note that cost structure was considered when selecting comparator sectors, including the comparability of capital intensity the sector relative to water, however this was not an overriding consideration where there were other reasons for including a comparator.

We consider that the use of explicit weightings, as recommended by Oxera, can lead to spurious accuracy in frontier shift assumptions. We therefore consider that it is better to consider productivity improvements of all comparator sectors in the round, as has been used by Europe Economics.

The comparator sectors chosen by Europe Economics are similar to those put forward by companies, and comparators proposed by companies have only been rejected for good reason. For example because sectors that are subject to regulation (such as the utility sector) or are not similar to water (such as the agricultural sector). We consider that the approach used by Europe Economics continues to be appropriate. We are also content that the upper bound is appropriate as this is consistent with productivity growth across a range of sectors and covers both the pre and post crisis periods.

Additionally, there is other evidence to suggest that the water sector can obtain higher on-going productivity growth. For example Frontier Economics for Water UK (2017) found a quality adjusted total factor productivity of 2.1% between 1994 and 2017. While this arguably includes some element of catch-up as well as frontier shift efficiency, this shows the scope for efficiency gains in the water sector in the past. Our final determination of allowance for on-going frontier shift of 1.1% per year is significantly less than the 2.1% quality adjusted average total factor productivity observed in the water sector from 1994 to 2017.

Both the pre and post-crisis periods are relevant to forecast frontier shift for PR19

Anglian Water, Dŵr Cymru, NERA, Oxera and Economic Insight raise concerns about the choice of time period used in Europe Economics analysis. Arguments raised include the exclusion of “full business cycles” or particular years, and that lesser weight was placed on productivity estimates in recent years.

Europe Economics’ considers that its forecast for frontier shift is appropriate as it considers both the more recent growth in the post crisis period, and also growth over a number of past full business cycles. In the absence of an updated data set from EU KLEMS, Europe Economics conduct further analysis of the impact of the financial crisis on productivity performance using ONS Multi Factor Productivity data to 2018. Europe Economics finds the financial crisis had little impact on productivity growth in comparator sectors from 2010-18, which suggests the financial crisis should not have significant impact on productivity growth in the water sector in the next price control period. Europe Economics also presents evidence to suggest that post-crisis growth should be measured from 2010-14 as excluding 2010 would exclude a year of growth from the data. They also note that if they were to cherry pick years in the post crisis period and exclude 2010 and 2012 (which had a negative growth), the average productivity growth would be 0.9% per year, which is higher than their proposed post-crisis average for 2010-14. Europe Economics also explains that if the years 2008-09 were included in pre and post-crisis averages, then the post-crisis figure would include a full economic downturn but only part of the subsequent economic expansion, introducing a downward bias into the analysis.

In terms of the upper bound of their range, Europe Economics notes that the recommendation is partly based on analysis of complete business cycles using the NACE 1²⁸ dataset (1971-2007). This analysis covers a number of full business cycles. Europe Economics notes that the lower bound for frontier shift is based on

²⁸ NACE (Nomenclature statistique des activités économiques dans la Communauté européenne) is the statistical classification of economic activities in the European Community

productivity growth in the post-crisis period and so takes account of more recent lower growth. It notes that comparator sectors have tended to exhibit stronger growth than the economy as a whole. Europe Economics states that their recommendation to select a number in the upper end of the range is to account for value added total factor productivity and embodied technical shift rather than because they expect productivity growth to be closer to the longer term trends.

Overall, we consider that Europe Economics' forecasts of frontier shift are based on an appropriate time period as they consider both growth over more recent years and a number of past full business cycles.

Some weight should be placed on value added measures of productivity

Thames Water and NERA continue to argue that Ofwat and Europe Economics attach weight to the value added measure of total factor productivity growth to select a value toward the upper end of Europe Economics' range without providing convincing evidence to support this. They continue to argue that it goes against Europe Economics' stated preference for gross output based total factor productivity measures. However, Thames Water and NERA have not provided new evidence to support their arguments.

As outlined in our draft determinations, Europe Economics confirms that while the upper and lower bounds to their frontier shift range are based on gross output based total factor productivity figures, some weight should be placed on the value added measure. While the gross output measure is generally preferable it is not superior in all cases, and this is a reason for considering a point towards the upper end of the range suggested by the gross output-based measure.

We continue to consider that our use of the Europe Economics range is consistent with its advice to take account of both gross output and value added measures. We note that many of the water companies' consultants originally used value added measures to forecast productivity and other regulators such as Ofgem have used them in the past. We continue to consider that we should place some weight on value added measures.

Our frontier shift analysis is consistent with other parts of the price control

Anglian Water and Wessex Water state that a true-up for real price effects will undermine the linkage between real price effects and frontier shift assumptions unless the frontier shift also has a true-up. They also argue that we have not fully addressed the inconsistency between the 1.5% per year frontier shift figure and the

lower economy-wide productivity growth (Thames Water also makes this argument). Yorkshire Water argues that the frontier shift assumption is inconsistent with other parts of the framework including:

- between high frontier shift efficiency and no allowance for real price effects, and argues that allowing a labour real price effect does not wholly address this point and there should be a real price effect for other costs;
- between high levels of productivity for frontier shift and low levels of productivity for the allowed return on capital; and
- between our assessment of stretch on costs and outcomes, and the impact on frontier shift (Thames Water also argues this point, suggesting that choosing a point towards the upper end of the range and imposing quality improvements would be imposing the efficiency challenge twice and can create the risk of double counting).

Europe Economics responds to each of these comments in turn.

On labour real price effects, Europe Economics states that the average OBR wage growth forecast is 1.1% per year, which is in the upper end of their frontier shift range. They also find no theoretical reason why high productivity growth in the water sector necessarily has to be associated with high input price growth for water companies, therefore it is consistent with their recommendation that real price effects allowances for all categories should not necessarily be given. Europe Economics states that there is not necessarily any link between productivity growth and real price effects in other sectors.

The OBR does not provide forecasts of total factor productivity growth. However separately [the OBR forecasts](#) that labour productivity growth of 1% per year is equivalent to total factor productivity growth of 0.4 to 0.6% per year. This relationship implies an OBR total factor productivity of between 0.4 to 0.7% per year, given the above 1% labour productivity growth over the forecast period.

The Europe Economics productivity growth forecast is based on growth in comparator sectors, including manufacturing and construction, which has tended to outperform UK productivity in recent years (and also in the longer term). Growth in these comparator sectors has outstripped UK productivity by 0.5% to 0.6% per year. Assuming this relationship continues, this implies an OBR forecast for comparator sectors of 0.9% to 1.3% per year, towards the upper end of the range provided Europe Economics.

While we recognise productivity forecasts for the wider UK economy are relatively low, we consider that our productivity growth estimates are consistent with forecasts for comparator sectors, and are consistent with our assumptions for real price effects.

A true up for productivity growth is not required

In terms of a true up for productivity growth as well as real price effects, Europe Economics states this is not necessary as the price review offers other mechanisms to manage risks around productivity growth and efficiency throughout the price control period including the substantial effects clause, interim determinations and cost sharing. We do not consider that we should true up for productivity growth or remove the true up for labour costs. The frontier shift estimate is an efficiency challenge, based on historic evidence of efficiency improvements, and should not depend on productivity in the economy as a whole. Whereas wage rates will be dependent on wage rates in comparative sectors and so should be trued up based on the outturn position.

Our frontier shift and cost of capital analysis is consistent

In response to the claim that our frontier shift and cost of capital analysis are based on different assumptions, Europe Economics note that an important input to their cost of capital analysis of the total market return is a dividend growth model which employs OBR forecasts for GDP growth. Europe Economics also uses the same OBR forecasts for labour productivity growth to estimate real price effects for labour costs. Given that both their frontier shift and return on capital analysis are using the same OBR forecasts for GDP growth and labour productivity, we consider that there is no inconsistency in their analysis.

Our frontier shift and outcomes analysis is consistent

In terms of consistency of frontier shift efficiency with the stretch on outcomes. Europe Economics states that at a theoretical level, there is the potential for double-counting between ongoing efficiency and quality improvements if total factor productivity figures that are used to inform the frontier shift range are quality adjusted. However, Europe Economics state that is not clear how fully quality adjustments have been taken into account in producing the relevant price deflators used in frontier shift analysis. More broadly Europe Economics find evidence that quality adjustments made to price indices may often fail to fully capture improvements in quality, including referencing the IMF who indicate it is highly unlikely price indices adjust for quality.

We consider that our cost allowances and quality improvements are consistent as:

- Our overall cost allowances take into account quality improvements in both base cost and enhancement funding.
- Most quality improvements are covered by enhancement funding. In PR19 we are providing £13bn of funding for the sector to improve service quality and industry outcomes beyond the on-going improvements we expect the sector to make.
- In the past regulators have not adjusted the efficiency challenge on base costs to allow for on-going improvements in service quality. For example, we did not provide additional funding for the move to upper quartile common performance commitments in PR14.
- Any potential for double-counting of quality improvements and productivity improvements is limited to the degree to which the on-going quality improvements (that are reflected in our base cost allowance) represent a frontier shift.
- For water supply interruptions, pollution incidents and internal sewer flooding, a number of companies have, are, or are forecast to be by 2019-20, perform better than their 2024-25 performance commitment level. For leakage we are providing funding for companies going beyond the forecast upper quartile. The stretch in on-going outcomes performance therefore reflects catch up rather than frontier shift. We therefore do not consider that there is double counting of quality improvements.
- Overall six companies' forecasts are within our efficient base cost allowances. Of these five have accepted our performance commitment stretch. We therefore consider that while stretching, our PR19 final determinations are achievable.

Further information on the consistency between the overall stretch on costs and outcomes is set out in the 'Overall level of stretch across costs, outcomes and allowed return on capital appendix'.

Our efficiency challenge is in line with other recent regulatory decisions

In response to our draft determinations, Economic Insight (on behalf of Anglian Water, Northumbrian Water, Dŵr Cymru and Yorkshire Water) produced a report on the financeability of the notionally efficiency firm.²⁹ A conclusion of the report is that Ofwat's efficiency assumptions (which include its frontier shift figure) amount to an "unprecedented" and "grossly disproportionate" increase in the efficiency challenge facing water companies. Several other companies made representations regarding

²⁹ Economic Insight, "Financeability of the notionally efficiency firm: top down analysis", August 2019

the overall level of stretch and required step change on cost efficiency. We note that these comments are in relation to our 1.5% rather than the current 1.1% frontier shift assumption.

In response to these points, Europe Economics has reviewed the recent regulatory decisions made by other regulators including Ofgem, the Civil Aviation Authority and the Competition and Markets Authority for Bristol Water in PR14. They find that their proposed frontier shift range of 0.6% to 1.2% is in line with the range of decisions made by regulators since 2013, with a typical frontier shift of 1.0% observed. Many of these frontier shift improvements have been introduced at the same time as quality improvements. The issue of step change in efficiency and overall level of stretch on costs is addressed in more detail in the 'Overall level of stretch across costs, outcomes and allowed return on capital appendix'.

Table A3.3: Overview of frontier shift efficiency challenges set by other regulators in recent periods

Regulator – Price Control	Sector	Years	Opex (%)	Capex (%)
ORR – PR13	Rail	2014-2019	-	0.4
Ofgem – RIIO-T1/GD1	Electricity and Gas Transmission	2013-2021	1.0	0.7
Ofgem – RIIO-ED1	Electricity Distribution	2013-2021	1.0	1.0
CMA Bristol Water – PR14	Water	2015-2020		1.0
Competition Commission (CC) – NIE	Electricity	2013-2017	1.0	1.0
The Utility Regulator (UR) – GD14	Gas Distribution	2014-2016	1.0	1.0
UR – PC15	Water and Sewerage	2015-2021	0.9	-
UR – GD17	Gas distribution	2017-2022	1.0	1.0
UR – RP6	Electricity	2017-2024	1.0	1.0
CAA - H7 (consultation phase)	Aviation	2020-2024	0.9	-

Productivity growth is relevant to both base and enhancement costs

Anglian Water argues against applying the frontier shift to enhancement costs, stating that “If totex incentives have any impact on expenditure, savings will likely manifest themselves in the form of companies not taking on capex at all but incurring opex instead.” They state that this will create a very different impact to a small reduction in the efficient cost of specific Ofwat-backed schemes, like building a new reservoir or a new treatment works.

We note that in response to our initial assessment, First Economics (John Earwaker) stated that in applying the uplift for totex and outcomes to base costs and not enhancement costs we were applying the uplift to the wrong part of costs, particularly as KPMG note their recommendation of an uplift relates to scope for totex reduction.

We continue to consider that there is scope for productivity growth in both base and enhancement expenditure. However, we note that recent evidence for a productivity uplift from the totex and outcomes framework is weaker than previously found as discussed below.

Application of frontier shift

In the draft determinations we applied frontier shift (and real price effects) to modelled base and some enhancement costs – the water industry national environment programme.

We have considered further whether our application of frontier shift to various cost elements is appropriate. In particular we are conscious that the frontier shift estimates developed by Europe Economics were for all costs, and not simply limited to part of base expenditure and part of enhancement expenditure.

In the draft determinations we did not apply frontier shift to unmodelled costs such as business rates and abstraction charges as we assumed current costs continued. However given that the frontier shift estimate is based on all costs in comparator industries (including business rates) then in our final determination we consider we should apply frontier shift (and real price effects) to all wholesale base expenditure.

In our final determination we consider we should apply the frontier shift (and real price effects) to elements of enhancement costs which are more common across companies including the wastewater water industry national environment plan (WINEP) and metering costs. This is because the potential gains from productivity improvements are likely to be more significant for large, relatively homogenous programmes of work that are more common across companies. We have reviewed company forecasts of frontier shift on enhancement costs. In general, we found that frontier shift assumptions on enhancement expenditure tend to be limited and are often offset by real price effect adjustments (where these are explicit). We therefore consider there is a case to apply frontier shift (and real price effect) adjustments to specific areas of enhancement costs which are more common and/or are part of large programme of work.

We do not apply a frontier shift estimate to other enhancement costs. We already make relatively large adjustments to other enhancement costs, where required, for lack of appropriate justification for cost efficiency and optioneering. We therefore consider that an additional frontier shift adjustment would not be appropriate.

We do not make a frontier shift adjustment for retail as this is based on forecast expenditure and already includes an around 10% reduction compared to historic expenditure (and so could be argued to include frontier shift efficiency with some companies forecasting large reductions in future costs).

We have also considered the time period over which we should apply our frontier shift and real price effects adjustments.

In our draft determination we proposed to apply the frontier shift challenge from 2020-21 onwards for relevant costs. However, our wholesale base cost models are based on data up to 2018-19. For unmodelled costs and metering and WINEP expenditure, our forecasts are based on business plan information from April 2019 (and from September 2018 for fast track companies). In each of these areas costs will therefore only take into account on-going efficiency improvements (and real price effects) up until 2018-19. If we only apply frontier shift and real price effects from 2020-21 onwards, this doesn't take into account on-going efficiency improvements and real price effects that take place in 2019-20. We therefore consider it appropriate to apply frontier shift and real price effects from 2019-20 for base and relevant enhancement costs.

There is some evidence that a lower uplift for outperformance of the totex and outcomes framework may be appropriate

Economic Insight raises concerns regarding potential double counting when adding an economy-wide uplift for the shift to a totex and outcomes framework. They also argue against Europe Economics' argument regarding additional industry catch-up following the introduction of the framework, arguing this relies on the following implicit assumptions being correct, for which there is no robust supporting evidence to support:

- The move to the totex and outcomes framework would result in a temporary period of faster productivity gains;
- Any temporary period of faster productivity gains: (a) has not already started and finished; and (b) will now be sustained until the end of 2025; and
- The comparator sectors have not experienced temporary periods of faster productivity gains for other reasons, such as technological change.

NERA also claims that Ofwat included a capital substitution effect alongside the impact of the totex and outcomes framework, which Europe Economics advised against.

In response to these comments, Europe Economics notes that there are reasons why the totex and outcomes framework introduced at PR14 allows water companies to achieve additional efficiency gains through innovation and lower cost solutions. In particular, the totex and outcomes framework allows for greater flexibility to optimise between opex and capex to reduce overall costs, and freedom for how companies achieve outcomes. A key reason why this is considered to be on top of the frontier shift is that there should also be a period of time in which the water sector makes additional “industry catch-up” efficiency gains as its input mix and approach to delivering outcomes are re-optimised, therefore moving the sector closer to the productivity levels that comparator sectors have already been able to achieve. This scope for a temporary period of faster productivity gains from re-optimisation is not open to the comparator sectors because their existing capex-opex balance has not been distorted by a historical capital bias. Since this temporary period of efficiency gains from re-optimisation is additional to ongoing frontier shift, Europe Economics considers that we are justified in adding an increment to the frontier shift to take account of these additional efficiency gains.

In terms of NERA’s comments regarding Ofwat’s inclusion of a capital substitution effect, Europe Economics confirms this was excluded when determining what uplift to apply for frontier shift for total expenditure.

Further work on the productivity uplift from totex and outcomes framework

At the draft determinations our assessment was that the combined “all-in” effect of ongoing frontier shift efficiency and the impact of the totex and outcomes framework was 1.5% per year for total expenditure. The 1.5% per year efficiency improvement was based on a range of factors including (but not limited to) the frontier shift efficiency ranges presented by both Europe Economics and KPMG, additional outperformance that can be attributed to the totex and outcomes framework (0.2%-1.2% per year based on work from KPMG), and weight placed on value-added measures of productivity. This efficiency challenge of 1.5% per year also took into account case study evidence of efficiency improvements made by water companies, and data regarding the efficiency performance of companies, and catch up opportunities to other sectors following privatisation.

However, more recent evidence on the outperformance of the totex and outcomes framework is weaker than previously found. The case for an additional efficiency

uplift from the shift to the totex and outcomes framework is less strong than at draft determinations.

Outperformance of the totex controls in energy has remained consistent in recent years as shown in table A3.4. However as shown in table A3.5, forecast outperformance in the water sector has declined, particularly for middle or average performing companies. This in part reflects a 6% overspend in 2018-19. There is evidence of company overspend in 2018-19 that suggests performance this year may not be illustrative of a typical year, or a true reflection of longer term costs, and outperformance may be higher than actually reported. For example, in their Annual Performance Report 2019, Hafren Dyfrdwy remark that cumulative totex outperformance from previous years has reduced in 2018-19, due to 'additional investment in water treatment and distribution asset base'. Thames Water state they have 'completely overhauled' their approach to leakage investing £378m in 2018-19. Anglian Water note that they have 'increased their planned investment by £165m over AMP6 to improve resilience and enhance service to our customers'.

The KPMG range was based on the median to upper quartile, factored down to account for declining returns based on experience from the energy sector.

Table A3.4: Forecast totex outperformance in the energy controls (equivalent % per year)

Timing	Electricity Distribution (ED1)	Gas Distribution (GD1)	Electricity Transmission (ET1)	Gas Transmission (GT1)
2016-17	1.0%	2.8%	2.1%	-1.6%
2017-18	1.0%	2.7%	2.9%	-1.5%

We consider that this suggests that there may be a case for lowering of the potential for overall frontier shift growth from our estimate of 1.5% per year, although we note that outperformance by better performing companies has remained little changed.

In addition we note that there are some factors that would indicate using a number towards the lower end of the range identified by KPMG. For example, not all outperformance in this period can be attributed to the totex and outcomes framework. There are also some factors that could indicate a figure towards the upper end of their range. For example, KPMG applies diminishing marginal returns to the totex and outcomes framework, however, evidence on diminishing returns from other sectors is mixed.

Table A3.5: Forecast water company totex outperformance (expressed as the equivalent outperformance per year)

	Time period	Mean	Median	Upper quartile
KPMG	2016-17	1.3%	1.2%	2.7%
Ofwat	2015-17	0.9%	0.6%	2.5%
Ofwat	2015-19	0.3%	0.3%	2.4%

Note: KPMG figures are based on earlier data than the Ofwat 2015-17 range and were adjusted for out- and under-performance due to external factors such as rates rebates.

Given we are focusing on productivity growth from the totex and outcomes framework, outperformance from earlier price controls is not relevant, and there are significant flaws in the Economic Insight analysis

Economic Insight, on behalf of Anglian Water, Dŵr Cymru and Yorkshire Water, argue that there have not been previous periods of outperformance that need to be reset, and therefore there is no rationale for requiring a step change in performance. To support this Economic Insight provide water sector Returns on Capital Employed (RoCE) data between 2006 and 2019.

Our assessment of frontier shift is not based on a reset for outperformance from previous price controls. As discussed earlier, we are simply considering the potential for ongoing frontier shift improvements, together with taking account of further productivity improvements from the totex and outcomes regime. As the totex and outcomes regime was only introduced in PR14, we consider it most appropriate to focus on outperformance in the PR14 period only.

We consider that there are flaws in the Economic Insight analysis which understate the scale of outperformance in PR14 for RoCE. Economic Insight's calculations for RoCE in PR14 are substantially below our expectations. Based on annual performance reports the PR14 outturn RoCE has been 5.7% including "other income" (or 5.2% excluding "other income"), compared to a 3.7% allowed return on capital. However, Economic Insight suggest a RoCE of 4.2%.

Economic Insight suggest that the average outturn Return on Regulatory Equity (RoRE) (weighted by average RCV for each company in each year 2015-18) is 6.2%, compared to a similarly weighted average of base RoRE of 5.6%, where base RoRE is the equity return in the allowed cost of capital. This demonstrates a level of

outperformance. This outperformance is higher on an unweighted basis given the poorer performance of some of the larger companies (an average (unweighted) RoRE of 6.6% versus a base RoRE of 5.8%).

RoRE analysis considers outperformance across totex, outcomes and financing. For the purposes of cost efficiency analysis we consider that it is most relevant to focus on totex out and under performance rather than overall RoRE. As set out in Table 5 above companies have on average outperformed their wholesale totex allowance during the PR14 period.

Changes in bills are in line with previous price controls

We have also reviewed Economic Insight's claim that our overall level of stretch on bills is more significant than in previous periods.

Table A3.6 shows the level of stretch we have imposed on company bills in previous price reviews, as well as at draft and final determinations for PR19, based on the same information used by Economic Insight. The table compares the level of stretch on bills at our final determination relative to final company business plans. Relative to the maximum challenge imposed from PR04 to PR14, our PR19 final determination bills are less than or equal to previous challenges we have imposed for 12 out of 16 companies, as shaded in **green**.³⁰ This suggests our level of stretch on bills is in line with previous levels of stretch for the majority of companies. It should be noted that the largest part of the reduction in bills stems from the reduction in the cost of capital, which reflects prevailing market conditions, rather than any interventions on cost efficiency or levels of investment.

³⁰ HDD is excluded as this is historical analysis.

Table A3.6: Overall level of stretch on bills in comparison to company plans

	PR04	PR09	PR14	Max challenge PR04 to PR14	PR19 draft determination	PR19 final determination
Anglian Water	-4%	-5%	-3%	-5%	-12%	-8%
Dŵr Cymru	-4%	-1%	0%	-4%	-9%	0%
Northumbria n Water	-6%	-2%	-1%	-6%	-7%	-6%
Severn Trent Water	-6%	-1%	-1%	-6%	-1%	-2%
South West Water	-2%	-1%	0%	-2%	-1%	-7%
Southern Water	-7%	-3%	-5%	-7%	-8%	-9%
Thames Water	-9%	-6%	-8%	-9%	-8%	-3%
United Utilities	-10%	-5%	-4%	-10%	-2%	-1%
Wessex Water	-6%	3%	-5%	-6%	-8%	-5%
Yorkshire Water	-1%	0%	-2%	-2%	-10%	-4%
Affinity Water	-9%	-10%	0%	-10%	-12%	-7%
Bristol Water	-11%	-11%	-21%	-21%	-11%	-8%
Portsmouth Water	-13%	-6%	1%	-13%	-7%	-1%
South East Water	-8%	-7%	-3%	-8%	-9%	-5%
South Staffs Water	-3%	-5%	-6%	-6%	-10%	-1%
SES Water	-16%	-13%	-5%	-16%	-11%	-6%

A3.2 Real price effects

Real price effects are a measure of how much we expect water company costs to change due to input price inflation, relative to the indexation we use in price controls. Key input prices for water are labour, energy and material costs. In PR19 we will index wholesale controls to the Consumer Prices Index including owner occupiers' housing costs (CPIH) as a measure of inflation. Hence any real price effects for wholesale expenditure will be additional to the change in CPIH and are based on a comparison of the growth of the relevant input price relative to CPIH.

At the initial assessment and draft determinations, we commissioned Europe Economics to examine the evidence available on the need to make allowances for real price effects. Their report, and our corresponding assessment of real price effects has been finalised for the final determinations, including addressing points raised by companies and their consultants in their responses to our draft determination.

In this section we first present our final determination assessment, then summarise changes since our draft determination, followed by stakeholder representations regarding our draft determination. Finally we outline our assessment and reasons, including responses to stakeholder representation.

11.6.5 Our final determination decision

Overall we consider that, given the protections available to companies and the information asymmetry between companies and Ofwat, there needs to be a compelling case for making an allowance for real price effects. Based on the report prepared by Europe Economics and further analysis we have conducted, we consider we should make a real price effect adjustment for labour costs only.

We continue to consider that we should include a real price effect adjustment for wages. Based on updated evidence from companies, we have increased the labour cost share to 38.6% of wholesale costs.

We consider that this should be based on OBR real wage forecasts with a true up for ASHE hourly manufacturing wages at the end of the period.

- The reliability of OBR forecasts is uncertain. Europe Economics' analysis of the accuracy of previous forecasts identifies that the OBR has systematically overestimated average earnings growth and therefore reliance on these forecasts could lead to an upward bias in any estimated real price effect adjustment.

- A labour real price effect should be true up at the end of the period to account for any over or underestimation by the OBR to avoid year on year fluctuations.
- Manufacturing is an appropriate benchmark for a true up as manufacturing and water sector labour markets are similar and often involve similar skills and expertise. Manufacturing wages also show a close correlation to water sector wage growth, and so should reflect similar cost pressure.
- The ASHE manufacturing wage index appears to be the most appropriate index for the true up as it provides wages on an hourly basis which allows for the real price effect to be isolated. Other manufacturing wage indices report weekly wages (so indices are impacted by changes in working hours as well as real price effects). The wages true up for the final determinations will adjust for the difference between the real wage growth assumed in the determinations and the outturn manufacturing wage growth. The true up will be based on the labour costs proportion assumed in our final determination, and the forecast cost allowances for the price control period.

Real price effects allowances have not been made for any other costs due to a range of factors. These include a lack of a significant historical wedge between the cost element and CPIH, the lack of a substantial wedge between the forecast costs and CPIH, the extent to which management can control the cost and the extent to which the cost is already captured in CPIH. Further details on the specific reasons why real price effects allowances are not made for other costs is provided below.

11.6.6 Changes from our draft determination

We revise the proportion of wholesale totex that labour costs account for from 35% to 38.6%. This follows a query process where all companies were given the opportunity to revise their cost shares.

We provide further detail on our true up mechanism for labour real price effects at the end of this annex.

11.6.7 Stakeholders' representations

In their response documents to our draft determinations, several companies and their consultants submitted reports regarding Europe Economics assessment of real price effects. These reports included:

- *Response to Ofwat's Draft Determination on Real Price Effects and Frontier Shift - Prepared for Bristol Water, NERA Economic Consulting, 23 August 2019*
- *Gross Input Price Inflation: Updated wholesale and retail forecasts – for Wessex Water, Economic Insight, July 2019*

The key points raised by companies in their draft determination representations, and their consultants in the reports listed above are summarised and grouped below:

Real price effects assessment framework

1. Evidence required for a real price effect allowance - companies state we set unnecessary requirements to show that the prices of the inputs are expected to evolve differently than inflation and that real price effects allowances should be based on 'best estimate' rather than a 'compelling' case. Companies also argue they do not have an 'information advantage'.
2. Subjectivity of framework - companies criticise the framework for assessing whether costs are outside management control and argue the framework is subjective and irrelevant for assessing the case for real price effects.

Allowance for labour costs

3. Labour cost share – companies state that using a labour cost share of 35% may be too low.

Allowance for other costs

4. Real price effects allowances for other costs - companies state that there should be a real price effect and true up for energy costs given forecast real price increases and high historical variability. Companies also argue real price effect allowances are required for other cost categories such as chemicals and materials, plant and equipment.

True up for labour costs

5. True up index for labour - companies suggested that manufacturing wage growth should not be used as a proxy for water and sewerage sector wage growth as it covers unrelated sectors, manufacturing wages will be adversely impacted by Brexit uncertainty which will not affect the water sector and the lack of evidence around a historical correlation between manufacturing and water sector wages. As an alternative companies suggest alternative measures such as all earnings, private sector wages and water sector wages.

6. True up for frontier shift - companies argue there should not be a true up for labour costs as there is no true up for frontier shift (note a similar point regarding true up for productivity growth is responded to in section A3.1).

Responses to the stakeholder representations above are provided in the sections below.

11.6.8 Our assessment and reasons

At the draft determinations we stated that companies needed to make a compelling case for an allowance for real price effects to be made. This is because of information asymmetry (as water companies are more likely to tell us that costs will go up rather than down) and that water companies already benefit from a range of protections not provided to companies that operate in other parts of the economy. These include CPIH indexation of revenues, cost sharing with customers, five yearly price control reviews, interim determinations and substantial effects provisions.

In the final determination our assessment is consistent with that at the draft determination. We are allowing for a real price effect for wage costs with a true up based on outturn manufacturing wages given the uncertainty in the OBR forecasts. We do not allow a real price effect for other costs. Further detail on our assessment and response to stakeholder representations is presented below.

Europe Economics work on real price effects at final determination

Following a review of stakeholder representations regarding our draft determinations, Europe Economics has finalised its assessment of whether it would be appropriate for Ofwat to make a real price effects allowance for labour, energy, chemicals and materials, plant and equipment costs.

Table A3.7 outlines Europe Economics' assessment of real price effects at final determinations. The outcome of their final assessment, which reflects comments from companies and their consultants on their initial and revised assessment, is a potential allowance for real price effects in labour and energy, depending on the reliance placed on forecasts made by the OBR (on labour) and BEIS (on energy), and on pre-2010 data (on energy). The remainder of this section outlines the assessment approach taken by Europe Economics and summarises its findings.

Europe Economics has finalised its structured framework to assess the case for real price effects, and assesses three criteria, one with two sub-criteria (1a and 1b):

1. Is there a significant likelihood that the value of the wedge between the input price and CPIH will differ substantially from zero over the period of the price control?

- a) **Is the expected value of the wedge between the input price and CPIH materially different from zero?**
- b) **Does the wedge between the input price and CPIH exhibit high volatility over time?** This could occur because the cost exhibits sufficient variability such that over the course of a five-year control period the wedge may differ substantially from zero. Europe Economics uses a wedge of 1% over a five year period as a threshold.

2. Are there sufficient and convincing reasons to think that CPIH does not adequately capture the input price? Europe Economics compares the share of a cost item in wholesale totex with the share of the most relatable cost item(s) in the CPIH basket. If the share is similar in both then CPIH indexation should already capture the evolution of the cost item.

3. Is the input price and exposure to that input price outside management control during the duration of the price control? Europe Economics considers the scope of management strategies to either substitute to alternative inputs, investing in new technologies and/or signing long-term contracts to reduce exposure to future price movements.

Each criterion (1A/1B, 2 or 3) is scored as a pass or fail (or a partial pass). If a cost fails any of the criteria (1A and 1B, or 2 or 3), a real price effect adjustment should not be considered.

Table A3.7 Europe Economics real price effects assessment at final determination

Cost item	Labour	Energy	Chemicals	Materials, plant and equipment
1A. Is there a significant likelihood that the value of the wedge between the input price and CPIH will differ substantially from zero over the period of the price control? Is the expected value of the wedge between the input price and CPIH materially different from zero?	Depends on whether reliance is placed on OBR forecasts. No historical statistically significant wedge. There is a material wedge in OBR forecasts although forecasts have been tended to over predict wage growth	Depends on whether reliance is placed on BEIS forecasts and weight placed on pre-2010 data. The evidence of a historical wedge depends on the choice of time period. BEIS forecasts show a material wedge going forwards. However historical forecasts show a significant difference to outturns.	Fail. No historical statistical significant wedge and wide variation in company forecasts.	Fail. There is mixed evidence. For some indices, there is evidence of a positive real price effect but in other cases, there is no evidence of a statistically significant wedge. Some water sector input costs have shown a negative wedge and some companies propose a zero or negative wedge for this cost item.
1B. Is there a significant likelihood that the value of the wedge between the input price and CPIH will differ substantially from zero over the period of the price control? Does the wedge between the input price and CPIH exhibit high volatility over time?	Fail. Labour costs wedge is below 1% of wholesale totex (-0.7 to +0.9% for ICLH index and -0.4 to +0.6% for AWE index and -0.1 and +0.5% for ASHE index).	Depends on whether weight is placed on pre 2011 data. Wedge is above 1% of totex based on pre 2011 data but below 1% since then.	Fail. Wedge is -0.1 to +0.1% of wholesale totex.	Fail. Most volatile index is construction price index, which has a wedge between -0.3 to +0.6% of wholesale totex.
2. Are there sufficient and convincing reasons to think that CPIH does not adequately capture the input price?	Pass. There is no discrete item for labour costs in the CPIH basket.	Partial Pass. Energy (including other fuels) share in CPIH is 5.2 per cent, however the estimated share of energy costs in water company totex is 9.0 per cent. Therefore CPIH does not fully capture	Pass. There is no explicit category for chemicals in the CPIH basket, and the closest categories that are included (cleaning equipment and cleaning and maintenance products) would also include	Partial Pass. CPIH categories include housing and DIY equipment, purchase of vehicles, relevant spare parts and the maintenance and repair of those vehicles. These items have a CPIH basket

Cost item	Labour	Energy	Chemicals	Materials, plant and equipment
		changes in energy input prices.	equipment and bear little resemblance to chemicals purchased by water companies.	weight of 15.5%. However, the read across from materials, plant and equipment to the CPIH basket may not reflect water company activities.
3. Is the input price and exposure to that input price outside management control during the duration of the price control?	Partial pass. While there is no evidence that water companies have market power in labour markets, there are a number of ways they can reduce their exposure to labour costs, for example through long term contracts.	Partial pass. There are a number of mechanisms for companies to reduce exposure to changes in energy costs, although a material element remains outside management control.	Pass. While some substitution between chemical products might be possible, moving away from chemical products entirely seems largely outside management control.	Partial Pass. Companies can sign long-term contracts that cover multiple regulatory control periods, therefore can insulate themselves from volatility in the prices within a given price control period.
Overall	Depends on whether reliance is placed on OBR forecasts	Depends on whether reliance is placed on BEIS forecasts, and on weight placed on pre-2010 data	Fail	Fail

Real price effects assessment framework

Companies raised a number of comments related to Europe Economics real price effects assessment framework. These comments and our responses are summarised below.

There should be sufficient and convincing evidence to allow for a real price effect

In its draft determination response, Thames Water argues we set unnecessary requirements to show that the prices of the inputs are expected to evolve differently than inflation. Dŵr Cymru states that companies do not have an 'information advantage' as real price effects analysis is based on historical macroeconomic data.

NERA states that our statement that some companies do not assume a significant real price effects adjustment contradicts Europe Economics analysis.

In response to NERA's point, Europe Economics confirms that some companies propose zero or negative real price effects, while others propose they will be positive.

In terms of unnecessary requirements, Europe Economics states that Thames Water mischaracterises their approach as requiring companies both to show that a wedge existed in the past and that it will exist in the future. However, this is not the case, as Europe Economics recognises that a reliable forecast of a wedge might provide evidence of a real price effect even if a wedge has not existed historically (e.g. in the case for labour).

Regarding the information advantage, Europe Economics agrees that historical macroeconomic data is readily available however companies clearly have a potential information advantage when it comes to the potential evolution of their own input prices. Companies have not provided their own input price information in support of their input price inflation forecasts.

In response to Thames Water's comments regarding the information and evidence threshold. To avoid misunderstandings Europe Economics has revised the terminology for criterion 2 so that it now reads "are there *sufficient and convincing* (rather than compelling) reasons to think that CPIH does not adequately capture the input price?" The underlying basis for the assessment is unchanged. Information asymmetry means companies have an incentive to argue where prices might increase but not if they are forecast to decrease (and note the significant over forecast of real price effects in the RII01 controls). We therefore consider it is important to set a reasonably high bar for making an adjustment.

Given the significant outperformance of real price effect assumptions in the Ofgem RII0-1 energy controls and the potential detriment to customers, we consider that there should be sufficient and convincing evidence of a real price effect before we allow for an adjustment.

Management control is an important way to mitigate real price effects

NERA criticises Europe Economics framework for assessing whether input costs are outside management control and argues the framework is subjective and irrelevant for assessing the case for real price effects.

Europe Economics disagrees with this claim. It states that if management can mitigate input price increases then a real price effect allowance (or at least a full real price effect allowance) may not be needed. Europe Economics outline a clear typology of ways in which companies may be able to limit their exposure to increases in input prices, for example through input substitution, provide a structured framework for the assessment of management control and note that NERA has not provided detail on why companies are not able to limit their prices in the ways suggested by Europe Economics. We continue to consider that management control is an important way to mitigate real price effects.

Allowance for labour costs

We have revised our labour cost share estimate to include contractor costs

Anglian Water and Dŵr Cymru state that Ofwat's figure of 35 per cent for the share of labour in totex may be biased downward, due to labour costs of contractors being included in the "other" category.

In response to this we queried the labour cost shares of all companies. Some companies included labour costs of hired and contract services in their labour cost share, while other companies had not (and likely they are captured in "other" costs). We have revised our calculation of labour costs to include all labour costs regardless of whether they are directly employed or part of a contract. This increases the labour cost share to 38.6%.

Other comments relating to labour costs are specific to the true up mechanism and are addressed later in this section.

Allowance for other costs

There is insufficient evidence that a real price adjustment is required for energy

For energy costs, which represent approximately 10% of water company costs gross and 9% net, in the draft determinations we rejected a real price adjustment due to concerns over the small scale of any potential uplift, the lack of a significant wedge over recent years and the uncertainty in the BEIS electricity forecasts. Companies responded with concerns that we had used an inconsistent approach with labour real price effects where there was also uncertainty in the forecasts and implicitly we had introduced a materiality threshold for real price effects.

In their draft determination representations, Anglian Water, Thames Water, Yorkshire Water and Bristol Water argue there should be a real price effect for energy given forecast real price increases and high historical variability. They argue that by rejecting an allowance for energy we have effectively retained the materiality threshold that was dropped from Europe Economics' analysis. NERA also argues our concerns about the unreliability of BEIS forecasts and Brexit contradict our conclusion on labour real price effects.

In response to company representations, we have reviewed whether there is a case for a real price effect for energy. There is some evidence to suggest that we should allow a real price effect for energy. For example:

- There is evidence of wedge of up to 10% in the last year (2018-19) – see figure A3.1, although there is mixed evidence of a wedge since 2010.
- The latest BEIS electricity forecast a wedge of 0.7% per year between 2020 and 2024 – see Table A3.8.

However, there is also evidence to suggest we should continue to not to allow a real price effect adjustment for energy, which includes the following:

- There is mixed evidence of a historical wedge which depends on the period of analysis.
- Energy costs are partially within management control, particularly the option to sign up to fixed energy tariffs to minimise exposure to price fluctuations, although these contracts are usually only for 1-2 years. Other mechanisms such as payment arrangements, increased energy generation by the companies themselves, timing of energy use and improved energy efficiency can assist companies to reduce costs through reduced consumption and minimising exposure to price fluctuations.
- There is significant uncertainty about forecasts of energy price, particularly as BEIS forecasts have repeatedly failed to provide accurate forecasts of energy costs in the past. This reflects the volatility of energy prices and interactions with global markets.
- Some energy costs are reflected in CPIH. Europe Economics presents evidence that CPIH partially captures the impact of changes in energy costs as the total share of energy (including other fuels which tend to move in line with energy prices) in CPIH is 5 per cent. Therefore CPIH indexation will in part reflect increases in electricity prices.

- Water companies produce as well as consume energy, reducing the net impact of energy prices. They also produce biofuels whose value will be linked to energy prices.
- Unlike labour costs, there is no clear theoretical link between energy costs and productivity growth.
- Some water companies do not assume a real price effect adjustment or assume that any adjustment would be very small.
- There are a number of protections within the price control such as cost sharing which provide additional protections to water companies.
- Unlike labour costs, the potential wedge is much smaller, equivalent to less than 0.1% of costs over the period based on BEIS forecasts, not taking account of the impact of cost sharing.
- Companies are moving towards their target of net zero carbon emissions during the 2020 to 2025 period, for example, Yorkshire Water will increase the amount of renewable energy it generates from biogas by 15%, and South East Water will reduce its carbon emissions by 68%. To do this water companies are using [a range of measures](#) including greater water efficiency, buying green energy, generating renewable energy, planting trees and working with their supply chain. These measures could have a substantial impact on energy usage in the sector

and therefore mitigate real price effects. Overall and on balance, for the reasons given above, we consider that we should not make a real price effect adjustment for energy costs.

Figure A3.1: Annual wedge between the electricity price index and CPIH, 2006Q1 - 2019Q2

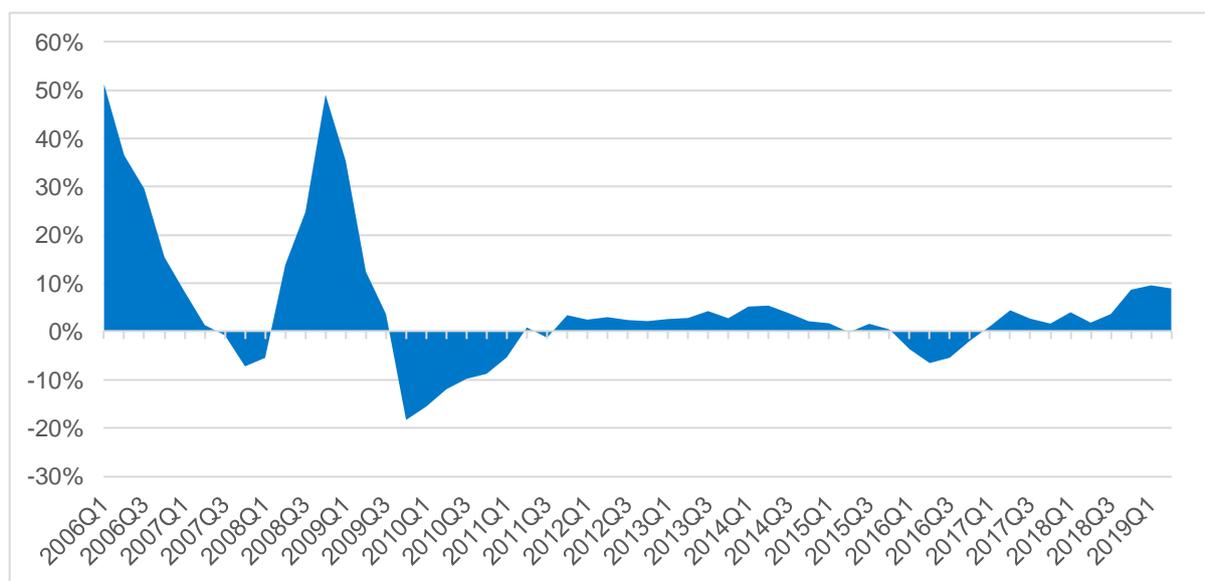


Table A3.8: BEIS electricity price forecasts

Scenario	Percentage change		
	Low	Reference	High
2020	0.6%	0.5%	3.0%
2021	0.8%	0.8%	-0.9%
2022	-1.4%	-0.2%	-0.8%
2023	0.6%	0.1%	-0.6%
2024	1.6%	2.4%	2.2%
Average % per year (2020-24)	0.4%	0.7%	0.6%

There is insufficient evidence that a real price adjustment is required for chemicals

Yorkshire Water claims that the ONS index used to assess chemical costs covers a wider range of chemicals than the ones actually used by companies and hence it may not be the most accurate index to use.

We continue to consider that we should not allow for a real price effect adjustment for chemical costs. While Yorkshire Water argues that the price indices that we consider do not reflect water company chemical costs, they do not suggest an alternative and other water company consultants have used the same indices (“Chemicals and Chemical Products” producer price index) as we do.

Europe Economics responds to Yorkshire Water’s comments by also examining another independent third party forecast on chemicals, the World Bank Commodities Price Forecast published in April 2018. The data implies negative wedges ranging from 1.1% to 2.7% for the chemicals sector globally. However, given that these are global estimates by the World Bank and only available for a few specific types of chemicals, we place less weight on these forecasts than the historical wedge analysis.

There is insufficient evidence that a real price adjustment is required for materials, plant and equipment

Dŵr Cymru and Yorkshire Water claim that there should be a real price effect for materials, plant and equipment costs as three of the available indices show a statistically significant wedge.

We agree that three of the indices we have considered show a real price effect, but the other three do not. Given half the indices do not show a real price effect, and the lack of a material wedge in water company forecasts, we do not consider there is sufficient and convincing evidence for us to make a real price effect allowance. Additionally, some companies have proposed a zero or negative real price effect for this cost component, suggesting efficient companies can limit input prices in this area to no more or less than CPIH.

Index for real price effects true up

Anglian Water, Dŵr Cymru, United Utilities and Yorkshire Water suggest that manufacturing wage growth should not be used as a proxy for water and sewerage sector wage growth as it covers unrelated sectors, manufacturing wages will be adversely impacted by Brexit uncertainty which will not affect the water sector and the lack of evidence around historical correlation between manufacturing and water sector wages. As an alternative, companies suggest measures such as all earnings (Dŵr Cymru), private sector wages (Anglian Water) and water sector wages (United Utilities).

We continue to consider that we should include a true up for real price effects for labour costs based on manufacturing wage index.

In the draft determinations we suggested that the true up on labour cost real price should be based on manufacturing wages, as opposed to all employees as:

- there is a higher correlation between manufacturing and water and sewerage wage growth; and
- manufacturing and water sector labour markets have similarities and often involve similar skills and expertise.

We continue to consider that using all employees is not a useful index. In particular it covers unrelated sectors such as public sector wages which reflect government policy rather than industry wage pressures.

We consider using water sector wages will create perverse incentives on water companies, particularly for larger water companies. This is because any increase in their wage rates would feed through into the index and increase their allowed revenues, thereby reducing companies' incentive to control wage rates. No such incentive problems arise if data from the overall economy or the manufacturing sector is used, as water companies do not have control over these input prices.

We therefore consider whether we should use:

- private sector wages - as suggested by Anglian Water, which avoids some of the problems of using all employees as it excludes public sector wages; or
- manufacturing wages, and
- which of the alternative statistical measures we should use as the basis for the true up.

To identify which measure to use Europe Economics considers the following issues on the coverage of any wage index used to true up for real price effects:

- True up relative to the OBR wage forecast or true to isolate pure price effects - Isolating pure price effects as we are trying to identify the underlying wage pressure relevant for the water sector which is outside management control.
- Hourly or weekly wages - Hourly wages of employees as this controls for changes in the numbers of hours worked.
- Mean or median earnings – Mean earnings as the true up is applied to total labour costs, which is a function of mean earnings and number of employees.
- All or full-time employees – All workers as the water sector employs both full and part time workers

- Including or excluding overtime – Including overtime to reflect overall earnings, which includes all forms of compensation.

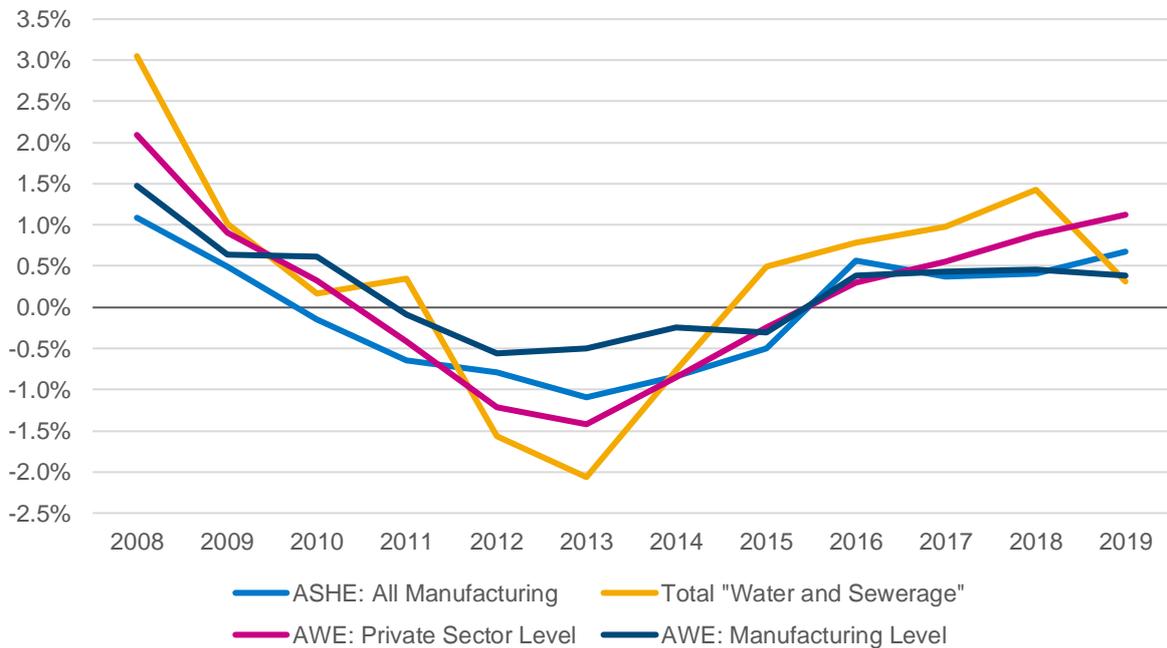
There are three main data sources for earnings data:

- Annual Survey of Hours and Earnings (ASHE), a national statistic, which covers hourly and weekly earnings and covers manufacturing;
- Average Weekly Earnings (AWE), a national statistic, which only covers weekly earnings and covers manufacturing and private sector wages; and
- Index of Labour Cost per Hour (ILCH) – which is an experimental statistic, and the ONS notes that “users have commented on the volatility of ILCH”.

We therefore consider that AWE or ASHE measures of wages are preferred. Overall we consider that ASHE manufacturing wages is preferred because:

- The correlation between private sector and manufacturing wages and water sector wages is similar;
- The ASHE index is a more reliable measure as AWE is carried out at an aggregate level, rather than an employee level; and can be impacted by the number of people joining or leaving an organisation;
- Manufacturing wages are a better reflection of wage pressure in the water sector given the similar skills sets and labour markets; and
- ASHE allows identification of hourly wages.

We therefore intend to true up using ASHE all employees, mean manufacturing hourly wages, including overtime.

Figure A3.2: Five year trailing average mean weekly pay - Real yearly growth**Table A3.9: Correlation coefficient of five year average real growth**

	Correlation coefficient
ASHE: All Manufacturing	0.86
AWE: Private Sector	0.92
AWE: Manufacturing	0.88

11.6.9 Assumptions for real price effects analysis

As set out above, we include a real price effect adjustment for wage rates. This is based on OBR assumptions of productivity growth and average hourly wages and consumer price inflation. We assume that labour accounts for 38.6% of costs. This has been revised up from 35% at our draft determinations, based on updated company information provided in their draft determination representations.

Table A3.10: Assumptions for real price effects

Year	OBR average hourly earnings growth (%)	OBR productivity growth (%)	OBR CPI growth (%)	Real hourly wage growth	Real input price inflation
2019-20	3.0%	0.9%	2.0%	1.0%	0.37%
2020-21	3.0%	1.0%	1.9%	1.1%	0.44%
2021-22	3.1%	1.2%	2.0%	1.1%	0.43%
2022-23	3.2%	1.3%	2.0%	1.2%	0.45%
2023-24	3.3%	1.3%	2.0%	1.3%	0.50%
2024-25		1.4%		1.4%	0.54%

Source: Economic and fiscal outlook, supplementary economic tables, March 2019, apart from 2024 where labour productivity figures are taken from long term economic determinants, March 2019. For 2024 have used labour productivity rather than average hourly earnings growth as this shows greater consistency with figures for earlier years.

Annex 4: Summary of remaining representation on our approach to environmental obligations

WINEP/NEP Wastewater

Investment area	Company	Summary of Representation	Our assessment and decision
General	Anglian Water	Our standardisation of the output from log-log models is inappropriate	We retain our approach to adjusting the output of our log-log models by the ratio of input (actual) to output cost estimates. We consider that this approach is sufficiently accurate for models of good quality, is transparent and easy to understand.
Flow monitors	Anglian Water	Company considers that the industry unit cost data for flow monitoring contains 'implausible variations'.	We consider the use of median unit costs, rather than mean unit costs, appropriate in instances where there are industry outliers, and we retain this modelling approach using itemised data confirmed in query responses from all companies.
Event duration monitors	Anglian Water	Company considers that the industry unit cost data for flow monitoring contains 'implausible variations'.	We consider the use of median unit costs, rather than mean unit costs, appropriate in instances where there are industry outliers, and we retain this modelling approach using itemised data confirmed in query responses from all companies.
STW storage model	Anglian Water	Our weighting between models for storage at sewage treatment works is arbitrary	We do not accept Anglian Water representation on the storage scheme for Sewage treatment work. We consider that the 50:50 weighting, whilst a judgement, reflects simply the fact that both models have a similar level of statistical robustness.
Network storage model	Anglian Water	The company considers that our model for Network storage solutions should have been in the log-log form and the variable 'number of sites' should have been	We accept that there is logic in Anglian Water's representation relating to the log-log form and that the variable number of sites could have been included in order to better account for the distribution of sites within company's

Investment area	Company	Summary of Representation	Our assessment and decision
		included in order to better address economies of scale,	programmes. We accept that there is some validity to these representations, and make an adjustment to the company's allowance as a result.
Wastewater Investigations	Hafren Dyfrdwy	Remove the low materiality items from their NEP uncertainty mechanism.	Representation accepted
Wastewater investigations	Northumbrian Water	Application of cost efficiency challenge	We retain our optioneering challenge to the wastewater investment cost for Northumbrian Water. The company does not evidence a clear link between the measures specification for this work and their requested costs.
UV Disinfection	Southern Water	Application of costs efficiency challenge	Southern Water provided further information to evidence their costs for the UV disinfection programme.
Phosphorus removal and Network storage schemes	Southern Water	Error in feeder models are draft determinations	We have removed the underpayment and overpayment errors in these feeder models.
Chemicals Removal programme	Thames Water	Model did not adequately account for no-deterioration schemes in setting allowances	We accept the representation from Thames Water on our allowance for their chemical removals programme. We carry out a deep dive and made an allowance that also accounts for the population equivalent served by the works with a 'no-deterioration' driver.
Event duration monitors	Wessex Water	Wessex Water made a representation for permit costs which were omitted from their April 2019 submission	The event duration model considers permit costs separately and we make an allowance for Wessex Water based on the industry median unit cost for permitting.
Wastewater Investigations	Wessex Water	Application of the efficiency challenge	We accept the representation from Wessex Water for their wastewater investigations allowance based on the further information provided to evidence their costs.
Flow to Full Treatment	Wessex Water	Our flow to full treatment model did not properly represent the costs of its two largest schemes (at Bristol (Avonmouth) STW	We accept there is some validity in Wessex Water's arguments and for the final determination remove Avonmouth from the Flow to Full Treatment model. We make an

Investment area	Company	Summary of Representation	Our assessment and decision
		and Bath (Salford) STW) due to their scale, complexity and exceptional characteristics.	adjustment to Wessex Water's modelled allowance assuming that this scheme is delivered at the same cost efficiency as implied by the new model for the remainder of the company's Flow to Full Treatment programme. Other than making a cost adjustment in respect of a new access bridge, we do not accept Wessex Water's argument that the Salford scheme should also be removed from the model. The removal of the data for Avonmouth from our model improves its fit and results in changes in the modelled allowances for all companies. The change for Severn Trent Water is material largely as a result of correcting an error in a cost driver used at draft determination.

WINEP/NEP wholesale water

Investment area	Company	Summary of Representation	Our assessment and decision.
General - Water	<ul style="list-style-type: none"> • Anglian Water • Bristol Water • South East Water • Southern Water 	Companies consider the application of the company-specific efficiency challenge is not justified	Our justification of applying the company-specific efficiency challenge is set out in section 4.1.
Drinking Water Protected Areas	<ul style="list-style-type: none"> • Affinity Water • Hafren Dyfrdwy • Northumbrian Water • Yorkshire Water 	Treatment of the metaldehyde ban	We look for evidence that companies consider the impact of the proposed metaldehyde ban on allowances. We have not allowed for any investment as we consider that the ban will be reintroduced. We have included a separate uncertainty mechanism for identified costs should the ban not be reintroduced.
Drinking Water Protected Areas	Affinity Water	Funding work to progress the development of options to address potential licence reductions in the river Brett catchment.	We make an allowance to investigate solutions to mitigate abstraction licence changes in the Brett region. The investigations will further determine the suitability of the preferred option for delivery via the DPC approach.

Investment area	Company	Summary of Representation	Our assessment and decision.
Invasive non-native species	<ul style="list-style-type: none"> • South East Water • Southern Water 	Joint representations to support their requested investment for a scheme to mitigate the risk of transfer of invasive non-native species between the Bewl and Darwell reservoirs. The companies provided a late submission after our August 2019 deadline. We are fully satisfied with the information provided by South East Water and we allow their costs. We also make an allowance for Southern Water for them to address this environmental obligation although they did not request any investment in previous submissions. However, we make an adjustment to their costs as their plan was not sufficiently detailed, particularly relating to evidence that their costs were efficient.	
Water - Eels	South Staffs Water	Further information provided on their programme relating to the protection of eels.	For final determination we review the additional evidence provided by South Staffordshire Water and we increase our allowance as a result.
Water Framework directive measures	South Staffs Water	Representation for additional investment for amber WINEP schemes that were excluded by the company at draft determination due to uncertainties.	We include the additional amber scheme requested by South Staffordshire Water in our assessment and allow the scheme costs arising from our deep dive assessment.
Water Framework directive measures	Thames Water	Hawridge and Bexley schemes had costs inappropriately reduced due to an implicit allowance in base costs.	We consider that both Hawridge and Bexley schemes include uprated/upgraded mains and upgrade to boosters and a significant element of implicit allowance should be excluded from these costs. We note that these scheme costs are not based on specific site surveys and definitive solutions. Therefore, we consider that there is a significant level of cost uncertainty and continue to apply an optioneering challenge and the company deep dive efficiency challenge to costs.

Annex 5: Cost adjustment claims submitted by companies in PR19

Company	Claim name	Amount requested	Our assessment	Amount allowed
Anglian Water	Maintain frontier leakage performance	136.9	Reject	0.00
Anglian Water	Sludge transport	17.6	Reject	0.00
Anglian Water	Capital maintenance	238.0	Reject	0.00
Anglian Water	Smart metering	42.4	Reject	0.00
Dŵr Cymru	Improving acceptability of water	27.2	Reject	0.00
Dŵr Cymru	Maintaining reservoir safety	69.5 (net)	Partial accept	75.5 (gross)
Dŵr Cymru	Cwm Taf Water Supply Strategy	73.0	Partial accept	13.6
Dŵr Cymru	Welsh language service retail costs	7.8	Reject	0.0
Hafren Dyfrdwy	Reducing lead in water networks	2.9	Accept	2.9
Hafren Dyfrdwy	Enhancing biodiversity and well-being in water resources	1.9	Partial accept	0.9
Hafren Dyfrdwy	Maintaining reservoir safety	4.3	Partial accept	2.8
Northumbrian Water	Reducing flooding risk for properties	86.0	Reject	0.0
Severn Trent	Enhancement expenditure for Water Industry National Environmental Programme	398.6	Reject	0.0
Severn Trent	Environmental investigations and mitigations for supply demand balance	84.1	Reject	0.0
Severn Trent	New supply schemes for supply demand balance	218.2	Reject	0.0
Severn Trent	Energy price increases	185.0	Reject	0.0
Severn Trent	Water resilience	135.4	Reject	0.0
Severn Trent	Security	67	Reject	0.0
Severn Trent	Economies of scale in water treatment works	0.0	Reject	0.0
Severn Trent	Economies of scale in sewage treatment works	72.0	Reject	0.0

Company	Claim name	Amount requested	Our assessment	Amount allowed
Severn Trent	Developer services costs	258.0	Reject	0.0
Severn Trent	Water treatment complexity	55.0	Reject	0.0
Southern Water	Thanet Groundwater protection	32.9	Partial accept	30.0
Southern Water	Improving bathing waters beyond statutory requirements	21.3	Partial accept	20.6
South West Water	Knapp Mill new water treatment works	72.6	Partial accept	34.5
South West Water	Aldernery new water treatment works	38.3	Partial accept	18.2
South West Water	Wastewater UV treatment	13.6	Reject	0.0
South West Water	Isle of Scilly	41.3	Accept	41.3
South West Water	Water growth expenditure	8.7	Reject	0.0
South West Water	Wastewater growth expenditure	20.1	Reject	0.0
Thames Water	Population transience - impact on debt recovery and customer account management costs	63.0	Reject	0.0
Thames Water	Incremental cost of water stress on balancing supply / demand	165.0	Partial accept	33.4
Thames Water	CRM and billing system - legacy depreciation costs	43.8	Reject	0.0
Thames Water	Growth and quality investment for bioresources	38.7	Reject	0.0
Thames Water	Network maintenance - higher costs incurred in central London	120.2	Reject	0.0
United Utilities	Impact of extreme deprivation and average bills	74.3	Reject	0.0
United Utilities	Manchester and Pennine resilience	72.7	Partial accept	57.4
United Utilities	Exogenous factors impacting surface water runoff	87.7	Reject	0.0
United Utilities	Keeping our reservoirs resilient	51.2	Reject	0.0
United Utilities	Agricultural landbank and biosolids	32.2	Reject	0.0

Company	Claim name	Amount requested	Our assessment	Amount allowed
United Utilities	Diversions special factor - water	68.2	Reject	0.0
United Utilities	Diversions special factor – wastewater	43.4	Reject	0.0
Wessex Water	Wastewater flooding programme	84.6	Partial accept	6.6
Wessex Water	Sewage treatment works capacity programme	58.8	Reject	0.0
Wessex Water	Reducing leakage by a further 15%	25.3	Reject	0.0
Wessex Water	North Bristol sewerage strategy	47.2	Partial accept	44.7
Wessex Water	Pollution reduction strategy	15.6	Reject	0.0
Wessex Water	Bristol sewage treatment works	44.2	Reject	0.0
Yorkshire Water	Bioresources handling and treatment due to Water Industry National Environmental Programme	35.6	Partial accept	35.6
Affinity Water	Population transience - regional operating circumstances	7.8	Reject	0.0
Affinity Water	Regional wages - regional operating circumstances	12.5	Reject	0.0
Bristol Water	Purchase of water from the Canal and River Trust	8.6	Partial accept	5.9
Bristol Water	Age and material of water distribution network	12.3	Reject	0.0
Bristol Water	Water treatment complexity	6.0	Reject	0.0
Portsmouth Water	Bill size (residential retail)	1.0	Reject	0.0
South East Water	Geological factors - diseconomies in network plus treatment plants and abnormal groundwater complexity	20	Reject	0.0
South East Water	New connections expenditure	23.3	Reject	0.0
South East Water	TWD model underestimates efficient cost level	14.1	Reject	0.0
South Staffs Water	Treatment works investment	68.5	Partial accept	68.0

Company	Claim name	Amount requested	Our assessment	Amount allowed
SES Water	Water softening statutory requirement	11.5	Accept	11.5
SES Water	Mains replacement for leakage reduction	13.1	Reject	0.0
SES Water	Wholesale electricity usage	10.5	Accept	10.5

Ofwat (The Water Services Regulation Authority) is a non-ministerial government department. We regulate the water sector in England and Wales.

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December 2019

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