Appendix 13d:
Estimating totex risk

YorkshireWater

Estimating totex risk from efficiency savings and input price inflation

PR19 Support

A note for Yorkshire Water | July 2018

Economic Insight

This note summarises our approach to estimating the RoRE risk associated with totex being 'higher' or 'lower' than the base case for Yorkshire Water's (Yorkshire) wholesale price control areas. Our methodology is based on three steps: (i) we model uncertainty by determining a triangular probability distribution for key risk factors; then (ii) we apply these distributions to the base case, where the difference between the base case and these predicted values is the overall risk impact; and finally (iii) we run a Monte Carlo simulation, to reflect the fact that the probability of being at the 'extremes' of multiple risk factors simultaneously is lower than implied by applying an 'additive' approach.

In this note, we set out the results of our analysis of 'totex' risk for Yorkshire's wholesale price control areas (where we identify 'high' and 'low' case scenario impacts, defined as P10 and P90 percentiles). The scope of our work was focused on analysing two key risks:

- the impact of under/over performance relative to assumed efficiency; and
- the impact of variation in input price inflation, relative to an assumed 'base' case (real price effects).

To further provide Yorkshire with an assessment of the overall totex risk associated with its wholesale businesses, we incorporated Yorkshire's internal analysis of the financial impact of various additional potential risks. Our key results are illustrated in the following table (see overleaf). Whilst there is some variation by control area, in totality for the company as a whole, this implies a relatively symmetrical balance of totex risk, which we find to be credible and plausible.

Table 1: Key results for table App26 (£m 2017/18 prices)

	2020 / 21	2021 / 22	2022 / 23	2023 / 24	2024 / 25	Total over AMP	Av over AMP
Water resources							
Water resources totex impact - high RoRE case	£4.09	£5.39	£5.49	£5.04	£4.20	£24.20	£4.84
Water resources totex impact – low RoRE case	-£6.08	-£5.35	-£5.96	-£6.31	-£4.28	-£27.98	-£5.60
Water network plus							
Water network plus totex impact - high RoRE case	£34.35	£58.52	£56.60	£59.62	£59.25	£268.33	£53.67
Water network plus totex impact - low RoRE case	-£35.18	-£41.05	-£45.96	-£42.37	-£40.44	-£205.00	-£41.00
Wastewater network plus							
Wastewater network plus totex impact - high RoRE case	£48.87	£58.28	£51.31	£35.70	£32.77	£226.92	£45.38
Wastewater network plus totex impact - low RoRE case	-£72.34	-£74.84	-£60.70	-£48.74	-£35.79	-£292.42	-£58.48
Bioresources							
Bioresources totex impact - high RoRE case	£7.33	£7.24	£5.86	£5.91	£5.81	£32.15	£6.43
Bioresources totex impact – low RoRE case	-£9.48	-£10.74	-£8.93	-£8.30	-£7.35	-£44.79	-£8.96

Source: Economic Insight analysis

The rest of this note is structured as follows:

- firstly, we set our analysis and findings regarding the risk associated with under / over performance in relation to efficiency;
- subsequently, we set our findings in relation to the variation in input price inflation, relative to the assumed base case; and
- finally, we present the results of our overall totex risk analysis – as informed by a Monte Carlo simulation.

2. Risk from under / over performance relative to assumed efficiency

Our analysis examines how 'uncertainty' regarding the level of efficiency savings impact the level of totex RoRE risk for the wholesale price control areas. Our method is based on calculating the financial impact between outturn efficiency and assumed efficiency levels. Specifically, our approach consists of two key steps, as set out below.

- **Probability distribution.** Here, we derive a probability distribution that defines the likelihood of being above or below an assumed level of efficiency. That is, we look at the distribution of risk levels associated with over / under performance in comparison with an assumed base efficiency level.

- **Totex impact.** Subsequently, we multiply the resulting probability distributions by the projected base totex, to get the range of financial impacts by price control area.

2.1 Probability distribution

Here, we derive triangular probability distributions, which are commonly used in risk analysis more broadly, and Monte Carlo simulations more specifically. The key parameters to define for the triangular distribution are the minimum, maximum and most likely levels. We use the efficiency range levels that we calculated for Yorkshire by price control area in a separate detailed report. For summary purposes here, we set out them out in the table below.

Table 2: Efficiency range levels by price control area

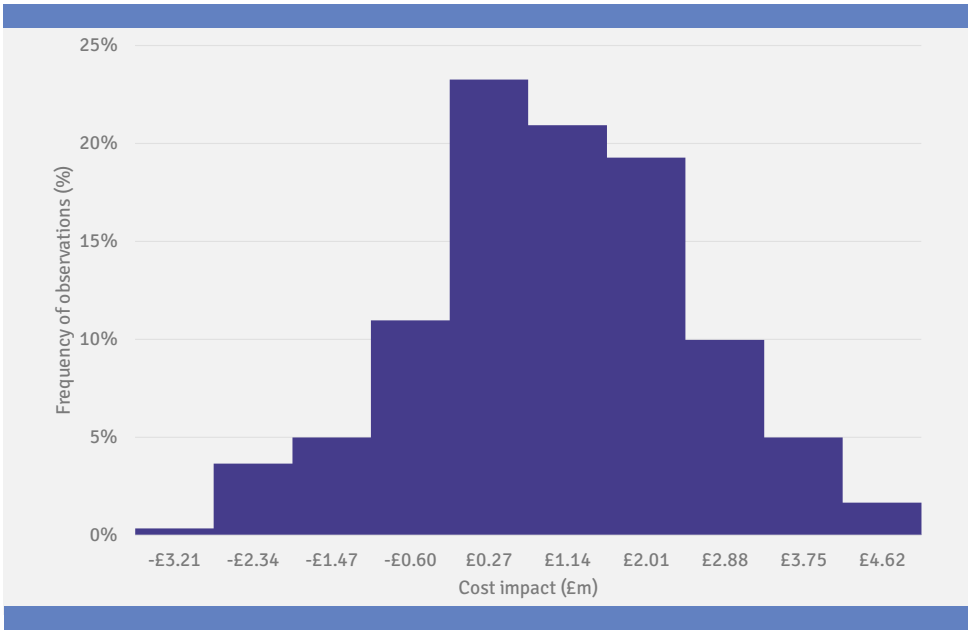
	Low case efficiency	Base case efficiency	High case efficiency
Water resources	-14.00%	6.00%	22.00%
Water network plus	-15.00%	0.00%	15.00%
Wastewater network plus	-13.00%	3.00%	16.00%
Bioresource	10.70%	23.30%	34.00%

Source: Economic Insight analysis

2.3 Totex impact from efficiency uncertainty

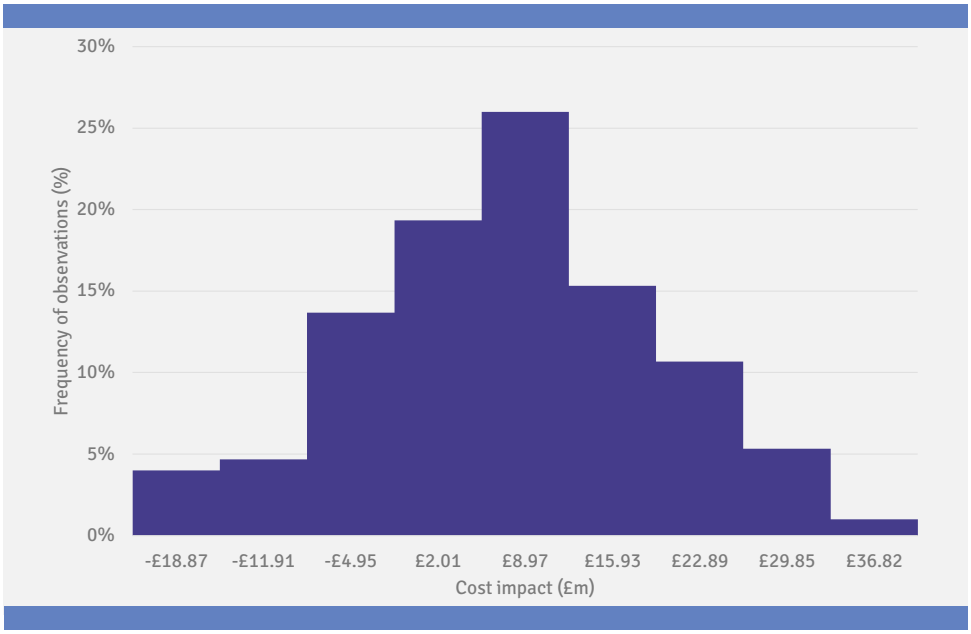
Subsequently, we estimate the financial risk impact by multiplying the resulting probability distribution by the projected base totex figures over PR19. In the following figures we present the average totex impact over PR19 for the wholesale price control areas relating to efficiency uncertainty.

Figure 1: Distribution of totex impact arising from over / under performance relative to assumed efficiency – water resources



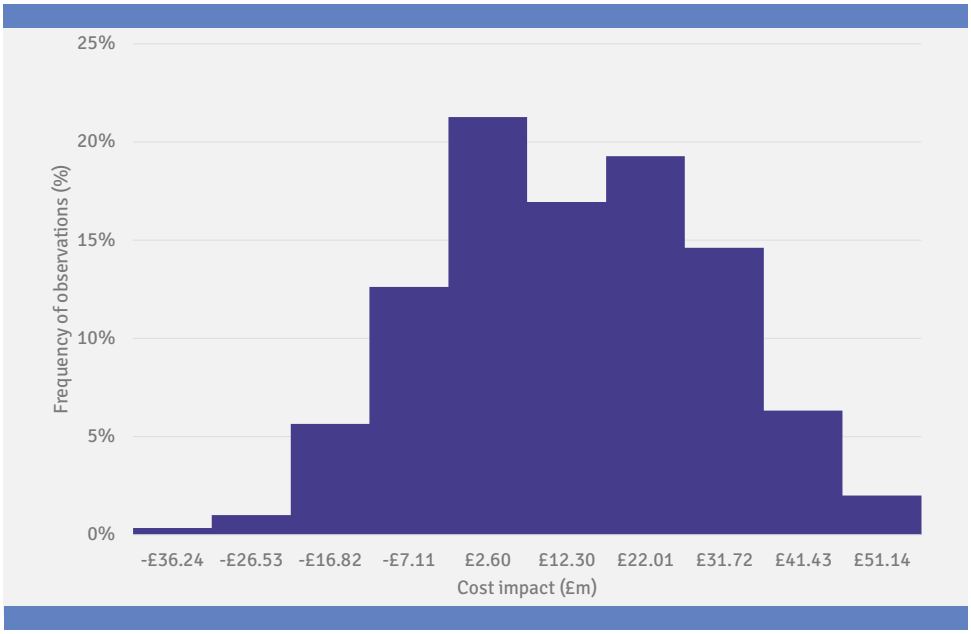
Source: Economic Insight analysis

Figure 2: Distribution of totex impact arising from over / under performance relative to assumed efficiency – water network plus



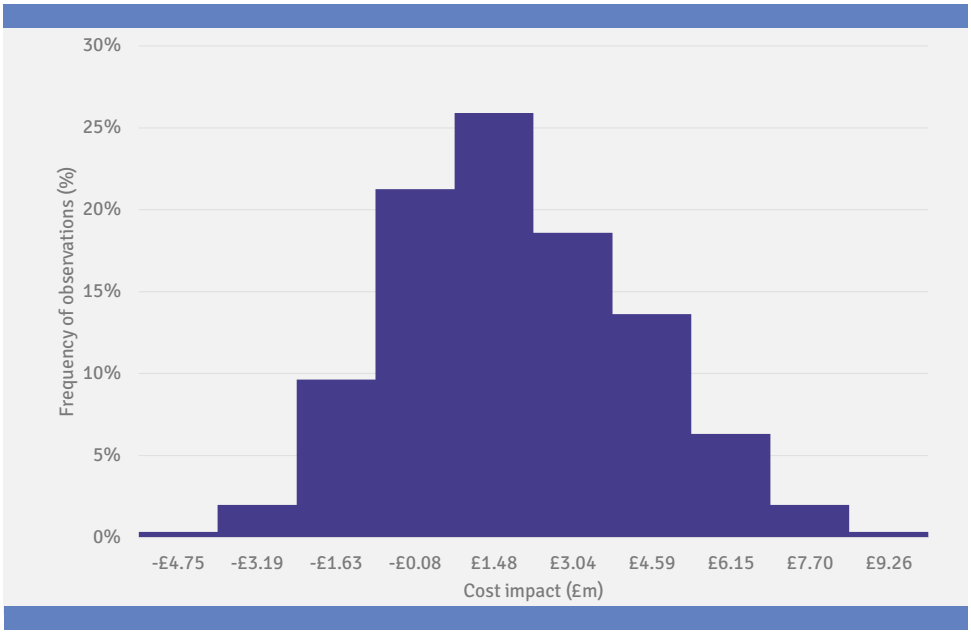
Source: Economic Insight analysis

Figure 3: Distribution of totex impact arising from over / under performance relative to assumed efficiency – wastewater network plus

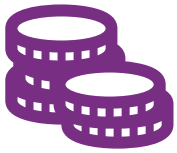


Source: Economic Insight analysis

Figure 4: Distribution of totex impact arising from over / under performance relative to assumed efficiency – bioresources



Source: Economic Insight analysis



4. Risk from variation in input price inflation (real price effects)

The second risk component we looked at is the variation in input price inflation (real price effects) relative to an assumed 'base' case. Similar to our approach above, we calculate the financial impact between outturn input price inflation and an assumed base case. Our analysis is based on the following two steps.

- **Probability distribution.** We derive the probability distribution to define the likelihood of variation in input price inflation relative to an assumed base case.
- **Totex impact.** Subsequently, we multiply the resulting probability distributions by the projected base totex, to get the range of totex impacts by price control area.

4.1 Probability distribution

To derive a probability distribution for input price inflation, again we had to define the 'low', 'central' and 'high' estimates for the triangular distribution. Here, we use the RPE ranges by price control area that we have estimated for Yorkshire in a separate detailed work. This is illustrated in the table below (for opex).

Table 3: Parameters of the triangular probability distributions input price inflation

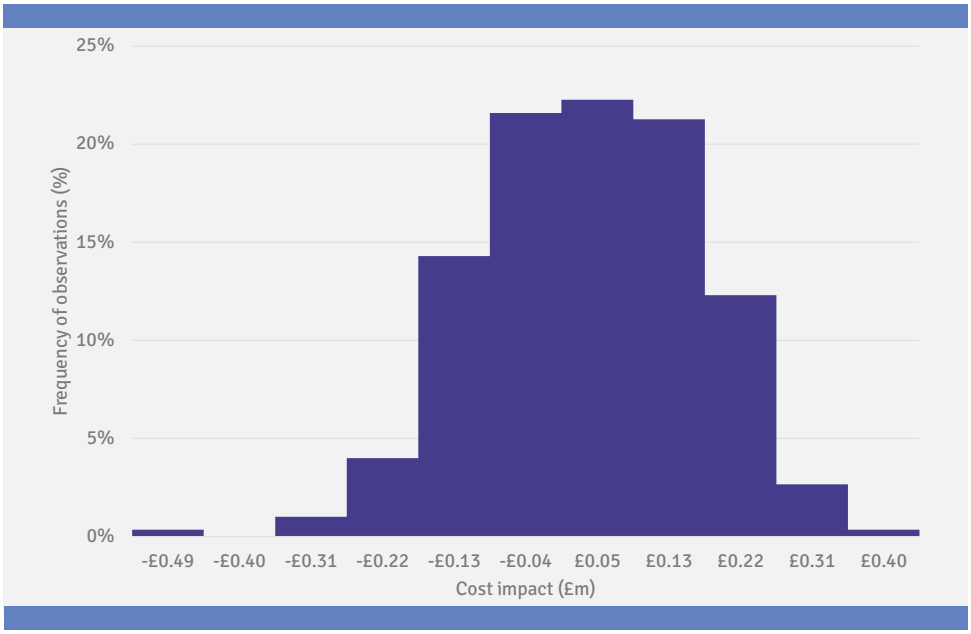
	Low case RPE	Base case RPE	High case RPE
Water resources	0.81%	2.31%	3.81%
Water network plus	0.66%	2.16%	3.66%
Wastewater network plus	0.82%	2.32%	3.82%
Bioresource	0.94%	2.44%	3.94%

Source: Economic Insight analysis

4.3 Totex impact arising from input price pressure uncertainty

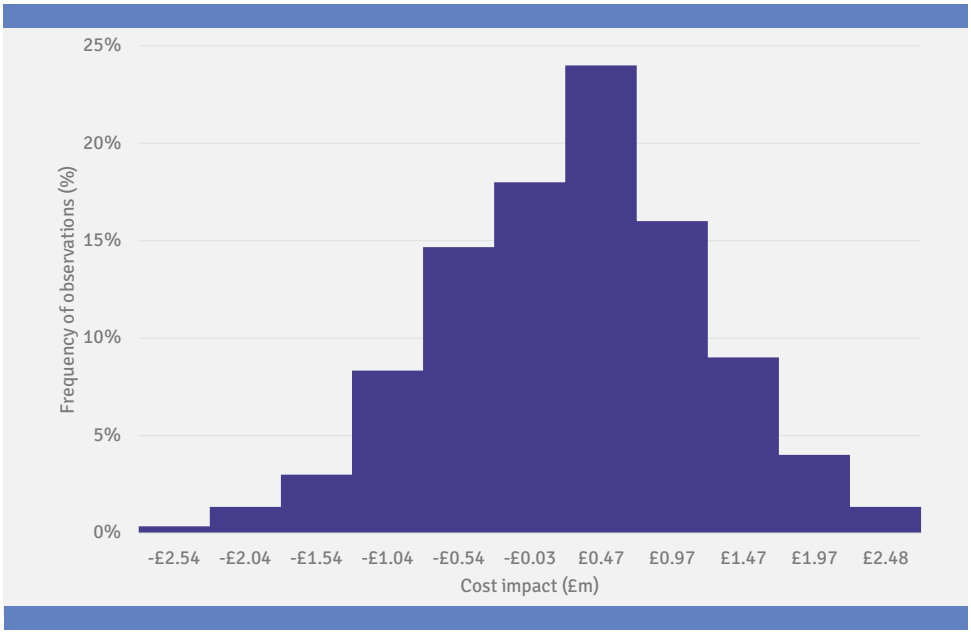
In the following figures we present the average totex impact over PR19 for the wholesale price control areas.

Figure 5: Distribution of totex impact arising from variation in input price pressure relative to assumed base case – water resources



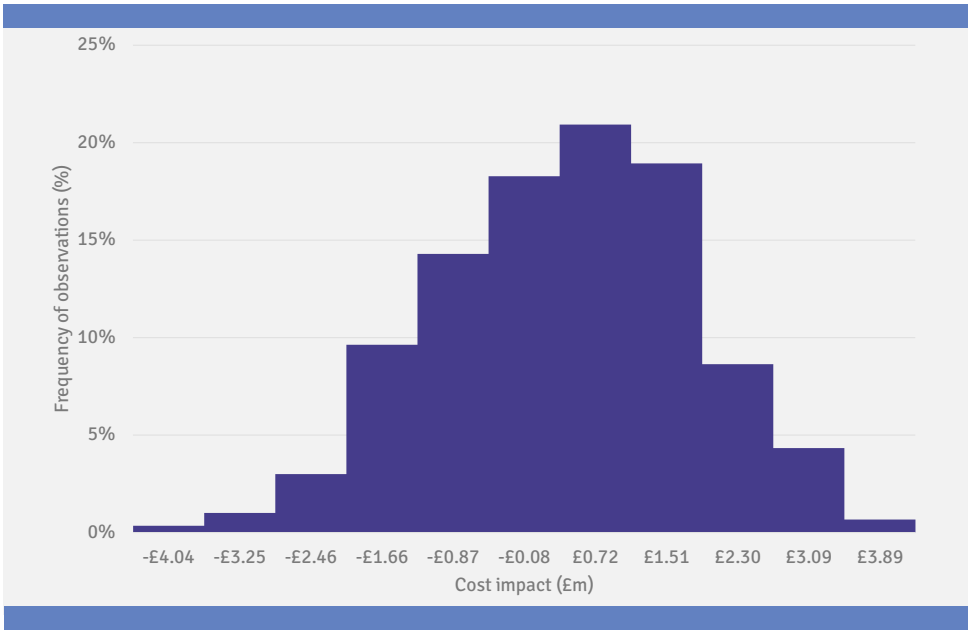
Source: Economic Insight analysis

Figure 6: Distribution of totex impact arising from variation in input price pressure relative to assumed base case – water network plus



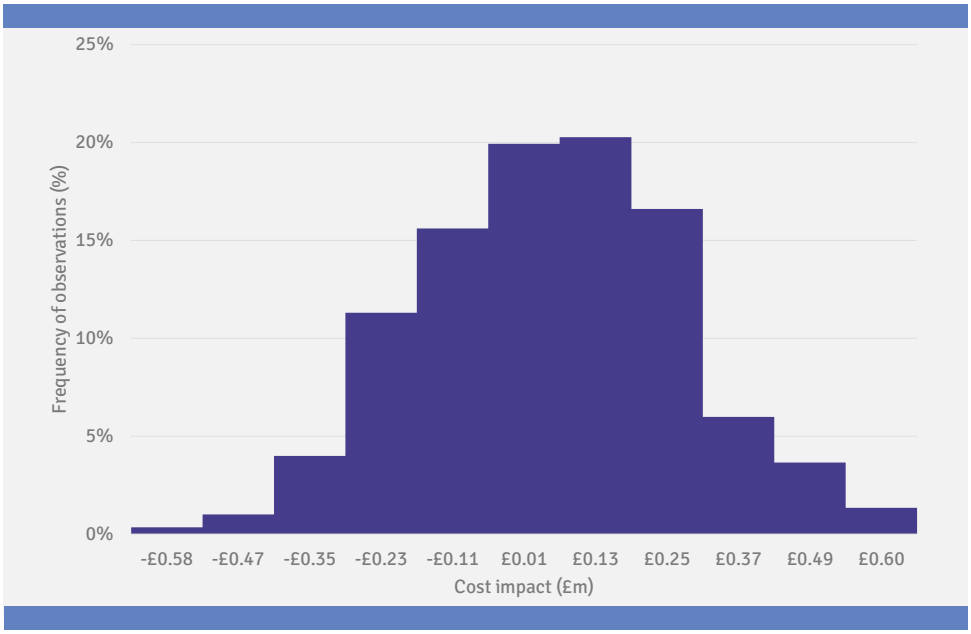
Source: Economic Insight analysis

Figure 7: Distribution of totex impact arising from variation in input price pressure relative to assumed base case – wastewater network plus



Source: Economic Insight analysis

Figure 8: Distribution of financial impact arising from variation in input price pressure relative to assumed base case – bioresources



Source: Economic Insight analysis

5. ‘Bottom-up’ assessment of addition totex risk factors

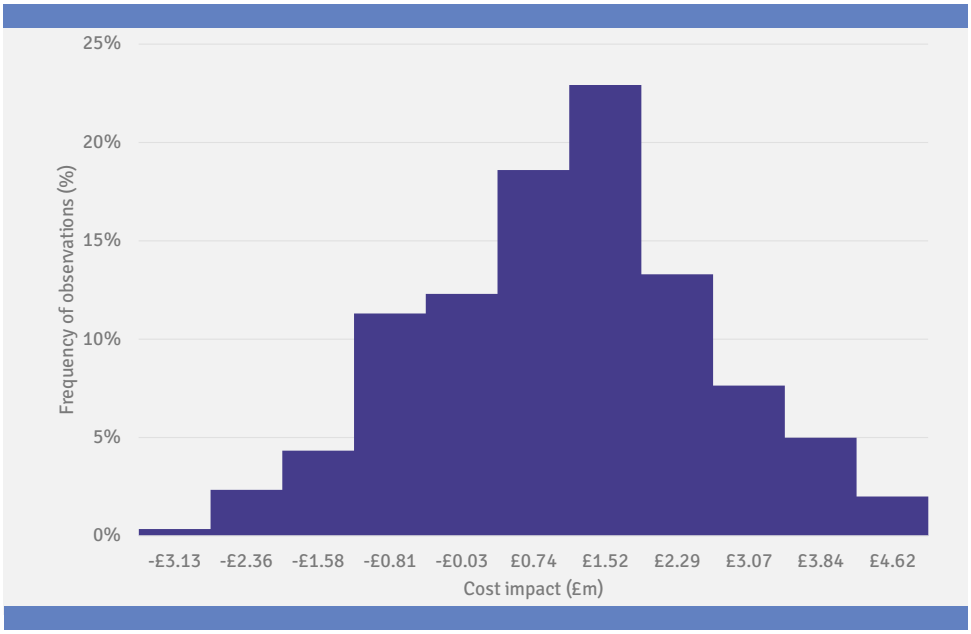
To capture all potential totex risks for the wholesale price control areas, we also incorporated Yorkshire’s ‘bottom-up’ estimates for various additional risks. These included risks associated with changes in: (a) household demand; (b) energy consumption; (c) mains bursts; (d) business rates; and (e) costs to recover service.

6. Monte Carlo analysis to derive overall totex risk

Using the methodologies above, we arrived at a set of ‘potential’ totex impacts for each underlying risk factor. To derive the overall risk impact in £m, we then applied a Monte Carlo analysis. Again, this is to reflect the fact that the probability of being at the ‘extremes’ on multiple risk factors simultaneously is unlikely – consistent with Ofwat’s methodology.

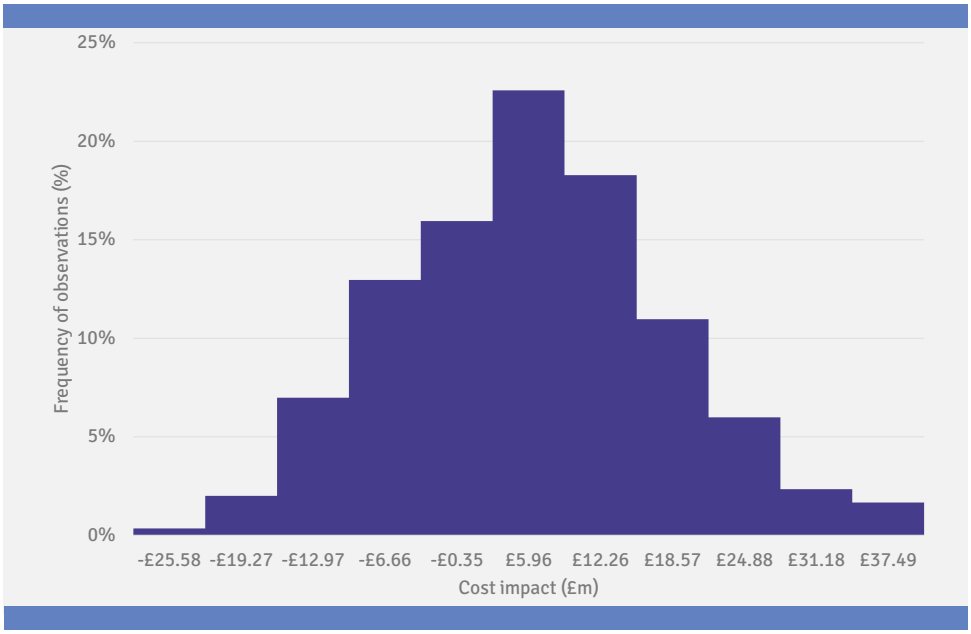
The Monte Carlo analysis randomly draws impacts from each of the above individual risk factors, capturing the fact that risk is not additive. From this, an overall distribution of £m totex risks impacts was calculated for each of the wholesale price control areas – as shown in the figures below.

Figure 9: Distribution of all totex impacts using Monte Carlo – water resources



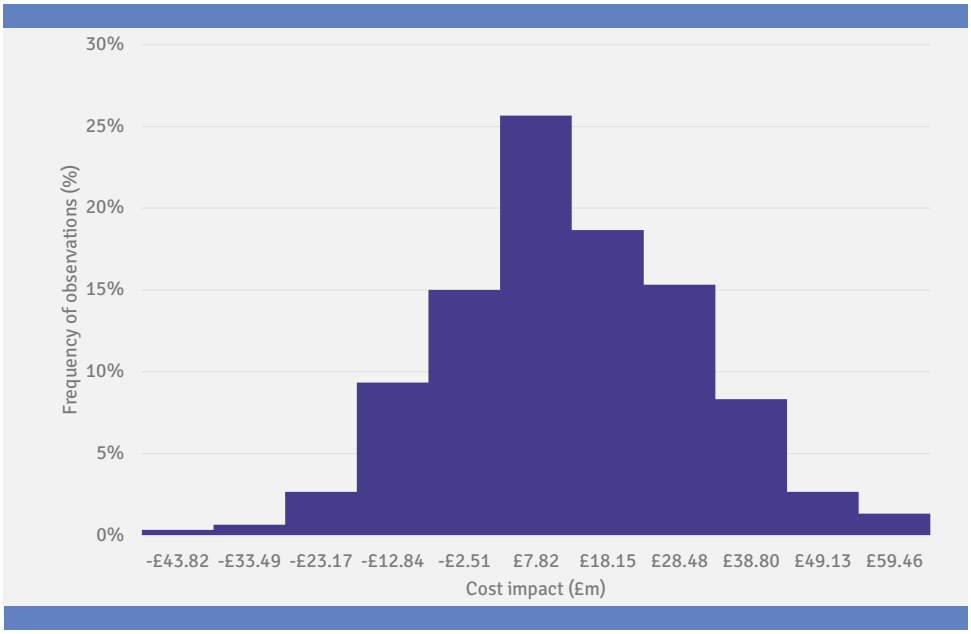
Source: Economic Insight analysis

Figure 10: Distribution of all totex impacts using Monte Carlo – water network plus



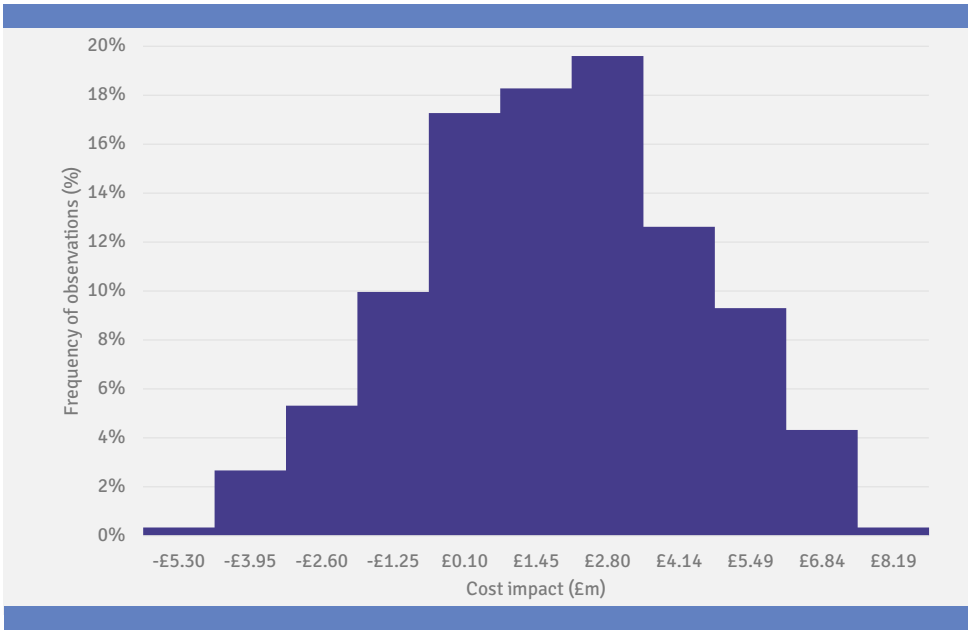
Source: Economic Insight analysis

Figure 11: Distribution of all totex impacts using Monte Carlo – wastewater network plus



Source: Economic Insight analysis

Figure 12: Distribution of all totex impacts using Monte Carlo – bioresources



Source: Economic Insight analysis

Finally, to identify the 'high' and 'low' case scenarios, the P10 and P90 percentiles for each of the above were calculated. As per Ofwat's requirements, the 'high' case scenario relates to totex being below the base case; and the 'low' case scenario relates to totex being above the base case. This final calculation step produces the £m impacts reported in Table 1 in this note.

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