United Utilities Bespoke ODI rates research

Final Report

March 2023

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Introduction

Valuation evidence plays a crucial role in business planning for the water industry, including for setting outcome delivery incentive (ODI) rates. For PR24, the principal source of evidence on customer values is expected to be the Collaborative ODI research study, a study designed and implemented by Accent and PJM economics for Ofwat and CCW.

Accent and PJM Economics were commissioned by United Utilities to design and implement a stated preference survey to estimate the values to attribute to seven bespoke performance commitments (PCs) in a manner consistent with the approach taken in the Collaborative ODI research, to supplement the valuations obtained therein. The study has adhered to Ofwat's published standards for high quality research (Ofwat, 2022) throughout.

This document is the final study report. It describes the survey design and the administration of the household and non-household surveys and presents findings and conclusions. Appendix A details how the study has adhered to Ofwat's requirements for customer research; the questionnaires used in the study are contained in Appendices B and E; the service issues tested in the research are included in Appendix C; Appendix D contains the survey invitations and reminders used; Appendix F contains details of the weighting procedure; and Appendix G contains details of the econometric analysis.

A peer reviewer, Prof. Stephane Hess, was appointed to assure the quality of the design, analysis and reporting of the study. Appendix H includes two notes from Prof. Hess's reviews as well as responses to each of the points raised.

Survey design

The survey was designed to closely mirror the Collaborative ODI research study in order to ensure full consistency between the values obtained from the present research for the bespoke ODIs, and the values obtained for the common ODIs from the Collaborative ODI research.

Accordingly, the survey centred around an impact-based stated preference choice exercise, in which customers saw a series of eight questions each asking which of two service issues would have the most impact on them. For the present research, ten new service issues were designed, and three service issues from the Collaborative ODI research were also included, meaning there were 13 service issues altogether in the present research. The intention was that the survey would obtain estimates of the relative impacts of these 13 service issues. Values for the new service issues could then be derived by 'pivoting' off the values obtained in the Collaborative ODI research for the three common service issues.

Household survey administration

The questionnaire was administered to households using an online approach combining commercial panel samples and a sample drawn from the Postcode Address File (PAF), in line with the Collaborative ODI research study.

The Panel survey achieved 1,151 interviews; the PAF survey achieved 868 interviews, of which the vast majority completed the survey online. This comprised the total household sample achieved of 2,019 interviews (against a target of 2,000).

The household survey interviews took place between November 2022 and December 2022.

Weights were generated to correct for departures from population proportions by Age, Sex and SEG.

Non-household survey administration

For the non-household survey, a sample was drawn from commercial sources, using a mixture of an online business panel and a purchased sample of business telephone numbers. This differs from the approach taken in the Collaborative ODI research in that Ofwat was able to use its regulatory powers to obtain non-household customer lists from water providers, an option that was not available to United Utilities for the present study.

A postcode sampling frame was applied to draw the sample of non-household premises with probability proportional to size. Water usage or size of bill was not available from commercial sample sources, so quotas were used on number of employees as a proxy.

The non-household survey interviews took place in December 2022.

The non-household survey achieved 201 interviews (against a target of 200). 32 interviews were conducted by telephone via the purchased sample of business telephone numbers and 170 were conducted online via the online panel.

Weights were generated to correct for departures from the optimal proportions using BEIS (2022) data on regional employment size distributions.

Findings

The main results on relative impacts were obtained via an econometric analysis of responses to the stated preference exercise using the same modelling approach as used within the Collaborative ODI research. Sensitivity analysis was conducted examining different approaches to sample exclusions, with no substantive impact on the results.

Participant feedback was very positive, and there were no signs of non-trading, suggesting good performance of the choice exercise.

As expected, internal sewer flooding incidents were by far the highest impact scenarios, accounting for around 50% and over 80% of the 'total impact' for household and non-household customers, respectively, and the impact ranking of the various sewer flooding incidents was generally as expected.

While impact scores for household customers were relatively precisely estimated, the confidence intervals around non-household impact scores were wide, leading to wide confidence intervals around non-household customers' valuations.

For households, valuations based on the Collaborative ODI research for England and Wales were 10-30% higher, depending on service issue, than valuations based on the Collaborative ODI research for United Utilities customers. The reverse was true for non-households. These differences were driven by differences between the underlying Collaborative ODI research pivot values for England and Wales and the company-specific ones.

The confidence ranges around valuations were wider for non-households than for households, reflecting a substantially smaller sample size of the non-household survey in comparison to the household survey.

Glossary

HH	Household
MOSL	Market Operator Services Ltd
NHH	Non-household
ODI	Outcome delivery incentive
PAF	Postcode Address File
PC	Performance commitment
PR14	The 2014 water price review
PR19	The 2019 water price review
PR24	The 2024 water price review
SEG	Socioeconomic grade
WTA	Willingness to accept

1 Introduction

1.1 Background and objectives

Valuation evidence plays a crucial role in business planning for the water industry, including for setting outcome delivery incentive (ODI) rates. For PR24, the principal source of evidence on customer values is expected to be the Collaborative ODI research study, a stated preference study designed and implemented by Accent and PJM economics for Ofwat and CCW. This study was proposed for PR24 to address the variability in results found at PR19, and previous reviews, which were thought to be caused by differences in design, quality and approach between water companies.

The Collaborative ODI research has obtained valuations that can be used to support enhancement business cases as well as ODIs for the common performance commitments (PCs). However, United Utilities needed further, company-specific, evidence on customer valuations to address gaps in the collaborative research evidence base with respect to bespoke ODIs. The primary objective for the present research was to obtain this evidence by means of a robust stated preference research study with United Utilities customers.

1.2 Structure of report

This document is the final study report. It describes the survey design and the administration of the household and non-household surveys and presents findings and conclusions. Appendix A details how the study has adhered to Ofwat's requirements for customer research; the questionnaires used in the study are contained in Appendices B and E; the service issues tested in the research are included in Appendix C; Appendix D contains the survey invitations and reminders used; Appendix F contains details of the weighting procedure; and Appendix G contains details of the econometric analysis.

A peer reviewer, Prof. Stephane Hess, was appointed to assure the quality of the design, analysis and reporting of the study. Appendix H includes two notes from Prof. Hess's reviews as well as responses to each of the points raised.

2 Survey design

2.1 Overview

The survey was designed to closely mirror the Collaborative ODI research study being conducted by Accent and PJM Economics for Ofwat and CCW. This ensures full consistency between the values obtained from the present research for the bespoke ODIs, and the values obtained for the common ODIs from the Collaborative ODI research.

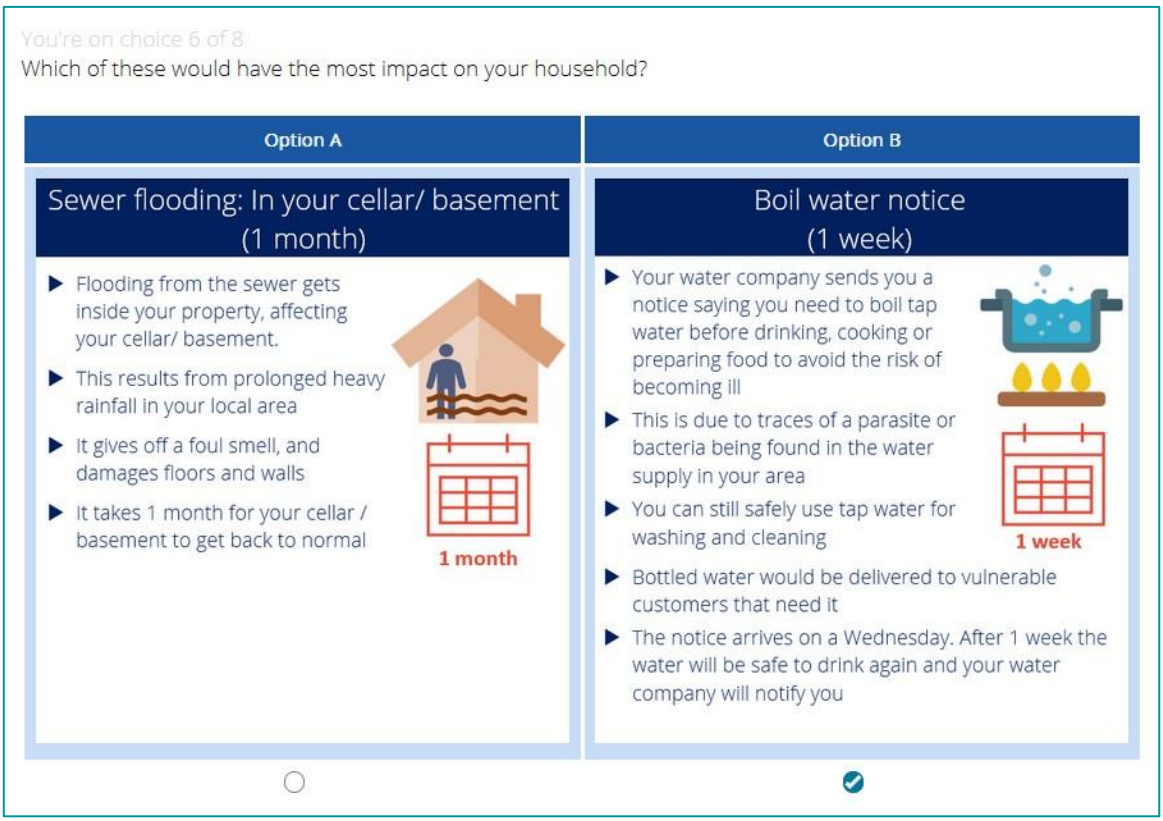
Accordingly, the survey centred around an impact-based stated preference choice exercise, in which customers saw a series of questions each asking which of two service issues would have the most impact on them. For the present research, ten new service issues were designed, and three service issues from the Collaborative ODI research were also included, meaning there were 13 service issues altogether in the present research. The intention was that the survey would obtain estimates of the relative impacts of these 13 service issues. Values for the new service issues could then be derived by 'pivoting' off the values obtained in the Collaborative ODI research for the three common service issues.

Further details of the core stated preference exercise are provided in the remainder of this section.

2.2 Stated preference choice format

Figure 1 below shows an example choice question from the survey. The format is accordingly exactly the same as was used in the Collaborative ODI research, but with new service issues.

Figure 1: Example impact choice question



2.3 Service issues tested

In order to apply this approach, three service issues were drawn directly from the Collaborative ODI research, along with 10 new issues to obtain the valuations required for the bespoke ODIs. The 'pivot' attributes carried over from the Collaborative ODI research were chosen to be close in impact to the new service issues.

The full set of service issue included in the research are shown in Table 1, along with the label used to shorten them within the analysis. (Full details of the service issues, as they were shown to customers, are included in Appendix C.)

Table 1: Service issues tested

Label	Short description
UnexpInt72	Unexpected water supply interruption (72h)
Boil1W	Boil water notice (1 week)
LowPressure72	Unexpected low pressure (72h)
TasteSmell1W	Water taste and smell (1 week)
InternalSFRep	Sewer flooding: inside your property once every 3 years (1 month)
ExternalSFRep	Sewer flooding: outside your property once every 3 years (1 week)
CellarSF	Sewer flooding: in your cellar/basement (1 month)
CellarSFRep	Sewer flooding: in your cellar/basement once every 3 years (1 month)
SlowDraining24	Slow draining wastewater (24h)
SlowDraining1W	Slow draining wastewater (1 week)
InternalSF	Sewer flooding: inside your property (1 month)
RotaCuts	Emergency drought restrictions (2 months)
Discolour24	Discoloured water (24h)

Importantly, two of the new service issues pertained to cellars:

- Sewer flooding: in your cellar/basement (1 month)
- Sewer flooding: in your cellar/basement once every 3 years (1 month)

Since these service issues would only be relevant to customers that had a cellar or basement, the survey included an extra question prior to the stated preference exercise, asking participants whether they had a cellar or basement (Q16B), and whether this was used as a living space (Q16C). Those that did have a cellar were shown choice questions that included the two cellar-based service issues, those that did not have a cellar were shown questions that did not include these as options.

2.4 Experimental design

The combinations of service issues shown were generated by applying the 'D-efficiency' design method (Rose and Bliemer, 2009[1]. This requires the specification of prior values for the econometric coefficients ultimately to be derived in order to calibrate the selection of alternatives to maximise the statistical precision of the estimates ultimately obtained. The priors for the main stage of the present study were obtained from analysis of the pilot data.

The design was restricted to avoid presenting dominant-dominated pairs of service issues. Thus, shorter duration/one-off incidents were not placed alongside longer duration/repeated incidents of the same kind. The full set of design restrictions applied are shown in Table 2.

[1] Rose, J. M. and Bliemer, M. C. J. (2009) Constructing Efficient Stated Choice Experimental Designs, Transport Reviews, 29:5, 587-617, DOI:10.1080/01441640902827623

Table 2: Impact exercise design restrictions: Excluded pairs

More impactful	Less impactful
Sewer flooding: inside your property once every 3 years (1 month)	Sewer flooding: inside your property (1 month)
Sewer flooding: in your cellar/basement once every 3 years (1 month)	Sewer flooding: in your cellar/basement (1 month)
Slow draining wastewater (1 week)	Slow draining wastewater (24h)

Note: The impact exercise was designed to exclude any choice sets that included the pairs of scenarios shown in the table.

In order to allow for variation across the sample, and to mitigate against order effects, 11 blocks were created for the design that excluded cellar service issues and 13 blocks were created for the design that included the two cellar service issues. Each block contained 8 pairwise choice questions, and each participant answered one block.

2.5 Testing and refinement

Peer review

Prof. Stephane Hess reviewed the initial design proposal prior to testing, and recommended that Discoloured water (24h) was added as a third pivot service issue. Originally, only two service issues had been proposed, Internal sewer flooding and Emergency drought restrictions. Prof. Hess suggested that adding a third pivot would improve the robustness of the results and this recommendation was implemented prior to testing with customers.

Cognitive testing

Once programmed, the questionnaire was cognitively tested to ensure accessibility and comprehensibility of the questionnaire and the service issues being tested. Although much of the survey design was the same as in the Collaborative ODI research (which was comprehensively tested and piloted), this process was important to check that the new service issues worked well for the SP analysis.

Cognitive interviewing involves taking a participant through the survey and includes additional questions to probe for levels of comprehension, ease of completion and response to stimuli.

10 cognitive interviews were completed with household customers, with participants from a range of age groups, social grades and genders.

Cognitive interviews took place online over Zoom. The interviewer shared their screen and gave control to the participants so they could independently navigate through the questionnaire. Participants were asked to work through the questionnaire autonomously whilst “thinking aloud” their decision-making processes. They were also asked to highlight areas of the questionnaire that were inaccessible, difficult to understand, or troublesome to navigate or complete.

At key points during questionnaire completion, interviewers used additional cognitive probes to assess how well the new service issues had been understood, the clarity of stimulus material, and how easy or difficult it was for the participant to provide an answer. These additional cognitive probes collectively formed the topic guide, which was used to direct all interviews.

Cognitive interviews took place between 14th and 15th of November 2022 and lasted approximately 45 minutes each.

Cognitive testing showed that the survey was thought to be straightforward and the stated preference section could be completed with ease. There were some minor scripting and wording queries that arose, but minimal changes were made due to the need to keep the questionnaire as close as possible to that used in the Collaborative ODI research.

The key issue that arose was that a couple of participants missed the reference to repeat events (those happening once every 3 years), interpreting them in the same way as the equivalent service issue that occurred as a one off event.

Recommendations based on the findings were synthesised with the outcome of the pilot, which took place at the same time (summarised below).

Pilot

Alongside the cognitive testing interviews, a pilot of 99 household participants was conducted via the online panels to test the stated preference component of the survey.

The pilot worked well in most respects. The feedback scores and diagnostics were very good, as for the collaborative ODI research on which the design was based. Furthermore, the econometric models performed reasonably well given the sample size.

The two key issues arising were the following:

- Hardly any participants had a cellar/basement, meaning that it was impossible to estimate models including the cellar-based service issues. If the same proportion of the main stage sample have no cellar or basement, then there will be very weak precision on the cellar-based attributes. (4% of 2,000 = 80 household participants in total).

- The second issue was that the repeat internal sewer flooding event appeared to be insufficiently differentiated from the one-off event.

Refinements to the survey design

Following discussion with United Utilities and the peer reviewer, Prof. Stephane Hess, the changes below were made in response to the issues identified above:

- Once every 3 year attributes: the reference to 'once every 3 years' was bolded in the title and the final bullet points were amended to emphasise that it is a repeat event, i.e.:
  - This happens at your property once every 3 years
  - Each time it happens, it takes XX for your property to get back to normal
- The question about whether or not participants had a cellar in their property was moved forward in the survey to allow quotas to be set on it if needed.
- The experimental designs for the mainstage for all exercises were also re-calibrated to improve their statistical efficiency.

3 Household survey administration

This section provides details on the following aspects pertaining to the household survey:

- Sample design
- Survey methodology
- Sample characteristics
- Weighting

3.1 Sample design

Target population

As per the Collaborative ODI research, the target population of the household survey was defined via the following key requirements:

- Households would be the unit of observation, in the sense that the survey would be seeking to measure the required compensation for the household due to service issue impacts, rather than individual-level compensation.
- Any adult member of a household could potentially be recruited, with the only constraint being that they should be willing and able to respond on behalf of their household.
- Non-bill paying households, e.g. where the bill was paid by the landlord, would be in scope for the survey, while those paying the bill, e.g. the landlord, would not be in scope to answer on the non-bill paying household's behalf.
- Post-sampling, households would be excluded if they were not connected to mains water and sewerage services, or if they worked in the water sector or market research.

Survey modes and sampling frames

As per the Collaborative ODI research, it was decided that the sample design should be constructed from two sampling frames:

- An online commercial panel
- The Postcode Address File (PAF) of all households in the United Utilities region

The online commercial panel would naturally be used to support online completion of the survey questionnaire, whilst the PAF would be used primarily also for online completion,

but would also support a paper survey for those that did not have easy access to the internet to ensure the research was inclusive.

The advantages and disadvantages of these approaches (Panel and PAF) were set out and deliberated within the Collaborative ODI research, and both approaches were pilot tested within Stage 2 of that study.

In the Collaborative ODI research, it was agreed to use both sampling approaches with the following bounds:

- Minimum 50% Postal (PAF) by company
- Maximum 50% online commercial panel by company

Due to budgetary constraints for this Bespoke ODI research, the methodology was originally designed to achieve a 35%:65% split (i.e. 700 interviews via the PAF approach and 1,300 via online panels). A higher than expected response rate to the initial invites and a subsequent decision to conduct a booster mailout to addresses with a higher likelihood of having a cellar resulted in a higher proportion of interviews conducted via the PAF method (868). This meant that the sampling approach was closer to the Collaborative ODI Research than anticipated (43% PAF and 57% online panel).

3.2 Survey methodology

Fieldwork period

The household survey interviews took place between November 2022 and December 2022.

Panel approach

For the Panel approach, two commercial panels were used (Kantar and Dynata). Each panel was initially given a maximum target of 25% of the target and a set of demographic quotas on age and gender.

Due to a technical fault on the panel provider side, Dynata achieved fewer than expected interviews and the quotas for Kantar were opened up to achieve the remaining interviews. In addition, the number of interviews achieved via the PAF approach was higher than planned, meaning that the panel target was lowered to reach the overall sample of 2,000. 759 interviews were achieved via Kantar and 392 via Dynata, giving a total of 1,151 from online panels.

Unlike with the PAF approach, the Panel survey required a process confirming that the participant was eligible to take part by living in the United Utilities region. Upon entering the survey, Panel participants were asked to provide the first part of their postcode (the district). So, for example, if the full postcode was ME1 3BN, this would be ME1 3. The questionnaire software then used a look-up table to identify whether United Utilities was their water and wastewater service company and asked the participant if they agreed with

that. If not, or if the look-up indicated that another water and/or wastewater company supplied the postcode district stated, the participant was provided with a list of water and/or wastewater companies and asked to identify the relevant provider. If they typed in another company, said don't know or that none provided the service (for example because they had a septic tank) then the interview was closed.

Quotas were set for the panels, designed to a target that the Panel contribution should bring the overall PAF-Panel sample closer to the Census demographic profile than the PAF sample on its own, given the expected contribution from the PAF sample based on pilot statistics.

For United Utilities regions, the following table shows, by demographic, the Census 2021 statistics, Collaborative ODI research PAF sample statistics, the Panel ideal outcome that would be expected to lead to a representative composition of the combined PAF-Panel sample, and the average panel quota.

Table 3: Quotas for Household Panel Survey (United Utilities region)

	Census 2021 %	PAF %	Panel ideal outcome %	Panel main maximum quota %
Age				
18-29	19	9	19	Unlimited
30-64	58	64	58	60
65 or older	23	25	23	35
Gender				
Male	48	48	48	50
Female	52	52	52	60
Base		**1,058**		

Bases for Collaborative ODI research: Age=1,042; Gender=1,058 (Excludes non-responses)

Progress was monitored during fieldwork and additional invitations issued to target specific areas as appropriate.

The interviews took place between 07/12/22 and 22/12/22.

PAF approach

In order to apply the sample design using the PAF, GIS software was used to match United Utilities boundaries to postcodes, to produce a list of all addresses in those regions. Full addresses were then sampled at random using a minimum expected conversion rate of 7.5%. This meant sampling a multiple of 1/0.075 addresses for each target completed interview required by the sample design. The conversion rate of 7.5% was based on findings from the Collaborative ODI research, which suggested that a response rate of around 10% was likely to be achievable, with some leeway in case the response rate in this study turned out to be lower.

The PAF did not include named addressees, so each letter was addressed to "The Occupier".

The letter was headed with United Utilities logos. It explained the purpose of the survey and additional information needed to fulfil GDPR requirements.

The letter included an online link and QR code as well as a unique ID code and PIN to be entered once the survey was accessed (to prevent multiple entries). A £10 incentive was offered to encourage participation in the form of a charitable donation (to WaterAid) or a voucher from a selection of leading retailers. Participants could choose to receive this via email or post.

Those unable, or who didn't wish, to respond online were offered the opportunity to request a paper version via a freephone telephone number that customers could call and leave their name and unique ID and PIN to request a paper copy. The inclusion of the unique ID number meant that non-responders could be sent a reminder letter.

Appendix D contains the invitation letters used in the survey.

Whereas for the Collaborative ODI research, letters were sent in tranches with reminders as required, for this study, letters were frontloaded, with an initial batch of 10,000 letters sent at the start of fieldwork to minimise the number of reminders needed, as sending reminders can prolong the fieldwork period. The reason for this approach was that postal strikes were taking place during the fieldwork period and the fieldwork period for this study was shorter than the Collaborative ODI research.

10,000 letters were sent on 25th November 2022. The response rate to the initial batch of letters was high enough that no reminders needed to be sent.

During the first few weeks of fieldwork, it became clear that the proportion of participants with cellars was unlikely to result in a large enough sample size to assess the impact of service issues that related to having a cellar (see Appendix C for details of the service issues tested). It was subsequently decided that further invites would be sent to specific postcodes, provided by United Utilities, that were thought to have a higher proportion of properties with cellars. 1,000 letters were sent to these postcodes on the 12th of December.

In total 11,000 households were invited by letter to contribute to the research. The overall response rate was 7.9%, which resulted in 869 completed interviews via the PAF method. This represented 43% of the full sample of 2,019 interviews.

Table 4 below shows the number of households contacted and the number of resulting achieved interviews.

These figures include 6 postal responses, which were acquired from 52 participants that rang requesting a paper version, of which 37 left enough information for them to be mailed a survey (either an ID/PIN, or an address). Paper versions of the questionnaire were sent on the 14th of December.

The occurrence of postal strikes and proximity to the Christmas period resulted in delays to some of the booster invites and paper versions of the questionnaire being delivered.

Fieldwork was subsequently held open until December 31st (though 18th December was stated on the invitation), to allow more time for people to complete the survey. The response rate for the booster invites and paper surveys was therefore lower than the initial batch of invites.

Table 4: PAF survey interviews achieved against contacted

Water-wastewater stratum	Households contacted	Interviews achieved	Conversion rate	Proportion with cellar
Initial invitation	10,000	812	8.1%	6.2%
Booster invites to postcodes with cellars	1,000	55	5.5%	40%
Total	**11,000**	**869**	**7.9%**	**16.9%**

3.3 Sample characteristics

Once fieldwork was completed, the resulting dataset was cleaned to remove poor quality responses (including speeders, straightliners, multiple responses from the same IP address and those providing poor quality verbatim). For open-ended questions, coding frames were developed, and responses coded.

The following tables and statistics are intended to present a brief snapshot of the household sample, with a particular focus on comparison to the Collaborative ODI research.

Achieved sample sizes

The HH Panel survey achieved 1,151 interviews. The HH PAF survey achieved 868 interviews. This comprised the total HH sample achieved of 2,019 interviews (against a target of 2,000).

Table 5 shows the sample composition by survey mode for this study in comparison to the Collaborative ODI research.

Table 5: Achieved sample sizes by survey mode in comparison to Collaborative ODI research

Sample	Panel interviews	PAF interviews	Total interviews	Panel proportion
United Utilities sample from Bespoke ODI research	1,151	868	2,019	57%
United Utilities sample from Collaborative ODI research	970	1,058	2,028	48%
England and Wales sample from Collaborative ODI research	5,338	7,229	12,567	42%

Survey completion times

The average completion times for the household survey were as follows:

Sample	Panel interviews	PAF interviews
United Utilities Bespoke ODI research	8 minutes 27 seconds	13 minutes 17 seconds
Collaborative ODI research	12 minutes 54 seconds	19 minutes 16 seconds

The survey for the Bespoke ODI research hence took less time than the Collaborative ODI research, principally due to the fact that the compensation exercise was removed. As in the Collaborative ODI research PAF participants from this study took substantially longer to complete the survey than those from the Panel sample.

Demographics

The demographic profile of the household samples is shown in Table 6 compared to Census statistics and what was achieved in the Collaborative ODI research.

Both samples were reasonably representative by Sex, Household size and Ethnicity. However, both samples had an older profile than the Census, and both had more SEG=AB than the population.

Data for Sex, Age and SEG were used for weighting to ensure representativeness, as described in Section 3.4 below.

Table 6: Household demographics

	Census[1] %	United Utilities sample from Collaborative ODI research	United Utilities sample from Bespoke ODI research
Sex			
Male	49%	46%	46%
Female	51%	54%	54%
Age			
18-29	19%	9%	12%
30-64	57%	64%	61%
65 or older	24%	28%	26%
SEG[3]			
AB	20%	37%	33%
C1C2	52%	42%	42%
DE	29%	20%	21%
Urban/Rural[4]			
Urban	82%	90%	84%
Rural	18%	10%	16%
Ethnicity			
White	90%	93%	92%
Mixed	2%	1%	1%
Asian or Asian British	6%	4%	5%
Black or Black British	1%	1%	1%
Other ethnic group	1%	0%	0
Household size			
1 or 2	64%	64%	61%
3 or 4	29%	30%	32%
5 or more	7%	4%	6%

Notes:
(1) Population statistics for Sex, Age, Ethnicity and Household size were obtained from 2021 Census data. Population statistics for SEG and Urban/Rural were obtained from 2011 Census data as 2021 data had not yet been released.
(2) Base sample size: 2,028 for Collaborative (PAF: 1,058 and Panel:970), 2,019 for Bespoke (PAF:868 and Panel:1,151). Sample sizes for individual demographics exclude those that did not answer the relevant question.
(3) Population and sample statistics shown for adults aged under 65.
(4) Panel sample statistics unavailable for Urban/Rural in the Collaborative ODI research as the full postcode was not known for these participants and so could not be reliably matched to urban/rural indicator data. For the United Utilities Bespoke ODI research, an additional question was included in the survey to measure urban/rural status for panel participants.

Vulnerability

The household sample was asked if they or another member of their household had any of the following:

- was disabled or suffer from a debilitating illness
- had a learning difficulty
- relied on water for medical reasons
- was visually impaired (i.e. struggles to read even with glasses)
- was over the age of 75 years old

- spoke English as a second language
- was deaf or hard of hearing
- was a new parent

For 59% of the sample, none of these factors were stated as applying, comparable to the Collaborative ODI research. The main ones that did apply were disability or suffering from a debilitating illness, aged over 75 year old, and deaf or hard of hearing for both samples.

Table 7: Vulnerability

	United Utilities sample from Collaborative ODI research	United Utilities sample from Bespoke ODI research
Disabled or suffers from a debilitating illness	14%	15%
Has a learning difficulty	4%	5%
Relies on water for medical reasons	5%	5%
Visually impaired (i.e. struggles to read even with glasses)	3%	2%
Over the age of 75 years old	10%	11%
Speaks English as a second language	4%	4%
Deaf or hard of hearing	8%	7%
A new parent	3%	4%
None of these statements apply	61%	59%
Prefer not to say	4%	5%
Base	**2,028**	**2,019**

The extent to which the household sample may have financial difficulties was also explored by asking which of the following statements they most agreed with:

- I can always afford to pay my household bills
- I can usually afford to pay my household bills
- I sometimes struggle to pay my household bills
- I usually struggle to pay my household bills
- I always struggle to pay for my household bills

Under half (47%) said they could always afford to pay their household bills. 7% said they usually or always struggled to pay their household bills.

Table 8: Financial vulnerability

	United Utilities sample from Collaborative ODI research	United Utilities sample from Bespoke ODI research
I can always afford to pay my household bills	49%	47%
I can usually afford to pay my household bills	28%	29%
I sometimes struggle to pay my household bills	14%	14%
I usually struggle to pay my household bills	3%	4%
I always struggle to pay for my household bills	2%	3%
Prefer not to say	4%	3%
Base	**2,028**	**2,019**

The degree of digital exclusion for the PAF sample was also explored by asking which of the following best described them:

- I have never used the internet
- I have used the internet but do not have regular access to it
- I have regular access to the internet

As shown below, 92% of the PAF sample said they had regular access to the internet; 3% said they had used the internet but did not have regular access to it; 1% said they had never used the internet and 4% preferred not to say.

Table 9: Use of the internet

	United Utilities sample from Collaborative ODI research	United Utilities sample from Bespoke ODI research
I have never used the internet	1%	1%
I have used the internet but do not have regular access to it	3%	3%
I have regular access to the internet	93%	92%
Prefer not to say	4%	4%
Base	**2,028**	**2,019**

The Panel sample was not asked this as they necessarily had internet access to be panel members, but they were asked how many hours they spend online in the last week (a question that wasn't asked in the Collaborative ODI research.

Table 10: Hours spent online

Number of hours spent online	United Utilities sample from Bespoke ODI research
None	2%
1-4	9%
5-9	16%
10-19	23%
20-29	20%
30-39	9%
40 hours or more	17%
Prefer not to say	4%
Base	**2,019**

Water metering and billing

The proportions of metered and unmetered customers matched the population data well, as shown in Table 11 below.

Table 11: Whether has water meter

	Data provided by United Utilities %	United Utilities sample from Collaborative ODI research	United Utilities sample from Bespoke ODI research
Yes	47%	47%	45%
No		46%	48%
Base(2)		**1,899**	**1,878**

(2) Bases exclude those that answered 'Don't know' or 'Prefer not to say'

As shown in Table 12, 97% of the sample were bill payers and the remaining proportions were non bill payers. 29 non bill payers were aged 18-29 and can be consider future bill payers (1.4% of the sample).

Table 12: Are you the person in your household who is responsible, either solely or jointly, for paying for your water services bill?

	United Utilities sample from Collaborative ODI research	United Utilities sample from Bespoke ODI research
I have complete responsibility for payment	65%	63%
I share responsibility for payment with others in my household	31%	34%
I have no responsibility	4%	3%
Don't know	1%	0%
Not stated	0%	0%
Base	**2,028**	**2,019**

3.4 Weighting

A weighting procedure was applied to ensure the household sample was representative of the United Utilities population by age, sex, and socio-economic group (SEG). The population proportions for age and sex were obtained from a first release of the 2021 Census data, while the population proportions for SEG are based on 2011 Census data. The weighting approach used a raking procedure (also known as iterative proportional fitting), details of which are given in Appendix F. Given that the sample design did not involve any deliberate over- or undersampling, the weighting procedure corrects for non-response bias only, arising from lower response rates among some groups.

4 Non-household survey administration

This section provides details on the following aspects pertaining to the non-household survey:

- Sample design
- Survey methodology
- Sample characteristics
- Weighting

4.1 Sample design

Target population

As per the Collaborative ODI research, the target population of the non-household survey was determined such that the site, or premises, would be the unit of observation, where this was defined as having a unique supply address.

Sampling frame

Ofwat used its regulatory powers to obtain non-household customer lists from water providers for the Collaborative ODI research. Because these powers were not available to United Utilities, a sample was drawn from commercial sources, using a mixture of an online business panel (from Quest Mindshare) and a purchased sample of business telephone numbers (from Sample Answers).

This split sample approach was partly chosen due to practicalities, because an online panel approach offers a more cost effective way to target non-household customers, and partly to replicate the contact mode in the Collaborative ODI research, where a proportion of the interviews were achieved via CATI, shown in Table 13.

Table 13: Mode shares for non-household survey

E-mail	Post	CATI
54%	28%	18%

The postcode sampling frame was applied to draw the sample of businesses (or outlets of businesses). Participants were also asked at the start of the survey to provide the first part of their organisation's trading address to enable the postcode lookup to check they were customers in the United Utilities region. For multi-site organisations, participants were asked to consider the main site or a site in the North West of England (to minimise the

number of potential screen-outs where participants passed the survey on to a head office or main site located in another region).

Target sample sizes by customer size

In the Collaborative ODI research, water and sewerage bill size from the MOSL data was used to design the sample to achieve representation by customer size. Water usage or size of bill was not available from commercial sample sources, so the sample of business telephone numbers was drawn using number of employees as a proxy. The sample targets were set according to the fallout achieved in the Collaborative ODI research, with a slightly higher proportion of larger businesses to ensure robust enough sample sizes to conduct sub-group analysis, given the overall sample target of 200. 2,500 records were drawn for an expected response rate of around 4%.

Table 14: Non-household sample size by employment size band

Customer size (number of employees)	United Utilities sample achieved in Collaborative ODI research	Sample target for Bespoke ODI research
Sole trader	13%	15%
2 to 4	26%	20%
4 to 49	44%	40%
50 to 249	10%	15%
250+	3%	10%

Due to the low numbers of businesses on the online panel in comparison to the overall sample target of 200, no sampling targets or quotas were applied.

4.2 Survey methodology

Fieldwork period

The non-household survey interviews took place between November 2022 and December 2022, at roughly the same period as the household survey.

Panel

For the Panel approach, a commercial panel was used (Quest Mindshare), with a maximum target of 100 interviews (50% of the overall target of 200). No sampling targets or quotas were applied.

Due to lower response rates than expected via CATI, the quota was opened up to achieve the remaining interviews, achieving a total of 169 interviews.

Unlike with the Collaborative ODI research that used MOSL data, the Panel survey required a process confirming that the participant was eligible to take part by representing a non-household customer in the United Utilities region. Similar to the household panel survey,

non-household panel participants were asked to provide the first part of their postcode (the district). The questionnaire software then used a look-up table to identify whether United Utilities was their water and wastewater service company and asked the participant if they agreed with that. If not, or if the look-up indicated that another water and/or wastewater company supplied the postcode district stated, the participant was provided with a list of water and/or wastewater companies and asked to identify the relevant provider. If they typed in another company, said don't know or that none provided the service (for example because they had a septic tank) then the interview was closed.

The interviews took place between 01/12/22 and 24/12/22.

Telephone

Contacts were phoned and informed that the survey would involve being offered a series of choice pairs, where they could choose whether they would rather Scenario A, or Scenario B to occur and that these were hosted online. They were told it might be helpful in terms of speed and understanding if they were able to quickly look at them via a short link that could be read out. If not they were reassured that these could be read out over the phone.

The link was in the following format: https://acsvy.com/3586/s1 with 30 variants.

Due to the proximity of the CATI fieldwork to the Christmas period, response rates were lower than expected, with potential participants saying they were too busy to take part and that they would be more willing to answer the survey in January. With timeline constraints requiring fieldwork to be completed at the end of December, the decision was made to fill the shortfall using the online panel.

32 interviews were achieved via CATI and they took place between 06/12/22 and 16/12/22.

4.3 Sample characteristics

Once fieldwork was completed, the resulting dataset was cleaned to remove poor quality responses (including speeders, straightliners, multiple responses from the same IP address and those providing poor quality verbatim). For open-ended questions, coding frames were developed, and responses coded.

The following tables and statistics are intended to present a brief snapshot of the non-household sample.

Achieved sample sizes

The non-household survey achieved 201 interviews against a target sample size of 200 business. 32 were completed via CATI and 169 via online panel.

Survey completion times

The average completion times for the non-household survey were as follows:

Table 15: Non-household survey completion times

Sample	Online interviews	CATI interviews
United Utilities Bespoke ODI research	6 minutes 44 seconds	14 minutes 32 seconds
Collaborative ODI research	15 minutes 19 seconds	19 minutes 14 seconds

The survey for the Bespoke ODI research hence took less time than the Collaborative ODI research, principally due to the fact that the compensation exercise was removed.

As in the Collaborative ODI research CATI interviews took longer than online, though the difference was greater in the Bespoke research, perhaps as a result of panel participants being more accustomed to completing surveys, a hypothesis that was used to explain the shorter survey times for panel vs PAF in the Collaborative ODI Research.

Key premises characteristics

Table 16 presents a comparison of key non-household sample characteristics against what was achieved in the Collaborative ODI research and population statistics where available. Unlike the Collaborative ODI research, consumption data is not shown as this was not available from the commercial sample used in this Bespoke ODI research.

For numbers of employees and industry sector, the relevant population data are drawn from BEIS business population estimates 2022. With respect to both size (number of employees) and sector, the achieved sample for the Bespoke ODI research is reasonably similar to the population data and much closer than the Collaborative ODI research was to population data.

Table 16: Key non-household sample characteristics compared to Collaborative ODI research sample and population statistics

Premises characteristic	Population %	United Utilities sample from Collaborative ODI research	United Utilities sample from Bespoke ODI research
Number of employees[(1)]			
0	15%	13%	12%
1-49	35%	68%	30%
50-249	15%	13%	21%
250+	35%	3%	35%
Base		*245*	*199*
Industry sector[(1)]			
A: Agriculture, Forestry and Fishing	1%	2%	0%
B,D,E: Mining and Quarrying; Electricity, Gas and Air Conditioning Supply; Water Supply; Sewerage, Waste Management and Remediation Activities	1%	7%	2%
C: Manufacturing	11%	3%	9%
F: Construction	7%	11%	9%
G: Wholesale and Retail Trade; Repair of Motor Vehicles and Motorcycles	21%	2%	12%
H: Transportation and Storage	5%	27%	4%
I: Accommodation and Food Service Activities	10%	1%	8%
J: Information and Communication	3%	1%	7%
K: Financial and Insurance Activities	2%	8%	3%
L: Real Estate Activities	2%	1%	4%
M: Professional, Scientific and Technical Activities	11%	1%	5%
N: Administrative and Support Service Activities	10%	2%	2%
O: Public Administration and Defence		4%	3%
P: Education	2%	8%	8%
Q: Human Health and Social Work Activities	7%	8%	10%
R: Arts, Entertainment and Recreation	3%	12%	4%
S: Other Service Activities	3%	3%	7%
Base		*246*	*201*

(1) Sample bases exclude 'don't know', 'not stated' and those that could not be coded. Sample bases=3,620 (Number of employees) and 3,596 (Industry sector).
Population figures are for private businesses only; ie they exclude the public sector.

4.4 Weighting

A weighting procedure was applied to ensure that the non-household sample was representative of the target population by business size (i.e., number of employees). The disaggregation of businesses into sizes (0, 1-49, 50-249, 250+ employees) in the population used data published by the Department for Business, Energy & Industrial Strategy (*Business Population Estimates for the UK and Regions 2022*). This data is at the regional level. The number of businesses in each region was assigned to water and sewerage companies proportionally to the area that those companies represent in the region. This was estimated in a Geographic Information System (GIS).

The weighting approach used a raking procedure (also known as iterative proportional fitting), details of which are given in Appendix F. Given that the sample design did not involve any deliberate over- or undersampling, the weighting procedure corrects for non-response bias only.

5 Analysis and results

This section provides a summary of the analysis undertaken and presents the results. It includes the following sub-sections:

- Participant feedback
- Diagnostics
- Impact scores
- Sensitivity analysis
- Segmentation analysis
- Customer valuations (based on Draft final Collaborative ODI Research results)

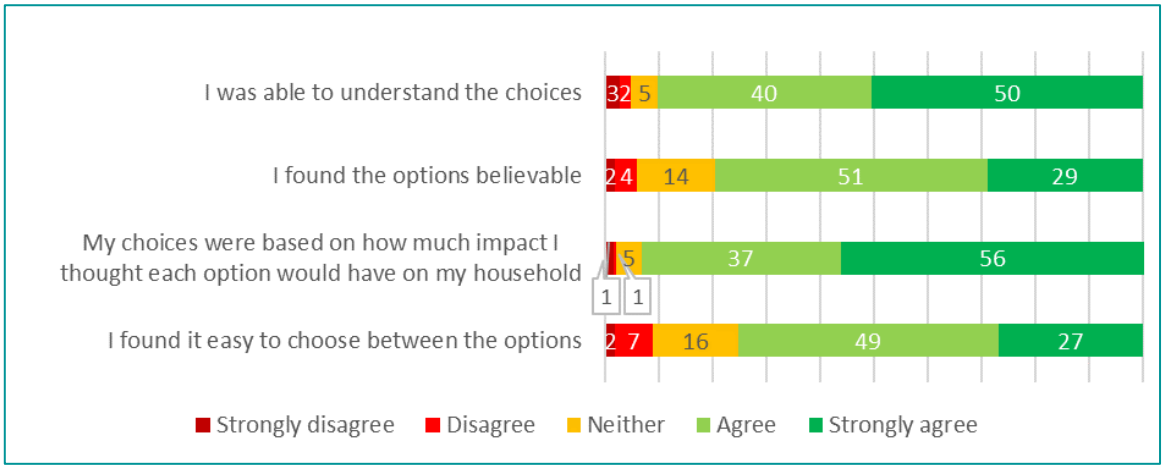
Technical details on the econometric modelling are contained within Appendix G.

5.1 Participant feedback

Feedback from household participants following the impact exercise was positive. As shown in Figure 2, only small proportions of participants disagreed a) that they were able to understand the choices, b) that they found the options believable, c) that their choices were based on how much impact each option would have on their household/organisation, and d) that they found it easy to choose between the options. Feedback from non-household participants was better than from household participants, with substantially higher proportions of participants in the top 'strongly agree' category compared to households.

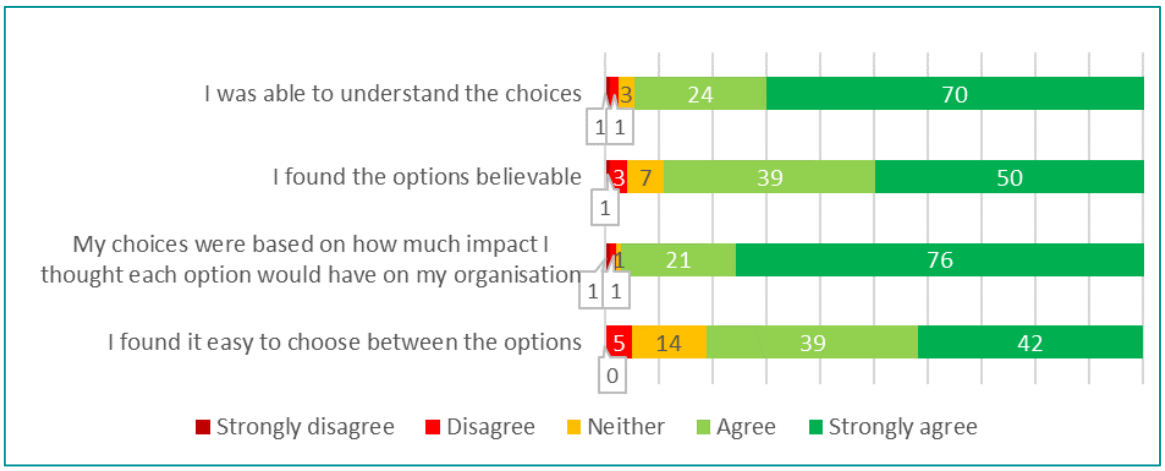
These findings provide support for considering the responses to the choice questions to be valid and meaningful in most cases. Moreover, we investigated the impact of potentially invalid responses from participants who gave negative feedback. (See Section 5.4 for details of this sensitivity analysis).

Figure 2: SP household participant feedback



Base: 2,019 household participants (unweighted)

Figure 3: SP non-household participant feedback

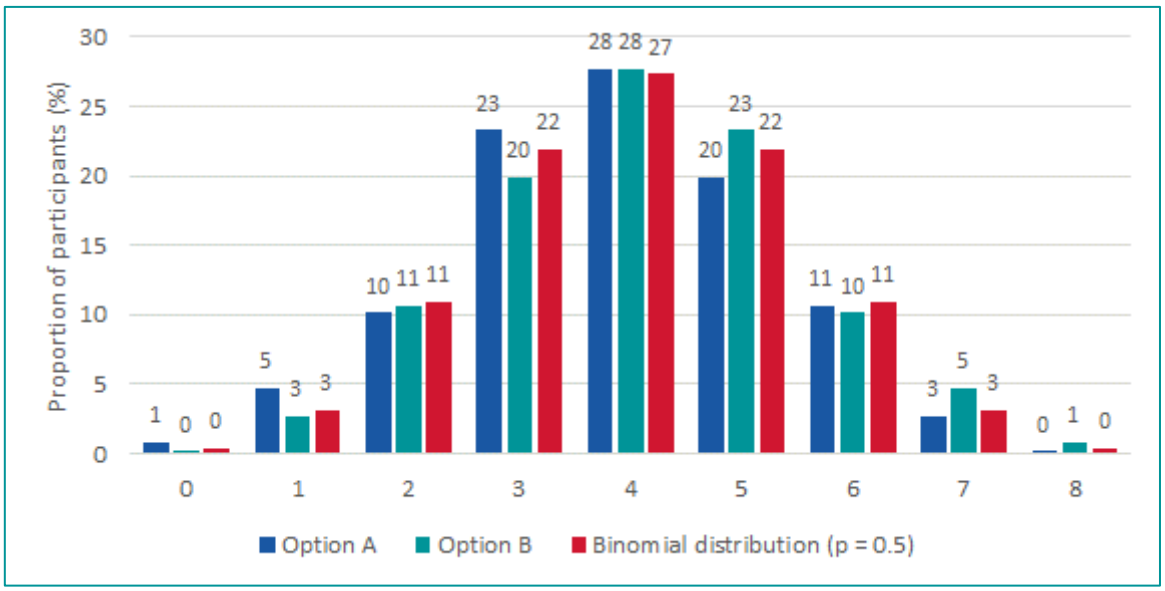


Base: 201 non-household participants (unweighted)

5.2 Diagnostics

Making the same choices repeatedly (e.g., Option A chosen nine times in a row) can be indicative of not engaging with the survey, and a large number of non-traders implies a poor-quality dataset for analysis. Figure 4 compares the sample distribution of the number of Option A/B choices against the theoretical (binomial) distribution that is obtained when there are equal choice probabilities for Option A and Option B in each question. Only a tiny proportion (1.9%) chose the same option across all 8 choice occasions, and the distributions of the number of Option A/B choices are in line with the expected theoretical distribution. This suggests that non-trading was not a cause for concern.

Figure 4: Distribution of the number of Option A/B choices (out of 8)



Base: 2,220 participants (households and non-households combined; unweighted)

5.3 Impact scores

The main results from the study are the relative impacts of each service issue in comparison to the three pivot service issues carried from the Collaborative ODI research. These relative impacts were estimated via an econometric analysis of the SP choice data, details of which are given in Appendix G.

Two sets of relative impact estimates were derived from the analysis. The first set of estimates was derived by calibrating to the Collaborative ODI research valuations for the whole of England and Wales, while the second set of estimates was derived using the Collaborative ODI research valuations for United Utilities customers. At the time of reporting, it was unclear which of these sets of estimates will be recommended by Ofwat for companies to use.

The relative impacts are shown in Table 17 and Table 18 (households) and Table 19 and Table 20 (non-households). For example, Table 17 shows that households regarded a one-off sewer flooding incident inside their property as being nearly 6 times more impactful than emergency drought restrictions. The impact of each scenario relative to each of the three pivot scenarios[2] is shown alongside the impact scores, which are re-based to sum to 100 over the full set of service issues. These are particularly useful for segmentation analysis as they sum to the same number for each segment.

As expected, internal sewer flooding incidents were by far the highest impact scenarios, accounting for around 50% and over 80% of the 'total impact' for household and non-household customers, respectively. The impact ranking of the various sewer flooding incidents was as expected, with internal sewer flooding incidents having a higher impact than flooding in the cellar/basement (households only), followed by external sewer flooding, and repeated incidents having a higher impact than one-off incidents.

While impact scores for household customers were relatively precisely estimated, as indicated by narrow confidence intervals, the confidence intervals around non-household impact scores are quite wide, indicating a relatively poor statistical fit. This lack of precision can be at least partly attributed to the substantially smaller sample size of the non-household survey in comparison to the household survey.

[2] The pivot scenarios, which were also included in the Collaborative ODI research are: a) 'Sewer flooding: inside your property (1 month)'; b) 'Emergency drought restrictions (2 months)'; c) 'Discoloured water (24h)'.

Table 17: Impact of service issues: household customers (rescaled based on Collaborative ODI research pivot valuations for England and Wales)

	Impact score			Impact relative to internal sewer flooding (1 month)			Impact relative to emergency drought restriction (2 months)			Impact relative to discoloured water (24h)		
		95% conf. int.			95% conf. int.			95% conf. int.			95% conf. int.	
Service issue	Score	Lower	Upper	Ratio	Lower	Upper	Ratio	Lower	Upper	Ratio	Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	27.15	23.80	30.97	1.02	0.92	1.14	5.87	4.98	6.92	14.86	12.39	17.81
Sewer flooding: inside your property (1 month)	26.50	24.52	28.64	1.00			5.73	4.91	6.68	14.50	12.18	17.28
Sewer flooding: in your cellar/basement once every 3 years (1 month)	9.01	7.81	10.40	0.34	0.30	0.38	1.95	1.72	2.20	4.93	4.42	5.50
Sewer flooding: in your cellar/basement (1 month)	7.50	6.11	9.20	0.28	0.23	0.34	1.62	1.45	1.81	4.10	3.71	4.54
Sewer flooding: outside your property once every 3 years (1 week)	5.71	4.87	6.68	0.22	0.19	0.25	1.23	1.14	1.33	3.12	2.87	3.39
Unexpected water supply interruption (72h)	5.04	4.28	5.94	0.19	0.16	0.22	1.09	1.02	1.16	2.76	2.58	2.95
Emergency drought restrictions (2 months)	4.62	3.89	5.49	0.17	0.15	0.20	1.00			2.53	2.37	2.71
Water taste and smell (1 week)	2.97	2.48	3.55	0.11	0.10	0.13	0.64	0.60	0.69	1.62	1.54	1.71
Boil water notice (1 week)	2.83	2.35	3.41	0.11	0.09	0.13	0.61	0.57	0.66	1.55	1.46	1.65
Slow draining wastewater (1 week)	2.79	2.30	3.38	0.11	0.09	0.13	0.60	0.56	0.65	1.53	1.44	1.61
Slow draining wastewater (24h)	2.11	1.76	2.53	0.08	0.07	0.09	0.46	0.42	0.49	1.16	1.08	1.24
Unexpected low pressure (72h)	1.95	1.61	2.36	0.07	0.06	0.09	0.42	0.39	0.45	1.07	1.00	1.13
Discoloured water (24h)	1.83	1.51	2.21	0.07	0.06	0.08	0.40	0.37	0.42	1.00		
Total	100											

Table 18: Impact of service issues: household customers (rescaled based on Collaborative ODI research pivot valuations for United Utilities)

	Impact score			Impact relative to internal sewer flooding (1 month)			Impact relative to emergency drought restriction (2 months)			Impact relative to discoloured water (24h)		
		95% conf. int.			95% conf. int.			95% conf. int.			95% conf. int.	
Service issue	Score	Lower	Upper	Ratio	Lower	Upper	Ratio	Lower	Upper	Ratio	Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	25.99	22.91	29.49	1.02	0.93	1.13	5.35	4.58	6.25	12.90	10.86	15.32
Sewer flooding: inside your property (1 month)	25.41	23.55	27.41	1.00			5.23	4.52	6.05	12.61	10.68	14.88
Sewer flooding: in your cellar/basement once every 3 years (1 month)	9.14	7.97	10.49	0.36	0.32	0.40	1.88	1.68	2.11	4.54	4.09	5.03
Sewer flooding: in your cellar/basement (1 month)	7.68	6.32	9.33	0.30	0.25	0.36	1.58	1.42	1.76	3.81	3.46	4.20
Sewer flooding: outside your property once every 3 years (1 week)	5.93	5.10	6.90	0.23	0.20	0.27	1.22	1.14	1.31	2.94	2.72	3.18
Unexpected water supply interruption (72h)	5.27	4.51	6.17	0.21	0.18	0.24	1.09	1.02	1.15	2.62	2.45	2.79
Emergency drought restrictions (2 months)	4.86	4.12	5.73	0.19	0.17	0.22	1.00			2.41	2.26	2.57
Water taste and smell (1 week)	3.19	2.69	3.78	0.13	0.11	0.15	0.66	0.62	0.70	1.58	1.51	1.66
Boil water notice (1 week)	3.05	2.55	3.64	0.12	0.10	0.14	0.63	0.59	0.67	1.51	1.43	1.61
Slow draining wastewater (1 week)	3.01	2.50	3.61	0.12	0.10	0.14	0.62	0.58	0.66	1.49	1.41	1.57
Slow draining wastewater (24h)	2.31	1.94	2.75	0.09	0.08	0.11	0.48	0.44	0.51	1.15	1.08	1.22
Unexpected low pressure (72h)	2.14	1.79	2.57	0.08	0.07	0.10	0.44	0.41	0.47	1.06	1.00	1.13
Discoloured water (24h)	2.02	1.68	2.42	0.08	0.07	0.09	0.41	0.39	0.44	1.00		
Total	100											

Table 19: Impact of service issues: non-household customers (rescaled based on Collaborative ODI research pivot valuations for England and Wales)

	Impact score			Impact relative to internal sewer flooding (1 month)			Impact relative to emergency drought restriction (2 months)			Impact relative to discoloured water (24h)		
		95% conf. int.			95% conf. int.		Ratio	95% conf. int.			95% conf. int.	
Service issue	Score	Lower	Upper	Ratio	Lower	Upper		Lower	Upper	Ratio	Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	56.56	29.55	108.24	2.43	1.42	4.15	14.83	7.73	28.45	56.53	24.04	132.94
Sewer flooding: inside your property (1 month)	23.28	16.12	33.62	1.00			6.11	3.29	11.32	23.27	10.38	52.16
Unexpected water supply interruption (72h)	4.04	2.01	8.10	0.17	0.10	0.31	1.06	0.77	1.45	4.03	2.85	5.70
Emergency drought restrictions (2 months)	3.81	1.86	7.82	0.16	0.09	0.30	1.00			3.81	2.64	5.50
Sewer flooding: outside your property once every 3 years (1 week)	3.52	1.76	7.04	0.15	0.08	0.27	0.92	0.67	1.27	3.52	2.44	5.09
Boil water notice (1 week)	1.89	0.92	3.86	0.08	0.04	0.15	0.49	0.37	0.66	1.89	1.40	2.54
Slow draining wastewater (1 week)	1.73	0.79	3.79	0.07	0.04	0.15	0.45	0.33	0.63	1.73	1.35	2.21
Water taste and smell (1 week)	1.69	0.70	4.05	0.07	0.03	0.16	0.44	0.31	0.64	1.69	1.40	2.04
Slow draining wastewater (24h)	1.41	0.62	3.20	0.06	0.03	0.13	0.37	0.26	0.52	1.41	1.15	1.72
Unexpected low pressure (72h)	1.08	0.49	2.38	0.05	0.02	0.09	0.28	0.21	0.39	1.08	0.88	1.32
Discoloured water (24h)	1.00	0.41	2.43	0.04	0.02	0.10	0.26	0.18	0.38	1.00		
Total	100											

Table 20: Impact of service issues: non-household customers (rescaled based on Collaborative ODI research pivot valuations for United Utilities)

	Impact score			Impact relative to internal sewer flooding (1 month)			Impact relative to emergency drought restriction (2 months)			Impact relative to discoloured water (24h)		
		95% conf. int.			95% conf. int.		Ratio	95% conf. int.			95% conf. int.	
Service issue	Score	Lower	Upper	Ratio	Lower	Upper		Lower	Upper	Ratio	Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	58.97	29.71	117.04	2.55	1.45	4.47	17.09	8.61	33.93	69.89	28.41	171.94
Sewer flooding: inside your property (1 month)	23.16	15.67	34.24	1.00			6.71	3.50	12.86	27.46	11.74	64.22
Unexpected water supply interruption (72h)	3.66	1.76	7.64	0.16	0.08	0.29	1.06	0.76	1.48	4.34	3.02	6.25
Emergency drought restrictions (2 months)	3.45	1.62	7.37	0.15	0.08	0.29	1.00			4.09	2.78	6.02
Sewer flooding: outside your property once every 3 years (1 week)	3.17	1.53	6.59	0.14	0.07	0.25	0.92	0.66	1.28	3.76	2.55	5.54
Boil water notice (1 week)	1.65	0.77	3.50	0.07	0.04	0.14	0.48	0.35	0.65	1.95	1.43	2.67
Slow draining wastewater (1 week)	1.50	0.66	3.43	0.06	0.03	0.13	0.43	0.31	0.61	1.78	1.37	2.31
Water taste and smell (1 week)	1.46	0.58	3.68	0.06	0.03	0.15	0.42	0.29	0.63	1.74	1.42	2.12
Slow draining wastewater (24h)	1.21	0.51	2.88	0.05	0.02	0.11	0.35	0.25	0.50	1.43	1.16	1.77
Unexpected low pressure (72h)	0.92	0.40	2.10	0.04	0.02	0.08	0.27	0.19	0.37	1.09	0.88	1.34
Discoloured water (24h)	0.84	0.33	2.15	0.04	0.02	0.09	0.24	0.17	0.36	1.00		
Total	100											

5.4 Sensitivity analysis

A sensitivity analysis was undertaken to investigate the impact of the following groups of potentially invalid responses from participants:

- Those who disagreed with any of the feedback questions:
  - that they were able to understand the choices
  - that they found the options believable
  - that their choices were based on how much impact they thought each option would have on their household/organisation
  - that they found it easy to choose between the options

- Those whose completion times of the SP questions were less than the 10^{th}/25^{th} percentiles, on the grounds that fast completion times may be indicative of a lack of engagement.

While we did find a greater variance, i.e., a lower degree of response consistency among those who gave negative feedback, the difference was not statistically significant, suggesting that it was appropriate to pool all responses.

Likewise, the impact scores were not substantively sensitive to excluding those with short completion times, for both households and non-households.

We used a similar approach to test for differences in preferences between participants who did/did not have a cellar/basement. (The sewer-flooding-in-cellar scenarios were only shown to those whose home had a cellar/basement.) These tests support pooling the two subsamples for the purposes of the analysis.

See Appendix G, 'Sensitivity analysis' section, for full details of the econometric models estimated and the tests applied to establish these findings.

5.5 Segmentation analysis

A segmentation analysis was undertaken to explore how preferences varied across the population. Table 21 shows the customer segments that were examined. Each segment's impact scores were compared against the impact scores of the complement segment 'Other' (for example, social grades A&B vs C&D&E combined) testing for statistically significant differences. Given the computationally intensive nature of the estimation of the Bayesian mixed logit models, the impact scores used for segmentation purposes were

derived by estimating conditional logit models allowing each coefficient to differ between any segment and the complement segment[3].

Significant differences in impact scores across household and non-household segments are shown in Table 22 and Table 23. For example, repeated internal sewer flooding incidents had a greater impact in rural areas compared to urban areas.

While several statistically significant differences were found, the differences were small in most cases. Notably, the scenario impact scores generally did not differ between customers who had/had not experienced the relevant service issues[4]. This supports the validity of our impact estimates as it suggests that participants' choices were based on assessed impacts as opposed to being driven by past experiences.

Table 21: Customer segments

Characteristic	Segment
Household segments	
Age	18-29
	30-64
	65+
Sex	Male
	Female
SEG	A&B
	C
	D&E
Household bills	Can always/usually afford to pay
	Sometimes/usually/always struggle to pay
Vulnerability	Medical
	Communications
	Lifestage
	Financial
	Any
Urban/rural	Urban
	Rural
Service issue experienced	Unexpected water supply interruption
	Unexpected low pressure
	Boil water notice
	Discolouration of tap water
	Change to the taste/smell of tap water
	Sewer flooding: inside property
	Sewer flooding: outside property
	Emergency drought restrictions
Non-household segments	

[3] The impact scores were calculated as exponentiated coefficients, rescaled to sum to 100. For segmentations by experience of service issues, only the relevant interaction terms were included, e.g., 'Has had/has not had discoloured tap water' × 'Discoloured water (24h)', only. Interaction terms between segment dummy variables and service issues were included for non-cellar attributes only, as the group of participants who had a cellar/basement was too small to be broken down into segments.

[4] The sole exception to this is the impact score of 'Discoloured water (24h)', which was counterintuitively, but only marginally, lower among customers who had experienced discoloured tap water than among those who had not.

Characteristic	Segment
Employees	0 (sole trader)
	1-49
	50-249
	250+
Water use	In the manufacturing process
	Supply of services (e.g. cleaning services)
	Ingredient or part of product or service
	Normal domestic use for organisation

Table 22: Significant differences in impacts among household segments

Sewer flooding: inside your property once every 3 years (1 month)	
SEG	C (22)
	D&E (11)
Bill affordability	Can always/usually afford to pay (20)
	Sometimes/usually/always struggle to pay (13)
Vulnerability	Communications (11)
Urban/rural	Urban (18)
	Rural (24)

Sewer flooding: inside your property (1 month)	
Bill affordability	Can always/usually afford to pay (25)
	Sometimes/usually/always struggle to pay (16)
Vulnerability	Medical (17)

Sewer flooding: in your cellar/basement once every 3 years (1 month)	
Age	18-29 (12)
SEG	C (13)
	D&E (21)
Bill affordability	Can always/usually afford to pay (14)
	Sometimes/usually/always struggle to pay (19)
Vulnerability	Medical (18)
	Any (17)

Sewer flooding: in your cellar/basement (1 month)	
Age	18-29 (7)
SEG	C (8)
	D&E (11)
Bill affordability	Can always/usually afford to pay (8)
	Sometimes/usually/always struggle to pay (11)
Vulnerability	Medical (11)
	Any (10)

Slow draining wastewater (1 week)	
Bill affordability	Can always/usually afford to pay (3)
	Sometimes/usually/always struggle to pay (4)

Slow draining wastewater (24h)	
Age	18-29 (2)
SEG	C (2)
	D&E (3)
Bill affordability	Can always/usually afford to pay (2)
	Sometimes/usually/always struggle to pay (3)
Vulnerability	Medical (3)
	Any (3)

Boil water notice (1 week)	
Age	65+ (3)
Bill affordability	Can always/usually afford to pay (3)
	Sometimes/usually/always struggle to pay (4)
Urban/rural	Urban (4)
	Rural (2)

Unexpected water supply interruption (72h)	
Sex	Male (6)
	Female (8)
Bill affordability	Can always/usually afford to pay (7)
	Sometimes/usually/always struggle to pay (8)

Water taste and smell (1 week)	
Age	18-29 (5)
	65+ (3)
SEG	A&B (3)
	C (4)
	D&E (6)
Bill affordability	Can always/usually afford to pay (3)
	Sometimes/usually/always struggle to pay (6)
Urban/rural	Urban (4)
	Rural (3)

Discoloured water (24h)	
Age	18-29 (3)
	65+ (1)
Bill affordability	Can always/usually afford to pay (2)
	Sometimes/usually/always struggle to pay (3)
Urban/rural	Urban (2)
	Rural (1)
Service issue	Discolouration of tap water (2)

Unexpected low pressure (72h)	
Age	18-29 (3)
	65+ (1)
SEG	D&E (3)
Bill affordability	Can always/usually afford to pay (2)
	Sometimes/usually/always struggle to pay (3)
Urban/rural	Urban (2)
	Rural (1)

Note: Green (red) cells for any given segment indicate that the relevant service issue has a higher impact on customers in that segment compared to customers in the complement segment 'Other', the difference in impact scores across segments being statistically significant at the 5% level. The numbers in parentheses are the segment-level impact scores.

Table 23: Significant differences in impacts among non-household segments

Sewer flooding: inside your property (1 month)	
Employees	0 (sole trader) (69)
Slow draining wastewater (24h)	
Water use	Ingredient or part of product or service (1)
Discoloured water (24h)	
Water use	Ingredient or part of product or service (0.4)
Unexpected low pressure (72h)	
Water use	Normal domestic use for organisation (2)

Note: Green (red) cells for any given segment indicate that the relevant service issue has a higher impact on customers in that segment compared to customers in the complement segment 'Other', the difference in impact scores across segments being statistically significant at the 5% level. The numbers in parentheses are the segment-level impact scores.

5.6 Customer valuations

Customer valuations of service issues, expressed in terms of customers' willingness-to-accept (WTA) compensation in the event of an incident, were calculated based on valuations of the three pivot issues from the Collaborative ODI research. The Collaborative ODI research has obtained values for England and Wales as well as values for United Utilities customers, as shown in Table 24. At present, it is not clear whether Ofwat will require companies to use the England and Wales values or the company specific ones. Hence, the following tables include valuations based on both 'England and Wales' and 'United Utilities' pivot valuations as provided by Ofwat.

Table 24: Customer valuations from the Collaborative ODI research

	England and Wales		United Utilities customers	
Service issue	Household	Non-household	Household	Non-household
Sewer flooding: inside your property (1 month)	£1,038.8	£50,340	£789.9	£73,730
Emergency drought restrictions (2 months)	£235.6	£9,205	£205.2	£8,817
Discoloured water (24h)	£78.5	£2,208	£69.7	£2,580

Source: 3524m_SPResults.xlsx, provided by Ofwat to companies on 19 Jan 2023.

A set of monetary valuations was constructed for each pivot by multiplying the pivot valuations shown in Table 24 by the corresponding relative impacts in Table 17 to Table 20[5]. These pivot-based valuations are shown in Table 32 to Table 35 in Appendix G. The valuations were relatively similar across pivots, for both household and non-household customers.

For the purpose of deriving a single central value for each service issue, the three pivot-based values were combined as an inverse variance-weighted average, with lower and upper bounds taken to be the lowest of the lower bounds across the three pivot estimates, and the upper bound taken to be the highest of the upper bounds across the three pivot

[5] For example, United Utilities household customers' value of £69.7 for discoloured water times the impact of each service issue relative to discoloured water as shown in Table 18.

estimates. This approach is consistent with the approach taken to combining valuations across pivots in the Collaborative ODI research.

The weighted average values are shown in Table 25 for household customers and Table 26 for non-household customers.

For households, valuations based on pivot values for England and Wales are 10-30% higher, depending on service issue, compared to valuations based on pivot values for United Utilities customers. The reverse is true for non-households. These differences are driven by differences between the underlying Collaborative ODI research pivot values for England and Wales and the Collaborative ODI research pivot values for United Utilities shown in Table 24.

The confidence ranges are based on a conservative approach which uses the smaller of the lower bounds of the three pivot-based value estimates, which are used to compute the weighted averages shown in Table 25 and Table 26, and the larger of the upper bounds. The confidence ranges are wider for non-households than for households, reflecting a substantially smaller sample size of the non-household survey in comparison to the household survey. The confidence ranges around the two values (based on Collaborative ODI research values for England and Wales vs for United Utilities customers) overlap for each service issue, for both households and non-households.

Table 25: Main values for households

	Pivot values: England and Wales			Pivot values: United Utilities		
		Confidence range			Confidence range	
Service issue	Value	Lower	Upper	Value	Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	£1,134.6	£956.8	£1,630.8	£868.5	£730.7	£1,283.0
Sewer flooding: in your cellar/basement once every 3 years (1 month)	£389.9	£313.3	£519.4	£318.0	£253.6	£433.9
Sewer flooding: in your cellar/basement (1 month)	£335.3	£243.4	£427.3	£277.7	£199.7	£360.6
Sewer flooding: outside your property once every 3 years (1 week)	£258.1	£194.9	£313.7	£217.2	£161.8	£269.0
Unexpected water supply interruption (72h)	£230.2	£171.0	£273.6	£195.3	£142.9	£236.4
Water taste and smell (1 week)	£133.0	£99.0	£161.9	£115.7	£85.2	£143.8
Boil water notice (1 week)	£127.7	£93.6	£155.0	£111.5	£80.8	£137.9
Slow draining wastewater (1 week)	£125.2	£91.6	£152.6	£109.4	£79.1	£135.9
Slow draining wastewater (24h)	£95.6	£70.2	£115.8	£84.8	£61.5	£104.6
Unexpected low pressure (72h)	£88.4	£64.3	£106.2	£78.8	£56.5	£96.4

Note: Value measured in pounds per household per incident. The confidence ranges around the values are not the statistical confidence intervals. The lower bound of each confidence range is set to be the smaller of the lower bounds of the three pivot-based value estimates, and the upper bound the larger of the upper bounds. This confidence range captures uncertainty around the true value attributable to the choice of pivot.

Table 26: Main values for non-households

Service issue	Pivot values: England and Wales			Pivot values: United Utilities		
	Value	Confidence range		Value	Confidence range	
		Lower	Upper		Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	£126,808	£53,061	£293,480	£170,765	£73,298	£443,578
Unexpected water supply interruption (72h)	£9,240	£4,834	£15,761	£10,197	£6,260	£21,716
Sewer flooding: outside your property once every 3 years (1 week)	£8,073	£4,240	£13,687	£8,814	£5,452	£18,719
Boil water notice (1 week)	£4,316	£2,207	£7,546	£4,590	£2,742	£10,002
Slow draining wastewater (1 week)	£3,914	£1,869	£7,473	£4,275	£2,302	£9,900
Water taste and smell (1 week)	£3,783	£1,650	£8,083	£4,289	£2,019	£10,753
Slow draining wastewater (24h)	£3,167	£1,461	£6,348	£3,507	£1,776	£8,338
Unexpected low pressure (72h)	£2,439	£1,169	£4,691	£2,649	£1,404	£6,065

Note: Value measured in pounds per organisation per incident. The confidence ranges around the values are not the statistical confidence intervals. The lower bound of each confidence range is set to be the smaller of the lower bounds of the three pivot-based value estimates, and the upper bound the larger of the upper bounds. This confidence range captures uncertainty around the true value attributable to the choice of pivot.

6 Conclusions

The core objective of the present research was to provide customer impact estimates of 13 service issues/scenarios as well as monetary valuations of these scenarios not happening. Three 'pivot' service issues (internal sewer flooding, rota cuts, and discoloured water) are in common between the present research and the Collaborative ODI research study, providing a consistent basis for obtaining valuations for the remaining 10 service issues.

The study adhered to Ofwat's standards for high quality customer research throughout, as detailed in Appendix A.

The findings support the following conclusions.

- Participant feedback was very positive, and there were no signs of non-trading, suggesting good performance of the choice exercise.
- As expected, internal sewer flooding incidents were by far the highest impact scenarios, accounting for around 50% and over 80% of the 'total impact' for household and non-household customers, respectively, and the impact ranking of the various sewer flooding incidents was generally as expected.
- While impact scores for household customers were relatively precisely estimated, the confidence intervals around non-household impact scores were wide, leading to wide confidence intervals around non-household customers' valuations.
- For households, valuations based on pivot values from the Collaborative ODI research for England and Wales were 10-30% higher, depending on service issue, compared to valuations based on pivot values from the Collaborative ODI research for United Utilities customers. The reverse is true for non-households. These differences are driven by differences between the underlying Collaborative ODI research pivot values for England and Wales and the company-specific ones.
- The confidence ranges around values were wider for non-households than for households, reflecting a substantially smaller sample size of the non-household survey in comparison to the household survey.

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Appendix A

Adherence to Ofwat's standards for high quality customer research

Adherence to Ofwat's standards for high quality customer research

The study has adhered to the requirements for quality customer research set out in Ofwat (2022), as shown in Table 27 below.

Table 27: Ofwat requirements and how the study has adhered

Requirement	How the study has adhered
Useful and contextualised	The research had clear objectives to gain United Utilities-specific, evidence on customer valuations needed to address gaps in the collaborative research evidence base with respect to bespoke ODIs and to fully evidence enhancement cases. This was fully aligned to PR24 and undertaken combination with Collaborative ODI research on behalf of Ofwat and CCW.
Neutrally designed	Research designed by an independent research agency and peer reviewed by an independent professional. All research materials underwent a pilot stage to ensure they were neutral and free from bias.
Fit for purpose	The methodology was designed to replicate Collaborative ODI research on behalf of Ofwat and CCW. Also, all research materials were cognitively tested with customers and underwent a pilot stage.
Inclusive	Household, business and future bill payers were represented. The PAF methodology enabled representation of harder to reach audiences (e.g. digitally excluded). All segments were monitored to ensure representation via a bespoke dashboard.
Continual	Questions included to compare result to other United Utilities quantitative research. Full methodology report to enable replicability. The outcomes of the research will be used to directly inform the bespoke PCs and the value attributed to them.
Independently assured	Research and analysis conducted by an independent research agency. United Utilities collaborated with Your Voice, the Independent Challenge Group, who reviewed all research materials and provided a check and challenge approach on the method and findings. The research was also reviewed by an independent peer reviewer, with their suggested changes and subsequent actions evidenced in this report.
Shared in full with others	The full final report and research materials will be shared on the United Utilities' research library webpage when appropriate to do so.
Ethical	Research conducted in accordance with the Market Research Society code of conduct and conforming to the requirements of ISO 20252:2019. Throughout the research, participants

	were reminded that the research was anonymous and both Accent and United Utilities were subject to strict data protection protocols.

Appendix B

Main Survey Questionnaire

Water Company Research

This survey is designed to get your views on water and sewerage services. It is being undertaken on behalf of United Utilities, the organisation which provides water and sewerage services for customers in the North West of England.

The research will be used to help them plan investment in their service from 2025, and will influence your future water services and bills.

This research is being conducted by Accent, an independent research agency on behalf of United Utilities.

NOT PANEL: Anyone who is eligible to take part and completes the full survey will receive a £10 voucher (either an Amazon voucher, an M&S voucher or a One4All voucher). Alternatively, we can donate your incentive to WaterAid. Details on how to claim your voucher are given at the end of the survey.

The questionnaire will take about 10 minutes to complete.

Any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society and your data will be treated in accordance with the Data Protection Act 2018. If you would like to confirm Accent's credentials type Accent in the search box at: https://www.mrs.org.uk/researchbuyersguide.

You do not have to answer any question you do not wish to and you may terminate the interview at any point.

QA IF PAF: Please enter the **Unique ID** that is printed on the top right of your letter.

Please enter the **PIN** number that is printed on the top right of your letter.

Q1. **IF PAF OR CATI: Any data collected over the course of this interview that could be used to identify you, such as your name, address, or other contact details, will be held securely and will not be shared with any third party, including United Utilities, unless you give permission (or unless we are legally required to do so). Our privacy statement is available at https://www.accent-mr.com/privacy-policy/.**

Do you agree to proceeding with the interview on this basis?

Yes
No **THANK AND CLOSE IF ONLINE**

Q1a. **IF KANTAR PANEL:** Our client, Accent, would like to analyse the results of this survey using geographical areas. For this purpose, they would like to collect your postcode. Your data will be processed and kept securely in accordance with their Privacy Policy: https://www.accent-mr.com/privacy-policy/. All information you provide is only used for research purposes related to this project, will be held in strict confidence and will not be shared in any public domain.

Do you agree to share your postcode with Accent for that purpose?

Yes, I agree
No, I do not agree **THANK & CLOSE**

Q2. **ASK HH ONLY:** Do you or any of your close family work in market research or for a water company?

Yes **THANK & CLOSE**
No

Q3. **Removed**

Q3b HH ONLY: Does your **NHH ONLY:** ~~that~~ property have a septic tank or cess pit? If you do have one, this would mean that your property is **not** connected to the main sewer and you would periodically arrange to have the septic tank emptied.

Yes **THANK & CLOSE**
No

Q4. **IF PANEL AND/OR NHH ASK (PAF GO TO Q8):** Please tell us the beginning of **HH ONLY:** your postcode **NHH ONLY:** the postcode of your organisation's trading address. If your organisation has more than one site, please think about either the main site, or another site that you know to be in the North West of England. We would then like you to think only about that specific site when responding to this survey, unless instructed otherwise.

So if your full postcode is ME14 3BN please just tell us ME14 3. (This will be used to check who supplies your water and wastewater services)

THANK AND CLOSE IF NON-UU POSTCODE

IF HH AND REFUSE GO TO Q6

IF NHH AND REFUSE, THANK AND CLOSE

If full postcode is given, shorten to enable lookup.

Q5.

IF HH PANEL: Based on your postcode area, we believe your clean water service and wastewater service company should be United Utilities. Is that correct?

Yes **GO TO Q8**
No **GO TO Q6**
Don't know **GO TO Q8**

Q6. **IF HH:** Which water company provides clean water and wastewater services to your home?

Affinity Water
Anglian Water
Bournemouth Water
Bristol Water
Cambridge Water
Essex & Suffolk Water
Hafren Dyfrdwy
Hartlepool Water
Northumbrian Water
Portsmouth Water
Severn Trent Water
South East Water
Southern Water
South Staffs Water
South West Water
Sutton & East Surrey (SES) Water
Thames Water
United Utilities **CONTINUE**
Welsh Water/Dŵr Cymru
Wessex Water
Yorkshire Water
Other (Please specify) **THEN THANK AND CLOSE**
Don't know **THANK AND CLOSE**
None **THANK AND CLOSE**

THANK AND CLOSE FOR NON-UU

Q7. **Removed**

Q7b. **IF NHH ASK:** Are you solely or jointly responsible as the decision maker for your organisation's water and wastewater service at that property?

Yes
No **THANK AND CLOSE**

Q7c **NHH ONLY:** Does that property have a septic tank or cess pit? If you do have one, this would mean that your property is **not** connected to the main sewer and you would periodically arrange to have the septic tank emptied.

Yes **THANK & CLOSE**
No

Q8. **IF HH:** Are you the person in your household who is responsible, either solely or jointly, for paying for your water services bill?

I have complete responsibility for payment
I share responsibility for payment with others in my household
I have no responsibility
Don't know

BILLPAYER : = CODE 1 OR 2
NONBILLPAYER : = CODE 3-4

Q9. IF HH Which of the following age groups do you fall into?

Under 18 THANK AND CLOSE
18-29
30-64
65 or older
Prefer not to say
USE HH QUOTA IF PANEL

Q10. IF HH What is your sex?

Male
Female
Prefer not to say
USE HH QUOTA IF PANEL

Q10b Would you describe the area in which HH ONLY: you live NHH ONLY: that property is located ALL: as being

An inner-city area
A suburban area
A town
A village
Rural/countryside

Q16b IF HH: Does your home have a cellar or basement?

Yes
No GO TO Q12b
Don't know GO TO Q12b

HASCELLAR : = CODE 1

Q16c IF HH: Is your cellar or basement used as a living space? For example as a bedroom, study or living room.

Yes
No
Don't know

Q11. Removed

Q12b IF HH & BILLPAYER: How often do you make payment for water and sewerage services?

Annually
Every six months
Every month, over eight months of the year
Every month
Other (please specify)
Don't know GO TO Q14

Q13 IF HH & BILLPAYER AND Q12B=1, 4-5 ASK: How much, roughly, do you pay for water and sewerage services each month, or in total for a year? The month amounts assume that the bills are paid evenly over a 12-month period, but

some customers pay over a different number of months.
IF HH & BILLPAYER AND Q12B=3 ASK: How much, roughly, do you pay for water and sewerage services for each of the eight months, or in total for a year?
IF HH & BILLPAYER AND Q12B=2 ASK: How much, roughly, do you pay for water and sewerage services every 6 months, or in total for a year?
IF NHH AND NO BILLING DATA FROM SAMPLE: Which of the following bands do you estimate that your organisation's annual total water bill at your premises falls into – that's the amount for both water and sewerage services.

IF HH and 12B=1, 4 or 5: Less than £10 per month/Less than £120 per year
IF HH and 12B=1, 4 or 5: £10 - £19.99 per month/£120 - £239.99 per year
IF HH and 12B=1, 4 or 5: £20 - £29.99 per month/£240 - £359.99 per year
IF HH and 12B=1, 4 or 5: £30 - £39.99 per month/£360 - £479.99 per year
IF HH and 12B=1, 4 or 5: £40 - £59.99 per month/£480 - £719.99 per year
IF HH and 12B=1, 4 or 5: £60 - £79.99 per month/£720 - £959.99 per year
IF HH and 12B=1, 4 or 5: £80 or more per month /£960 or more per year
IF HH and 12B=3: Less than £15 per month/Less than £120 per year
IF HH and 12B=3: £15 - £29.99 per month/£120 - £239.99 per year
IF HH and 12B=3: £30 - £39.99 per month/£240 - £319.99 per year
IF HH and 12B=3: £40 - £59.99 per month/£320 - £479.99 per year
IF HH and 12B=3: £60 - £89.99 per month/£480 - £719.99 per year
IF HH and 12B=3: £90 - £119.99 per month/£720 - £959.99 per year
IF HH and 12B=3: £120 or more per month /£960 or more per year
IF HH and 12B=2: Less than £60 every 6 months/Less than £120 per year
IF HH and 12B=2: £60 - £119.99 every 6 months /£120 - £239.99 per year
IF HH and 12B=2: £120 - £179.99 every 6 months /£240 - £359.99 per year
IF HH and 12B=2: £180 - £239.99 every 6 months /£360 - £479.99 per year
IF HH and 12B=2: £240 - £359.99 every 6 months /£480 - £719.99 per year
IF HH and 12B=2: £360- £479.99 every 6 months /£720 - £959.99 per year
IF HH and 12B=2: £480 or more every 6 months /£960 or more per year
IF NHH: Less than £1,000 per year
IF NHH: £1,000 to £5,000 per year
IF NHH: £5,000 to £25,000 per year
IF NHH: More than £25,000 per year
I'm not sure

TIMESTAMP

Service issues

Q14 Have you ever experienced any of the following **NHH ONLY:** at this property?
ROTATE **Please tick one or more**

Unexpected water supply interruption
Planned water supply interruption
Unexpected low pressure
Boil water notice
Do not drink notice
Discolouration of water coming out of your tap
A change to the taste and/or smell of your tap water
Sewer flooding: inside your property
Sewer flooding: outside your property
Hosepipe ban
Emergency drought restrictions **(e.g. tap water being cut off on a rota basis to conserve supplies)**
Pollution in a river

Pollution in the sea near a beach
Other (please specify)
I haven't experienced any of these GO TO Q15

Q14b **IF ONE BELOW IN Q14 ASK:** Have you experienced the following in the last 12 months **NHH ONLY:** at this property?
IF BOTH BELOW IN Q14 ASK: Have you experienced any of the following in the last 12 months **NHH ONLY:** at this property?

IF TICKED IN Q14: Discolouration of water coming out of your tap
IF TICKED IN Q14: A change to the taste and/or smell of your tap water

Q15 **Removed**

Q16 **Removed**

Q13A IF NHH CATI, PROVIDE OPTION TO SEND EMAIL WITH SERVICE ISSUES FOR PARTICIPANT TO HAVE ON SCREEN

Impact of service issues

You are now going to be shown a series of eight short questions where you will be asked to choose between two different scenarios for your water or wastewater service.

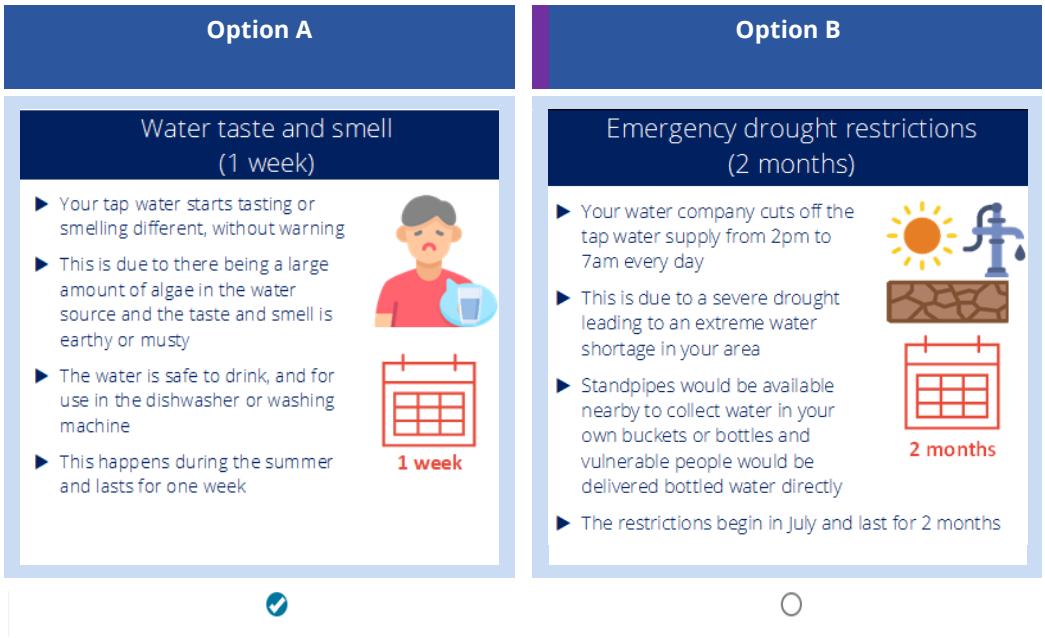
Please consider, and then compare the scenarios carefully, and then **choose the one which would have the most impact** on your IF HH: household IF NHH: organisation if it were to happen.

When comparing the impact that each would have, please:

- **do** consider any concerns you may have for your local or regional environment; but
- **don't** consider any impacts on other people outside your IF HH: household IF NHH: organisation - other people will answer for themselves!

Q17 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

EXAMPLE:



Q17b Why did you choose this option?

Q18 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

Q19 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

Q20 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

Q21 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

Q22 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

Q23 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

Q24 Which of these would have the most impact on your IF HH: household IF NHH: organisation?

TIMESTAMP

Q25 We would now like to ask you a few questions about the choices you have just made. How strongly do you agree or disagree with the following statements about the choices you have just made?

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
I was able to understand the choices					
I found the options believable					
My choices were based on how much impact I thought each option would have on my [IF HH] household [IF NHH] organisation.					
I found it easy to choose between the options					
NHH ONLY: I found it easy to answer with this specific property in mind					

Q26 ASK IF Q25R1 = 1 OR 2. OTHERS GO TO Q27: Why were you unable to understand the choices?

Q27 ASK IF Q25R2 = 1 OR 2. OTHERS GO TO Q28: What was not believable about the options shown?

Q28 ASK IF Q25R3 = 1 OR 2. OTHERS GO TO Q29: What were the main factors driving your choices if not the impact that each would have on your [IF HH] household [IF NHH] organisation?

Q29 ASK IF Q25R4 = 1 OR 2. OTHERS GO TO NEXT SECTION: Why was it difficult choosing between the options?

Q29B ASK IF 0.5 = 1 OR 2. OTHERS GO TO NEXT SECTION: Why was it difficult to answer with this specific property in mind?

Q38 Please use this box to leave any further comments about this topic or this survey. Please note, your water company will be unable to respond to individuals.

TIMESTAMP

Classification Questions

We will now ask you a few questions about you and your IF HH household IF NHH organisation. These will only be used to ensure we have spoken to a wide range of customers. All responses you give will be kept strictly confidential.

Q39 **IF HH:** How would you describe the occupation type of the main income earner in your household?

Higher managerial/ professional/ administrative (e.g. Established doctor, Solicitor, Board Director in a large organisation (200+ employees), top level civil servant/public service employee)
Intermediate managerial/ professional/ administrative (e.g. Newly qualified (under 3 years) doctor, Solicitor, Board director small organisation, middle manager in large organisation, principle officer in civil service/local government)
Supervisory or clerical/ junior managerial/ professional/ administrative (e.g. Office worker, Student Doctor, Foreman with 25+ employees, salesperson, etc)
Skilled manual work (e.g. Skilled Bricklayer, Carpenter, Plumber, Painter, Bus/Ambulance Driver, HGV driver, AA patrolman, pub/bar worker, etc)
Semi or unskilled manual work (e.g. Manual worker, apprentice to skilled trade, Caretaker, Park keeper, non-HGV driver, shop assistant)
Unemployed
Retired
Student
Prefer not to say **GO TO Q44**

Q40 **IF Q39=7 (RETIRED) ASK:** Does the main income earner have a state pension, a private pension or both?

State only
Private only
Both
Prefer not to say **GO TO Q44**

Q41 **IF Q40= PRIVATE OR BOTH ASK:** How would you describe the main income earner's occupation type before retirement?

Higher managerial/ professional/ administrative (e.g. Established doctor, Solicitor, Board Director in a large organisation (200+ employees), top level civil servant/public service employee)
Intermediate managerial/ professional/ administrative (e.g. Newly qualified (under 3 years) doctor, Solicitor, Board director small organisation, middle manager in large organisation, principle officer in civil service/local government)
Supervisory or clerical/ junior managerial/ professional/ administrative (e.g. Office worker, Student Doctor, Foreman with 25+ employees, salesperson, etc)
Skilled manual work (e.g. Skilled Bricklayer, Carpenter, Plumber, Painter, Bus/ Ambulance Driver, HGV driver, AA patrolman, pub/bar worker, etc)
Semi or unskilled manual work. (e.g. Manual worker, apprentice to skilled trade, Caretaker, Park keeper, non-HGV driver, shop assistant)
None of these
Prefer not to say

Q41a. **IF KANTAR PANEL:**

The next question of this survey is about your ethnicity, which is considered as sensitive data. It will be used by our client for data classification purpose only. It will remain confidential in line with our privacy policy. If answering this

question makes you uncomfortable, please feel free to choose the answer "No, I would prefer not to respond".

Do you agree to answer this question on this basis?

Yes, I agree
No, I do not agree **GO TO Q45**

Q44 **IF HH:** To which of these ethnic groups do you consider you belong to? **We would like to collect this to ensure that people of all backgrounds are represented in the study, but you do not have to answer if you do not wish to. This information will not be shared with any third party and will be destroyed within 12 months of project completion.**

WHITE
English, Welsh, Scottish, Northern Irish or British
Irish
Gypsy or Irish Traveller
Any other White background

MIXED
White and Black Caribbean
White and Black African
White and Asian
Any other Mixed background

ASIAN OR ASIAN BRITISH
Indian
Pakistani
Bangladeshi
Chinese
Any other Asian background

BLACK OR BLACK BRITISH
Caribbean
African
Any other Black background

OTHER ETHNIC GROUP
Arab
Any other ethnic group
Prefer not to say

Q45 **IF HH:** Thinking about all the people in your household, including yourself, how many people live here?

1 or 2
3 or 4
5 or more
Prefer not to say

Q46 **IF HH:** Please let us know if any of the following apply to you or a member of your household. ***RANDOMISE ROWS***
We would like to collect this to ensure that people with a variety of particular needs are represented in the study, but you do not have to answer if you do not wish to. This information will not be shared with any third party and will be destroyed within 12 months of project completion.

Disabled or suffers from a debilitating illness

Has a learning difficulty
Relies on water for medical reasons
Visually impaired (i.e. struggles to read even with glasses)
Over the age of 75 years old
Speaks English as a second language
Deaf or hard of hearing
A new parent
None of these statements apply
Prefer not to say

Q47 **IF HH:** Which of the following statements do you most agree with? ***Please remember, this research is entirely confidential and that it is only by understanding the views of people who are struggling to pay their household bills (eg gas, electricity, telephone etc) that change can be made.***

I can always afford to pay my household bills
I can usually afford to pay my household bills
I sometimes struggle to pay my household bills
I usually struggle to pay my household bills
I always struggle to pay my household bills
Prefer not to say

Q47a. **IF HH:** Thinking about your household finances, do you expect your household to be better off, worse off or about the same in 12 months' time?

Better off
The same
Worse off
Don't know

Q47i **IF HH:** Which of the following income bands does your total household income fall into? Please take into account earnings before tax and other deductions.

Up to £874 a month/Up to £10,499 a year
From £875 to £1,334 a month/From £10,500 to £15,999 a year
From £1,335 to £1,750 a month/From £16,000 to £20,999 a year
From £1,751 to £2,164 a month/From £21,000 to £25,999 a year
From £2,165 to £2,999 a month/From £26,000 to £35,999 a year
From £3,000 to £4,334 a month/From £36,000 to £51,999 a year
From £4,335 to £6,084 a month/From £52,000 to £72,999 a year
From £6,085 to £8,664 a month/From £73,000 to £103,999 a year
£8,665 and above a month/£104,000 and above a year
Don't know
Prefer not to say

Q47ii **IF HH:** Approximately how many hours would you say you spent online in the last week?

This includes the time you are online at home, at your workplace, your place of education or anywhere else on any device

None
1-4 hours
5-9 hours
10-19 hours

20-29 hours
30-39 hours
40 hours or more
Prefer not to say

Q47b **IF NHH:** How does your organisation mainly use water at this property? **You can choose more than one answer**

The manufacturing process which is essential to the running of your organisation (e.g. to power machinery, agricultural production etc.)
The supply of services your organisation provides (e.g. cleaning services etc.)
An ingredient or part of the product or service your organisation provides (e.g. food or drink, chemical, cosmetics manufacturer etc.)
Normal domestic use for your organisation's customers and employees (e.g. customer toilets, supply of drinking water)
None of the above
Don't Know

Q48 **IF NHH:** How many sites in the UK does your organisation operate from?

1
2
3
4
5-10
11-50
51-250
250+
Prefer not to say

Q49 **IF NHH:** How many employees does your organisation have in the UK?

None, sole trader
Fewer than 4 employees
4 to 49 employees
50 to 249 employees
250+ employees
Prefer not to say

Q50 **IF NHH:** Which of the following best defines the core activity of your organisation?

Agriculture, forestry and fishing
Mining and quarrying
Energy or water service & supply
Manufacturing
Construction
Wholesale and retail trade (including motor vehicles repair)
Transport and storage
Hotels & catering
IT and Communication
Finance and insurance activities
Real estate activities
Professional, scientific and technical activities
Administrative and Support Service Activities
Public administration and defence
Education
Human health and social work activities
Arts, entertainment and recreation

Other service activities
Other (please specify)
Prefer not to say

Q52 **IF HH:** Do you have a water meter?
IF NHH: Does this property have a water meter?

Yes
No
Don't know
Prefer not to say

Q53 **IF HH AND Q52=1 ASK:** Did you ask to have a water meter fitted for your household?

Yes
No
Prefer not to say

Q54 **IF HH AND POSTAL:** Which of these best describes you?

I have never used the internet
I have used the internet but do not have regular access to it
I have regular access to the internet
Prefer not to say

Q55 **IF NON PANEL:** We mentioned that there would be a £10 incentive for completing this survey. This incentive will be administered by Accent, within 4 weeks.

This can be sent as an Amazon, Marks & Spencer or One4All voucher by email **[PAPER ONLY:** or by post]. Alternatively, we can donate your incentive to WaterAid. Which would you prefer?

Amazon voucher by email **COLLECT EMAIL ADDRESS**
M&S Voucher by email **COLLECT EMAIL ADDRESS**
One4All by email **COLLECT EMAIL ADDRESS**
PAPER ONLY: Amazon voucher by post **COLLECT ADDRESS**
PAPER ONLY: M&S voucher by post **COLLECT ADDRESS**
PAPER ONLY: One4All voucher by post **COLLECT ADDRESS**
Donation to Water Aid

If you have any queries about your incentive, please contact us on info@accent-mr.com

Q56 Thank you. Would you be willing to be contacted again if we need to clarify any of the answers you have given today?

Yes
No

Thank you. This research was conducted under the terms of the MRS code of conduct and is completely confidential.

Add time limit of 3 minutes to SP questions.

Appendix C

Service issues

BESPOKE IMPACTS

UNEXPECTED water supply interruption (72 hours)

- Your water supply stops working without warning, affecting all taps, toilets, dishwasher, etc
- This is due to a failure of a major water aqueduct, leading to water being unable to be transported to your local area
- Water would be made available nearby to collect in buckets or bottles and vulnerable people would be delivered water directly
- It stops for 72 hours, from a Tuesday morning to a Friday morning

72 hours

Boil water notice (1 week)

- Your water company sends you a notice saying you need to boil tap water before drinking, cooking or preparing food to avoid the risk of becoming ill
- This is due to traces of a parasite or bacteria being found in the water supply in your area
- You can still safely use tap water for washing and cleaning
- Bottled water would be delivered to vulnerable customers that need it
- The notice arrives on a Wednesday. After 1 week the water will be safe to drink again and your water company will notify you

1 week

Water taste and smell (1 week)

- Your tap water starts tasting or smelling different, without warning
- This is due to there being a large amount of algae in the water source and the taste and smell is earthy or musty
- The water is safe to drink, and for use in the dishwasher or washing machine
- This happens during the summer and lasts for one week

1 week

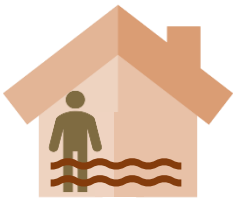
UNEXPECTED Low water pressure (72 hours)

- The pressure of your water supply reduces without warning, affecting all taps, toilets, dishwasher, etc.
- This is due to a region-wide pipe burst event following an intense winter freeze and thaw
- It takes longer to fill a kettle, sink or bath and a shower would be weak. Some appliances like dishwashers and washing machines may not work properly
- The low pressure continues for 72 hours, from a Tuesday morning to a Friday morning

72 hours

Sewer flooding: INSIDE your property ONCE EVERY 3 YEARS (1 month)

- Flooding from the sewer gets inside your property, affecting your living areas
- This results from prolonged heavy rainfall in your local area
- It gives off a foul smell, and damages floors, walls and furniture
- This happens at your property once every 3 years
- Each time it happens, it takes 1 month for your property to get back to normal



1 month every 3

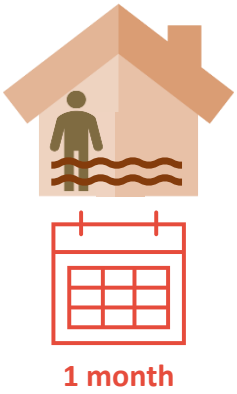
Sewer flooding: OUTSIDE your property ONCE EVERY 3 YEARS (1 week)

- Flooding from the sewer affects access to your front door / entrance
- This results from prolonged heavy rainfall in your local area
- It gives off a foul smell, and could cause damage
- This happens at your property once every 3 years
- Each time it happens, it takes 1 week for access to your property to get back to normal

1 week every 3

Sewer flooding: In your cellar/ basement (1 month)

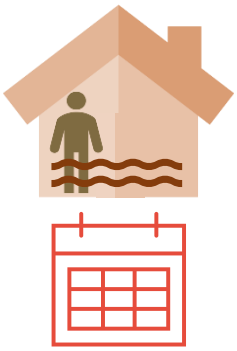
- Flooding from the sewer gets inside your property, affecting your cellar/ basement.
- This results from prolonged heavy rainfall in your local area
- It gives off a foul smell, and damages floors and walls
- It takes 1 month for your cellar / basement to get back to normal



1 month

Sewer flooding: In your cellar/ basement ONCE EVERY 3 YEARS (1 month)

- Flooding from the sewer gets inside your property, affecting your cellar/ basement
- This results from prolonged heavy rainfall in your local area
- It gives off a foul smell, and damages floors and walls
- This happens at your property once every 3 years
- Each time it happens, it takes 1 month for your cellar / basement to get back to normal



1 month every 3 years

Slow draining wastewater (24 hours)

- Your wastewater starts draining very slowly, without warning
- This is due to a blockage in the pipes that your water provider is responsible for
- It takes longer to flush the toilet, drain a sink, bath or shower
- You notice an odour inside or outside of your property
- This happens for 24 hours from a Wednesday morning

24 hours

Slow draining wastewater (1 week)

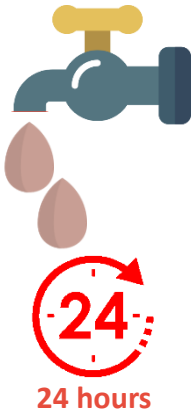
- Your wastewater starts draining very slowly, without warning
- This is due to a blockage in the pipes that your water provider is responsible for
- It takes longer to flush the toilet, drain a sink, bath or shower
- You notice an odour inside or outside of your property
- This happens for 1 week starting from a Wednesday morning

1 week

PIVOT IMPACTS

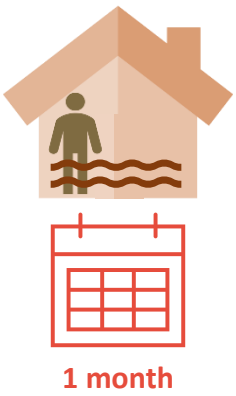
Discoloured water (24 hours)

- Your tap water starts running light brown, without warning
- This is due to traces of sediment from pipes being disturbed
- The water is safe to drink, but you shouldn't use a dishwasher or washing machine until the water runs clear again
- This happens for 24 hours from a Wednesday morning



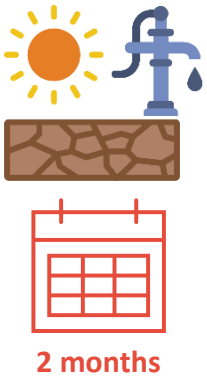
Sewer flooding: INSIDE your property (1 month)

- Flooding from the sewer gets inside your property, affecting your living areas
- This results from prolonged heavy rainfall in your local area
- It gives off a foul smell, and damages floors, walls and furniture
- It takes 1 month for your property to get back to normal



Emergency drought restrictions (2 months)

- Your water company cuts off the tap water supply from 2pm to 7am every day
- This is due to a severe drought leading to an extreme water shortage in your area
- Standpipes would be available nearby to collect water in your own buckets or bottles and vulnerable people would be delivered bottled water directly
- The restrictions begin in July and last for 2 months



Appendix D

Survey invitations

The Occupier
Address

2 Portman Street
London
W1H 6DU

Unique ID number: XXXX
PIN: nnnn

Dear Sir/Madam

Water services research: complete a 10 minute survey and receive a £10 voucher

This letter has been sent to you by Accent (an independent market research company) on behalf of United Utilities, the organisation which supplies water and sewerage for customers in North West England.

We are looking for people to complete a survey about their views on water and sewerage services. The research will be used to help United Utilities plan investment in their service from 2025 and will influence your future water services and bills.

Anyone who is eligible to take part and completes the full 10 minute survey will receive a £10 voucher (an Amazon voucher, an M&S voucher or a One4All voucher). Alternatively we can donate your incentive to WaterAid. Details on how to claim your voucher are given at the end of the survey.

How to take part

The questionnaire will take about 10 minutes to complete. You can check your eligibility to participate, and complete the survey online by entering the following link or scanning the QR code: https://acsvy.com/3586survey and entering your Unique ID (XXXX) and PIN (nnnn).

Alternatively, you can fill the survey in by pen and paper. To request a paper version of the survey please call FREEPHONE 0800 099 6598. You will be asked to leave your name and the 4 digit unique ID number (XXXX) and PIN (nnnn). We will send a paper version of the survey by post, and include a FREEPOST return envelope for you to post it back.

The final date for us to receive completed surveys is 18th December 2022. United Utilities will be very grateful if you are able to complete the survey, but taking part is completely optional.

If you have any questions, please don't hesitate to contact the research team at UUResearch@accent-mr.com

Yours faithfully

Julian Hollo-Tas on behalf of the study team

The Occupier
Address

2 Portman Street
London
W1H 6DU

Unique ID number: XXXX
PIN: nnnn

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Anyone who is eligible to take part and completes the full 10 minute survey will receive a £10 voucher (an Amazon voucher, an M&S voucher or a One4All voucher). Alternatively we can donate your incentive to WaterAid. Details on how to claim your voucher are given at the end of the survey.

We are interested in the views of residents of all types of housing stock but particularly at this stage those with a cellar/basement (who are under-represented in the research so far) – so *if you do have a cellar/basement, please do respond; we would appreciate it very much*.

How to take part

The questionnaire will take about 10 minutes to complete. You can check your eligibility to participate, and complete the survey online by entering the following link or scanning the QR code: https://acsvy.com/3586survey and entering your Unique ID (XXXX) and PIN (nnnn).

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If you have any questions, please don't hesitate to contact the research team at UUResearch@accent-mr.com

Yours faithfully

Julian Hollo-Tas on behalf of the study team

Appendix E

Paper version of household questionnaire

Water Company Research

This survey is designed to get your views on water and sewerage services. It is being undertaken on behalf of United Utilities, the organisation which provides water and sewerage services for customers in the North West of England.

The research will be used to help them plan investment in their service from 2025 and will influence your future water services and bills.

This research is being conducted by Accent, an independent research agency on behalf of United Utilities.

Anyone who is eligible to take part and completes the full survey will receive a £10 voucher (either an Amazon voucher, an M&S voucher or a One4All voucher). Alternatively, we can donate your incentive to WaterAid. Details on how to claim your voucher are given at the end of the survey.

The questionnaire will take about 10 minutes to complete.

Any answer you give will be treated in confidence in accordance with the Code of Conduct of the Market Research Society and your data will be treated in accordance with the Data Protection Act 2018. If you would like to confirm Accent's credentials type Accent in the search box at: https://www.mrs.org.uk/researchbuyersguide.

You do not have to answer any question you do not wish to and you may terminate the interview at any point.

QA. Please enter the **Unique ID** that is printed on the top right of your letter.

Please enter the **PIN** number that is printed on the top right of your letter.

Q12. Any data collected over the course of this interview that could be used to identify you, such as your name, address, or other contact details, will be held securely and will not be shared with any third party, including United Utilities, unless you give permission (or unless we are legally required to do so). Our privacy statement is available at https://www.accent-mr.com/privacy-policy/.

Do you agree to proceeding with the interview on this basis?

☐ Yes

☐ No

Q13. Do you or any of your close family work in market research or for a water company?

☐ Yes
☐ No

Q3b. Does your property have a septic tank or cess pit? If you do have one, this would mean that your property is **not** connected to the main sewer and you would periodically arrange to have the septic tank emptied.

☐ Yes
☐ No

Q4. Please tell us the beginning of your postcode. So if your full postcode is ME14 3BN please just tell us ME14 3. (This will be used to check who supplies your water and wastewater services)

Q8. Are you the person in your household who is responsible, either solely or jointly, for paying for your water services bill?

☐ I have complete responsibility for payment
☐ I share responsibility for payment with others in my household
☐ I have no responsibility
☐ Don't know

Q9. Which of the following age groups do you fall into?

☐ Under 18
☐ 18-29
☐ 30-64
☐ 65 or older
☐ Prefer not to say

Q10. What is your sex?

☐ Male
☐ Female
☐ Prefer not to say

Q10b. Would you describe the area in which you live as being

☐ An inner-city area
☐ A suburban area
☐ A town
☐ A village
☐ Rural/countryside

Q12b. How often do you make payment for water and sewerage services?

- ☐ Annually
- ☐ Every six months
- ☐ Every month, over eight months of the year
- ☐ Every month
- ☐ Other (please specify)
- ☐ Don't know

Q13 How much, roughly, do you pay for water and sewerage services? **Please tick one only**

IF EVERY MONTH OR ANNUALLY

- ☐ Less than £10 per month/Less than £120 per year
- ☐ £10 - £19.99 per month/£120 - £239.99 per year
- ☐ £20 - £29.99 per month/£240 - £359.99 per year
- ☐ £30 - £39.99 per month/£360 - £479.99 per year
- ☐ £40 - £59.99 per month/£480 - £719.99 per year
- ☐ £60 - £79.99 per month/£720 - £959.99 per year
- ☐ £80 or more per month /£960 or more per year

IF EVERY MONTH OVER EIGHT MONTHS

- ☐ Less than £15 per month/Less than £120 per year
- ☐ £15 - £29.99 per month/£120 - £239.99 per year
- ☐ £30 - £39.99 per month/£240 - £319.99 per year
- ☐ £40 - £59.99 per month/£320 - £479.99 per year
- ☐ £60 - £89.99 per month/£480 - £719.99 per year
- ☐ £90 - £119.99 per month/£720 - £959.99 per year
- ☐ £120 or more per month /£960 or more per year

IF EVERY MONTH OVER SIX MONTHS

- ☐ Less than £60 every 6 months/Less than £120 per year
- ☐ £60 - £119.99 every 6 months /£120 - £239.99 per year
- ☐ £120 - £179.99 every 6 months /£240 - £359.99 per year
- ☐ £180 - £239.99 every 6 months /£360 - £479.99 per year
- ☐ £240 - £359.99 every 6 months /£480 - £719.99 per year
- ☐ £360- £479.99 every 6 months /£720 - £959.99 per year
- ☐ £480 or more every 6 months /£960 or more per year
- ☐ I'm not sure

Service issues

Q14. Have you ever experienced any of the following? **Please tick one or more**

- ☐ Unexpected water supply interruption
- ☐ Planned water supply interruption
- ☐ Unexpected low pressure
- ☐ Boil water notice
- ☐ Do not drink notice
- ☐ **Discolouration of water coming out of your tap**
- ☐ **A change to the taste and/or smell of your tap water**
- ☐ Sewer flooding: inside your property
- ☐ Sewer flooding: outside your property
- ☐ Hosepipe ban
- ☐ Emergency drought restrictions **(e.g. tap water being cut off on a rota basis to conserve supplies)**
- ☐ **Pollution in a river**
- ☐ **Pollution in the sea near a beach**
- ☐ **Other (please specify)**
- ☐ **I haven't experienced any of these GO TO Q17**

Q14b. Have you experienced the following in the last 12 months?

- ☐ Discolouration of water coming out of your tap
- ☐ A change to the taste and/or smell of your tap water

Impact of service issues

You are now going to be shown a series of eight short questions where you will be asked to choose between two different scenarios for your water or wastewater service.

Please consider, and then compare the scenarios carefully, and then **choose the one which would have the most impact** on your household if it were to happen.

When comparing the impact that each would have, please:

- **do** consider any concerns you may have for your local or regional environment; but
- **don't** consider any impacts on other people outside your household - other people will answer for themselves!

Q17. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]
○	○

Q17b. Why did you choose this option?

Q18. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]
○	○

Q19. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]

○	○

Q20. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]
○	○

Q21. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]
○	○

Q22. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]
○	○

Q23. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]
○	○

Q24. Which of these would have the most impact on your household?

Option A	Option B
[Service impact]	[Service impact]
○	○

Q25. We would now like to ask you a few questions about the choices you have just made. How strongly do you agree or disagree with the following statements about the choices you have just made?

Please tick one in each row

	Strongly disagree	Disagree	Neither	Agree	Strongly agree
I was able to understand the choices	☐	☐	☐	☐	☐
I found the options believable	☐	☐	☐	☐	☐
My choices were based on how much impact I thought each option would have on my household	☐	☐	☐	☐	☐
I found it easy to choose between the options	☐	☐	☐	☐	☐

Q26. **IF YOU ANSWERED DISAGREE OR DISAGREE STRONGLY TO 'I WAS ABLE TO UNDERSTAND THE CHOICES':** Why were you unable to understand the choices?

Q27. **IF YOU ANSWERED DISAGREE OR DISAGREE STRONGLY TO 'I FOUND THE OPTIONS BELIEVABLE':** What was not believable about the options shown?

Q28. **IF YOU ANSWERED DISAGREE OR DISAGREE STRONGLY TO "MY CHOICES WERE BASED ON HOW MUCH IMPACT I THOUGHT EACH OPTION WOULD HAVE ON MY HOUSEHOLD':** What were the main factors driving your choices if not the impact that each would have on your household?

Q29. **IF YOU ANSWERED DISAGREE OR DISAGREE STRONGLY TO 'I FOUND IT EASY TO CHOOSE BETWEEN THE OPTIONS':** Why was it difficult choosing between the options?

Classification Questions

We will now ask you a few questions about you and your household. These will only be used to ensure we have spoken to a wide range of customers. All responses you give will be kept strictly confidential.

Q39. How would you describe the occupation type of the main income earner in your household?

☐ **Higher managerial/ professional/ administrative** (e.g. Established doctor, Solicitor, Board Director in a large organisation (200+ employees), top level civil servant/public service employee) **GO TO Q44**
☐ **Intermediate managerial/ professional/ administrative** (e.g. Newly qualified (under 3 years) doctor, Solicitor, Board director small organisation, middle manager in large organisation, principle officer in civil service/local government) **GO TO Q44**
☐ **Supervisory or clerical/ junior managerial/ professional/ administrative** (e.g. Office worker, Student Doctor, Foreman with 25+ employees, salesperson, etc) **GO TO Q44**
☐ **Skilled manual work** (e.g. Skilled Bricklayer, Carpenter, Plumber, Painter, Bus/Ambulance Driver, HGV driver, AA patrolman, pub/bar worker, etc) **GO TO Q44**
☐ **Semi or unskilled manual work** (e.g. Manual worker, apprentice to skilled trade, Caretaker, Park keeper, non-HGV driver, shop assistant) **GO TO Q44**
☐ Unemployed **GO TO Q44**
☐ Retired
☐ Student **GO TO Q44**
☐ Prefer not to say **GO TO Q44**

Q40. **IF RETIRED:** Does the main income earner have a state pension, a private pension or both?

☐ State only **GO TO Q44**
☐ Private only
☐ Both
☐ Prefer not to say **GO TO Q44**

Q41. **IF PRIVATE OR BOTH STATE AND PRIVATE:** How would you describe the main income earner's occupation type before retirement?

☐ **Higher managerial/ professional/ administrative** (e.g. Established doctor, Solicitor, Board Director in a large organisation (200+ employees), top level civil servant/public service employee)
☐ **Intermediate managerial/ professional/ administrative** (e.g. Newly qualified (under 3 years) doctor, Solicitor, Board director small organisation, middle manager in large organisation, principle officer in civil service/local government)
☐ **Supervisory or clerical/ junior managerial/ professional/ administrative** (e.g. Office worker, Student Doctor, Foreman with 25+ employees, salesperson, etc)
☐ **Skilled manual work** (e.g. Skilled Bricklayer, Carpenter, Plumber, Painter, Bus/ Ambulance Driver, HGV driver, AA patrolman, pub/bar worker, etc)
☐ **Semi or unskilled manual work.** (e.g. Manual worker, apprentice to skilled trade, Caretaker, Park keeper, non-HGV driver, shop assistant)
☐ None of these
☐ Prefer not to say

Q44. To which of these ethnic groups do you consider you belong to? **We would like to collect this to ensure that people of all backgrounds are represented in the study, but you do not have to answer if you do not wish to. This information will not be shared with any third party and will be destroyed within 12 months of project completion.**

WHITE
- ☐ English, Welsh, Scottish, Northern Irish or British
- ☐ Irish
- ☐ Gypsy or Irish Traveller
- ☐ Any other White background

MIXED
- ☐ White and Black Caribbean
- ☐ White and Black African
- ☐ White and Asian
- ☐ Any other Mixed background

ASIAN OR ASIAN BRITISH
- ☐ Indian
- ☐ Pakistani
- ☐ Bangladeshi
- ☐ Chinese
- ☐ Any other Asian background

BLACK OR BLACK BRITISH
- ☐ Caribbean
- ☐ African
- ☐ Any other Black background

OTHER ETHNIC GROUP
- ☐ Arab
- ☐ Any other ethnic group
- ☐ Prefer not to say

Q45. Thinking about all the people in your household, including yourself, how many people live here?

- ☐ 1 or 2
- ☐ 3 or 4
- ☐ 5 or more
- ☐ Prefer not to say

Q46. Please let us know if any of the following apply to you or a member of your household.
We would like to collect this to ensure that people with a variety of particular needs are represented in the study, but you do not have to answer if you do not wish to. This information will not be shared with any third party and will be destroyed within 12 months of project completion.

- ☐ Disabled or suffers from a debilitating illness
- ☐ Has a learning difficulty
- ☐ Relies on water for medical reasons
- ☐ Visually impaired (i.e. struggles to read even with glasses)
- ☐ Over the age of 75 years old
- ☐ Speaks English as a second language
- ☐ Deaf or hard of hearing

☐ A new parent
☐ None of these statements apply
☐ Prefer not to say

Q47. Which of the following statements do you most agree with? **Please remember, this research is entirely confidential and that it is only by understanding the views of people who are struggling to pay their household bills (eg gas, electricity, telephone etc) that change can be made.**
PLEASE TICK ONE ONLY

☐ I can always afford to pay my household bills
☐ I can usually afford to pay my household bills
☐ I sometimes struggle to pay my household bills
☐ I usually struggle to pay my household bills
☐ I always struggle to pay my household bills
☐ Prefer not to say

Q47a. Thinking about your household finances, do you expect your household to be better off, worse off or about the same in 12 months' time?

☐ Better off
☐ The same
☐ Worse off
☐ Don't know

Q47i. Which of the following income bands does your total household income fall into? Please take into account earnings before tax and other deductions.

☐ Up to £874 a month/Up to £10,499 a year
☐ From £875 to £1,334 a month/From £10,500 to £15,999 a year
☐ From £1,335 to £1,750 a month/From £16,000 to £20,999 a year
☐ From £1,751 to £2,164 a month/From £21,000 to £25,999 a year
☐ From £2,165 to £2,999 a month/From £26,000 to £35,999 a year
☐ From £3,000 to £4,334 a month/From £36,000 to £51,999 a year
☐ From £4,335 to £6,084 a month/From £52,000 to £72,999 a year
☐ From £6,085 to £8,664 a month/From £73,000 to £103,999 a year
☐ £8,665 and above a month/£104,000 and above a year
☐ Don't know
☐ Prefer not to say

Q52. Do you have a water meter?

☐ Yes
☐ No **GO TO Q54**
☐ Don't know **GO TO Q54**
☐ Prefer not to say **GO TO Q54**

Q53. **IF YOU HAVE A WATER METER:** Did you ask to have a water meter fitted for your household?

☐ Yes
☐ No
☐ Prefer not to say

Q54. Which of these best describes you?

☐ I have never used the internet
☐ I have used the internet but do not have regular access to it
☐ I have regular access to the internet
☐ Prefer not to say

Q55. We mentioned that there would be a £10 incentive for completing this survey. This incentive will be administered by Accent, within 4 weeks.

This can be sent as an Amazon, Marks & Spencer or One4All voucher by email or by post. Alternatively, we can donate your incentive to WaterAid. Which would you prefer?

☐ Amazon voucher by email **PLEASE WRITE EMAIL ADDRESS BELOW**
☐ M&S Voucher by email **PLEASE WRITE EMAIL ADDRESS BELOW**
☐ One4All by email **PLEASE WRITE EMAIL ADDRESS BELOW**
☐ Amazon voucher by post **PLEASE WRITE ADDRESS BELOW**
☐ M&S voucher by post **PLEASE WRITE ADDRESS BELOW**
☐ One4All voucher by post **PLEASE WRITE ADDRESS BELOW**
☐ Donation to Water Aid

If you have any queries about your incentive, please contact us on 0800 099 6598

Q56. Thank you. Would you be willing to be contacted again if we need to clarify any of the answers you have given today?

☐ Yes
☐ No

Thank you. This research was conducted under the terms of the MRS code of conduct and is completely confidential.

Appendix F

Weighting

Weighting

The weights were obtained via iterative proportional fitting, following Kott (2006) and Särndal (2007), using the Stata software package (StataCorp, 2021) and the user-written *ipfraking* command (Kolenikov 2014). The weighting variables were age (18-29, 30-64, 65+), sex, and socio-economic group (SEG A/B, C, D/E, 65+[6]) for households, and employee size bands (sole trader, 1-49, 50-249, 250+) for non-households.

The procedure consists of an outer cycle, in which convergence criteria are checked, and an inner cycle which iterates over the levels of the weighting variables. Let t denote iterations of the outer cycle. The procedure starts by assigning a base weight of 1 to each participant. For each group g defined by the weighting variables (ages 18-29, SEG A/B, etc.), a target total T_g is calculated by multiplying the relevant population proportion by the sample size[7]. At each iteration g in the inner cycle, the weight of participant p is updated according to the following rule:

$$w_p^{t,g} = \begin{cases} w_p^{t,g-1} \dfrac{T_g}{\sum_{s \in S} w_s^{t,g-1} I_g(s)}, & I_g(p) = 1 \\ w_p^{t,g-1}, & I_g(p) = 0 \end{cases} \qquad (1)$$

where s is a participant index, S denotes the sample, and $I_g(s)$ denotes an indicator function that returns 1/0 depending on whether or not participant s belongs to group g.

Convergence is assessed at the end of each inner cycle, and it is defined in terms of the maximum relative change in the weights between iterations of the outer cycle:

$$\max_{p \in S} \frac{\left| w_p^t - w_p^{t-1} \right|}{w_p^{t-1}} < 0.000001 \qquad (2)$$

The weighting procedure was set up to trim weights to the interval [0.25-4] to ensure that they were not excessively small or large for any of the participants, following Théberge (2000). However, no trimming was applied as the weights did not fall outside the interval.

[6] The age group 65+ was treated as a separate SEG group for weighting purposes as the SEG population proportions refer to the population aged 16-64.

[7] Participants with missing data on any of the weighting variables are assigned a final weight of 1 and are excluded from the sample used for iterative proportional fitting.

Appendix G

Econometric modelling of the SP choice data

Econometric modelling

The stated preference choice data consisted of eight choices per participant, each between two service issues/scenarios. In each choice situation, participants were asked to indicate which scenario would have the most impact on their household/organisation. The choices were analysed via econometric discrete choice models, with choice as the dependent variable, a {1,0} variable indicating which of the two issues shown in any given choice situation had the highest impact.

Choices were interpreted as indicating that the impact/'disutility' of the chosen service issue was greater than the impact of the other service issue included in the same choice question. This interpretation follows the principles of random utility theory[8].

The log of the impact I_{ijt} on participant i of scenario j (one of two service issues shown) in choice situation t (i.e., a question from the SP exercise) was assumed to be a function of twelve impact parameters[9] β_k, a set of twelve explanatory variables x_{kjt} (as explained below), and a random component e_{ijt}:

$$I_{ijt} = \sum_{k} \beta_k x_{kjt} + e_{ijt} \qquad (3)$$

The explanatory variables were dummy coded, i.e., any given x_{kjt} variable was coded as '1' if the j-th scenario was given by the k-th service issue in choice situation t, and '0' otherwise.

The models estimated the log of the impact, ie the relative impact, of each service issue in comparison to a base service issue/variable which is omitted (here, the 'Discoloured water (24h)').

The choice data were analysed using an unweighted Bayesian mixed logit model, following the same approach adopted in the Collaborative ODI research. A key feature of mixed logit models is that the impact parameters or coefficients, i.e., the βs of the impact function, are not assumed to be the same (fixed) for every individual, as in conditional logit models, but instead may vary across participants according to a specified distribution. For the models presented here, the coefficients were assumed to be jointly normally distributed over the population allowing for correlations among the coefficients.

The software package R (R Core Team 2021) was used for the analysis. The models were estimated using the 'RSGHB' library[10], using 60,000 draws, with a burn-in of 50,000 and a sampling rate of 1 in 10 for the remainder. This resulted in 1,000 draws from which the

[8] See, e.g., Kenneth Train, *Discrete Choice Methods with Simulation* (Cambridge University Press, 2003).
[9] Ten parameters for non-households, as the model does not include the cellar-based scenarios.
[10] Dumont, J. and Keller, J. (2019). "RSGHB: Functions for Hierarchical Bayesian Estimation: A Flexible Approach. R package version 1.2.2." https://CRAN.R-project.org/package=RSGHB

means and standard deviations across draws can be interpreted as the means and standard errors of the estimated parameters[11].

The main household model is presented in Table 28 (means and variances alongside) and Table 29 (covariances), while the non-household model is presented in Table 30 and Table 31. Larger coefficients on any of the variables imply a greater impact of the relevant scenario compared to scenarios that have smaller coefficients.

Table 28: Household econometric model (means and variances)

Service issue	Mean	Std. err.	Var.	Std. err.
Unexpected water supply interruption (72h)	2.404	(0.093)***	3.888	(0.492)***
Boil water notice (1 week)	1.051	(0.084)***	3.927	(0.663)***
Unexpected low pressure (72h)	0.168	(0.08)**	2.319	(0.392)***
Water taste and smell (1 week)	1.138	(0.068)***	0.943	(0.098)***
Sewer flooding: inside your property once every 3 years (1 month)	6.421	(0.252)***	44.620	(3.728)***
Sewer flooding: outside your property once every 3 years (1 week)	2.723	(0.123)***	10.885	(1.028)***
Slow draining wastewater (24h)	0.365	(0.09)***	3.363	(0.483)***
Slow draining wastewater (1 week)	1.018	(0.079)***	3.376	(0.493)***
Sewer flooding: inside your property (1 month)	6.351	(0.239)***	34.405	(3.006)***
Emergency drought restrictions (2 months)	2.222	(0.102)***	9.719	(0.882)***
Sewer flooding: in your cellar/basement (1 month)	3.346	(0.132)***	7.135	(0.765)***
Sewer flooding: in your cellar/basement once every 3 years (1 month)	3.737	(0.138)***	5.285	(0.602)***

Base: 2,019 participants, 16,152 choices
Total draws = 60,000; Burn-in draws = 50,000; Accept rate = 1/10
Significance levels: *** (p<.01); ** (0.01<p<.05); * (0.05<p<.1)
Base (omitted) service issue: Discoloured water (24h)

Table 29: Household econometric model (covariances)

Variable	Cov.	Std. err.	z	p	Sig.(1)
UnexpInt72 x UnexpInt72	3.888	0.492	7.91	0.000	***
Boil1W x UnexpInt72	2.531	0.445	5.69	0.000	***
LowPressure72 x UnexpInt72	1.647	0.346	4.76	0.000	***
TasteSmell1W x UnexpInt72	0.859	0.267	3.22	0.001	***
InternalSFRep x UnexpInt72	9.842	1.065	9.25	0.000	***
ExternalSFRep x UnexpInt72	5.085	0.589	8.63	0.000	***
SlowDraining24 x UnexpInt72	1.188	0.364	3.26	0.001	***
SlowDraining1W x UnexpInt72	1.952	0.467	4.18	0.000	***
InternalSF x UnexpInt72	9.334	0.984	9.48	0.000	***
RotaCuts x UnexpInt72	5.455	0.613	8.90	0.000	***
CellarSF x UnexpInt72	4.564	0.499	9.15	0.000	***
CellarSFRep x UnexpInt72	1.401	0.387	3.62	0.000	***
Boil1W x Boil1W	3.927	0.663	5.92	0.000	***
LowPressure72 x Boil1W	0.308	0.418	0.74	0.462	
TasteSmell1W x Boil1W	0.776	0.232	3.34	0.001	***
InternalSFRep x Boil1W	6.938	0.890	7.80	0.000	***

[11] This interpretation, which is based on the Bernstein-von Mises theorem (see Train 2003), is only valid if the sample size is large enough. Huber and Train (2001) present an example in which this interpretation is approximately valid despite a relatively small sample of only a few hundred respondents.

Variable	Cov.	Std. err.	z	p	Sig.[1]
ExternalSFRep x Boil1W	3.950	0.488	8.09	0.000	***
SlowDraining24 x Boil1W	1.617	0.442	3.65	0.000	***
SlowDraining1W x Boil1W	2.046	0.413	4.96	0.000	***
InternalSF x Boil1W	7.361	0.977	7.53	0.000	***
RotaCuts x Boil1W	3.657	0.537	6.81	0.000	***
CellarSF x Boil1W	3.610	0.507	7.12	0.000	***
CellarSFRep x Boil1W	1.851	0.436	4.24	0.000	***
LowPressure72 x LowPressure72	2.319	0.392	5.91	0.000	***
TasteSmell1W x LowPressure72	-0.330	0.226	-1.46	0.144	
InternalSFRep x LowPressure72	1.795	0.813	2.21	0.027	**
ExternalSFRep x LowPressure72	1.270	0.538	2.36	0.018	**
SlowDraining24 x LowPressure72	1.411	0.372	3.79	0.000	***
SlowDraining1W x LowPressure72	1.133	0.476	2.38	0.017	**
InternalSF x LowPressure72	1.818	0.795	2.29	0.022	**
RotaCuts x LowPressure72	2.018	0.460	4.38	0.000	***
CellarSF x LowPressure72	1.463	0.429	3.41	0.001	***
CellarSFRep x LowPressure72	-1.400	0.314	-4.45	0.000	***
TasteSmell1W x TasteSmell1W	0.943	0.098	9.66	0.000	***
InternalSFRep x TasteSmell1W	4.587	0.647	7.08	0.000	***
ExternalSFRep x TasteSmell1W	1.888	0.356	5.31	0.000	***
SlowDraining24 x TasteSmell1W	-0.165	0.168	-0.98	0.325	
SlowDraining1W x TasteSmell1W	0.447	0.215	2.08	0.038	**
InternalSF x TasteSmell1W	4.251	0.527	8.07	0.000	***
RotaCuts x TasteSmell1W	1.778	0.301	5.91	0.000	***
CellarSF x TasteSmell1W	1.562	0.359	4.36	0.000	***
CellarSFRep x TasteSmell1W	1.663	0.212	7.86	0.000	***
InternalSFRep x InternalSFRep	44.620	3.728	11.97	0.000	***
ExternalSFRep x InternalSFRep	20.829	1.736	12.00	0.000	***
SlowDraining24 x InternalSFRep	2.508	0.648	3.87	0.000	***
SlowDraining1W x InternalSFRep	6.153	0.971	6.34	0.000	***
InternalSF x InternalSFRep	37.411	3.069	12.19	0.000	***
RotaCuts x InternalSFRep	14.486	1.327	10.92	0.000	***
CellarSF x InternalSFRep	16.574	1.563	10.61	0.000	***
CellarSFRep x InternalSFRep	11.516	1.364	8.44	0.000	***
ExternalSFRep x ExternalSFRep	10.885	1.028	10.59	0.000	***
SlowDraining24 x ExternalSFRep	1.909	0.436	4.37	0.000	***
SlowDraining1W x ExternalSFRep	3.653	0.528	6.91	0.000	***
InternalSF x ExternalSFRep	17.112	1.342	12.75	0.000	***
RotaCuts x ExternalSFRep	7.375	0.672	10.98	0.000	***
CellarSF x ExternalSFRep	8.063	0.716	11.26	0.000	***
CellarSFRep x ExternalSFRep	4.503	0.583	7.72	0.000	***
SlowDraining24 x SlowDraining24	3.363	0.483	6.96	0.000	***
SlowDraining1W x SlowDraining24	2.892	0.412	7.03	0.000	***
InternalSF x SlowDraining24	3.064	0.682	4.49	0.000	***
RotaCuts x SlowDraining24	1.612	0.380	4.25	0.000	***
CellarSF x SlowDraining24	1.856	0.379	4.90	0.000	***
CellarSFRep x SlowDraining24	-0.645	0.428	-1.51	0.132	
SlowDraining1W x SlowDraining1W	3.376	0.493	6.84	0.000	***
InternalSF x SlowDraining1W	6.017	0.922	6.53	0.000	***
RotaCuts x SlowDraining1W	3.080	0.554	5.56	0.000	***
CellarSF x SlowDraining1W	3.021	0.523	5.77	0.000	***
CellarSFRep x SlowDraining1W	0.494	0.451	1.10	0.273	
InternalSF x InternalSF	34.405	3.006	11.44	0.000	***
RotaCuts x InternalSF	14.613	1.276	11.45	0.000	***

Variable	Cov.	Std. err.	z	p	Sig.(1)
CellarSF x InternalSF	14.891	1.441	10.34	0.000	***
CellarSFRep x InternalSF	9.725	1.354	7.18	0.000	***
RotaCuts x RotaCuts	9.719	0.882	11.02	0.000	***
CellarSF x RotaCuts	6.569	0.606	10.85	0.000	***
CellarSFRep x RotaCuts	2.028	0.626	3.24	0.001	***
CellarSF x CellarSF	7.135	0.765	9.33	0.000	***
CellarSFRep x CellarSF	3.696	0.670	5.51	0.000	***
CellarSFRep x CellarSFRep	5.285	0.602	8.78	0.000	***

Significance levels: *** (p<.01); ** (0.01<p<.05); * (0.05<p<.1)

Table 30: Non-household econometric model (means and variances)

Service issue	Mean	Std. err.	Var.	Std. err.
Unexpected water supply interruption (72h)	2.654	(0.365)***	4.878	(2.386)**
Boil water notice (1 week)	1.204	(0.319)***	4.096	(1.903)**
Unexpected low pressure (72h)	0.150	(0.201)	0.455	(0.242)*
Water taste and smell (1 week)	0.996	(0.202)***	1.639	(0.668)**
Sewer flooding: inside your property once every 3 years (1 month)	7.673	(0.953)***	52.110	(14.643)***
Sewer flooding: outside your property once every 3 years (1 week)	2.386	(0.408)***	9.172	(4.186)**
Slow draining wastewater (24h)	0.653	(0.216)***	2.064	(1.076)*
Slow draining wastewater (1 week)	1.045	(0.26)***	2.037	(0.952)**
Sewer flooding: inside your property (1 month)	5.986	(0.855)***	27.401	(9.81)***
Emergency drought restrictions (2 months)	2.546	(0.42)***	9.726	(4.167)**

Base: 201 participants, 1,608 choices
Total draws = 60,000; Burn-in draws = 50,000; Accept rate = 1/10
Significance levels: *** (p<.01); ** (0.01<p<.05); * (0.05<p<.1)
Base (omitted) service issue: Discoloured water (24h)

Table 31: Non-household econometric model (covariances)

Variable	Cov.	Std. err.	z	p	Sig.(1)
UnexpInt72 x UnexpInt72	4.878	2.386	2.04	0.041	**
Boil1W x UnexpInt72	3.854	1.990	1.94	0.053	*
LowPressure72 x UnexpInt72	0.034	0.426	0.08	0.937	
TasteSmell1W x UnexpInt72	0.992	0.669	1.48	0.138	
InternalSFRep x UnexpInt72	14.331	4.860	2.95	0.003	***
ExternalSFRep x UnexpInt72	5.524	2.499	2.21	0.027	**
SlowDraining24 x UnexpInt72	0.911	0.800	1.14	0.255	
SlowDraining1W x UnexpInt72	1.609	0.953	1.69	0.091	*
InternalSF x UnexpInt72	10.537	4.154	2.54	0.011	**
RotaCuts x UnexpInt72	6.437	2.974	2.16	0.030	**
Boil1W x Boil1W	4.096	1.903	2.15	0.031	**
LowPressure72 x Boil1W	-0.085	0.413	-0.21	0.837	
TasteSmell1W x Boil1W	0.329	0.583	0.56	0.573	
InternalSFRep x Boil1W	10.765	4.458	2.42	0.016	**
ExternalSFRep x Boil1W	3.678	1.769	2.08	0.038	**
SlowDraining24 x Boil1W	0.123	0.786	0.16	0.876	
SlowDraining1W x Boil1W	0.878	0.963	0.91	0.362	
InternalSF x Boil1W	8.205	3.332	2.46	0.014	**
RotaCuts x Boil1W	5.781	2.729	2.12	0.034	**
LowPressure72 x LowPressure72	0.455	0.242	1.88	0.060	*
TasteSmell1W x LowPressure72	0.077	0.354	0.22	0.827	
InternalSFRep x LowPressure72	0.354	1.210	0.29	0.770	

Variable	Cov.	Std. err.	z	p	Sig.(1)
ExternalSFRep x LowPressure72	0.350	0.580	0.60	0.546	
SlowDraining24 x LowPressure72	0.398	0.469	0.85	0.396	
SlowDraining1W x LowPressure72	0.234	0.362	0.65	0.518	
InternalSF x LowPressure72	0.099	0.876	0.11	0.910	
RotaCuts x LowPressure72	-0.133	0.614	-0.22	0.829	
TasteSmell1W x TasteSmell1W	1.639	0.668	2.45	0.014	**
InternalSFRep x TasteSmell1W	5.618	2.496	2.25	0.024	**
ExternalSFRep x TasteSmell1W	2.494	1.122	2.22	0.026	**
SlowDraining24 x TasteSmell1W	0.816	0.685	1.19	0.233	
SlowDraining1W x TasteSmell1W	0.957	0.634	1.51	0.131	
InternalSF x TasteSmell1W	3.932	1.768	2.22	0.026	**
RotaCuts x TasteSmell1W	0.958	0.817	1.17	0.240	
InternalSFRep x InternalSFRep	52.110	14.643	3.56	0.000	***
ExternalSFRep x InternalSFRep	20.682	6.736	3.07	0.002	***
SlowDraining24 x InternalSFRep	4.983	2.403	2.07	0.038	**
SlowDraining1W x InternalSFRep	7.006	2.690	2.60	0.009	***
InternalSF x InternalSFRep	36.862	11.108	3.32	0.001	***
RotaCuts x InternalSFRep	19.283	6.237	3.09	0.002	***
ExternalSFRep x ExternalSFRep	9.172	4.186	2.19	0.028	**
SlowDraining24 x ExternalSFRep	2.612	1.351	1.93	0.053	*
SlowDraining1W x ExternalSFRep	3.202	1.306	2.45	0.014	**
InternalSF x ExternalSFRep	14.659	5.792	2.53	0.011	**
RotaCuts x ExternalSFRep	7.069	3.029	2.33	0.020	**
SlowDraining24 x SlowDraining24	2.064	1.076	1.92	0.055	*
SlowDraining1W x SlowDraining24	1.681	0.822	2.04	0.041	**
InternalSF x SlowDraining24	2.960	1.724	1.72	0.086	*
RotaCuts x SlowDraining24	0.866	1.089	0.80	0.427	
SlowDraining1W x SlowDraining1W	2.037	0.952	2.14	0.032	**
InternalSF x SlowDraining1W	4.584	2.133	2.15	0.032	**
RotaCuts x SlowDraining1W	2.006	1.293	1.55	0.121	
InternalSF x InternalSF	27.401	9.810	2.79	0.005	***
RotaCuts x InternalSF	14.283	5.269	2.71	0.007	***
RotaCuts x RotaCuts	9.726	4.167	2.33	0.020	**

Significance levels: *** (p<.01); ** (0.01<p<.05); * (0.05<p<.1)

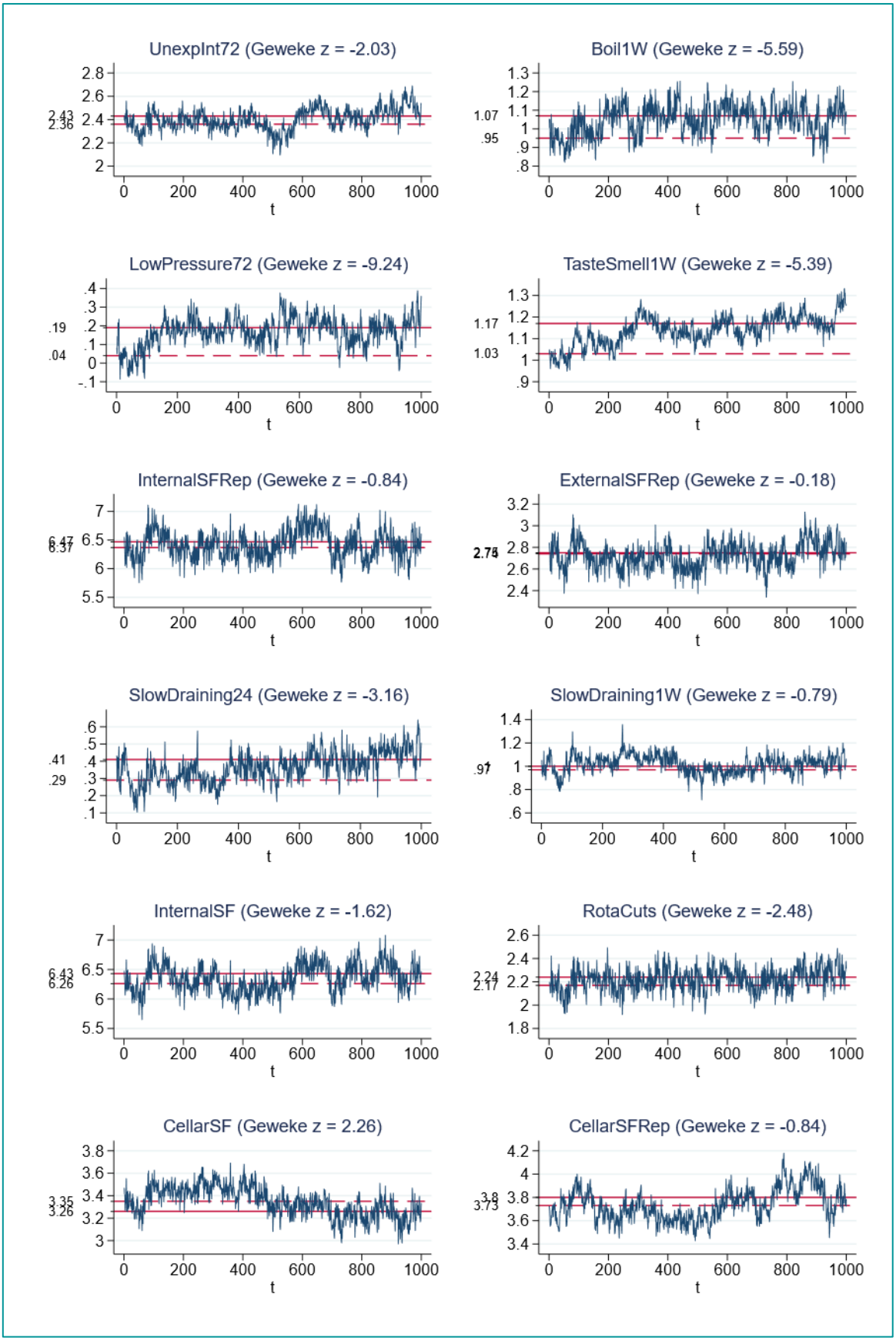
Diagnostics

This section presents an analysis of the convergence of the Markov chain Monte Carlo procedures used in the estimation of the Bayesian mixed logit models. The graphs in Figure 5 and Figure 6 show (post burn-in) trace plots for the household and non-household models respectively. The z-statistic of the Geweke test is given in each panel header[12]. The dashed horizontal line indicates the mean of the first 10% of post burn-in draws, while the solid line shows the mean of the last 50%.

The trace plots do not show any clear upward or downward trend. While the Geweke test rejects the equality of the means in around half of all cases (both for households and non-households), the differences between the means are practically small in most cases, especially if translated into differences in relative impacts.

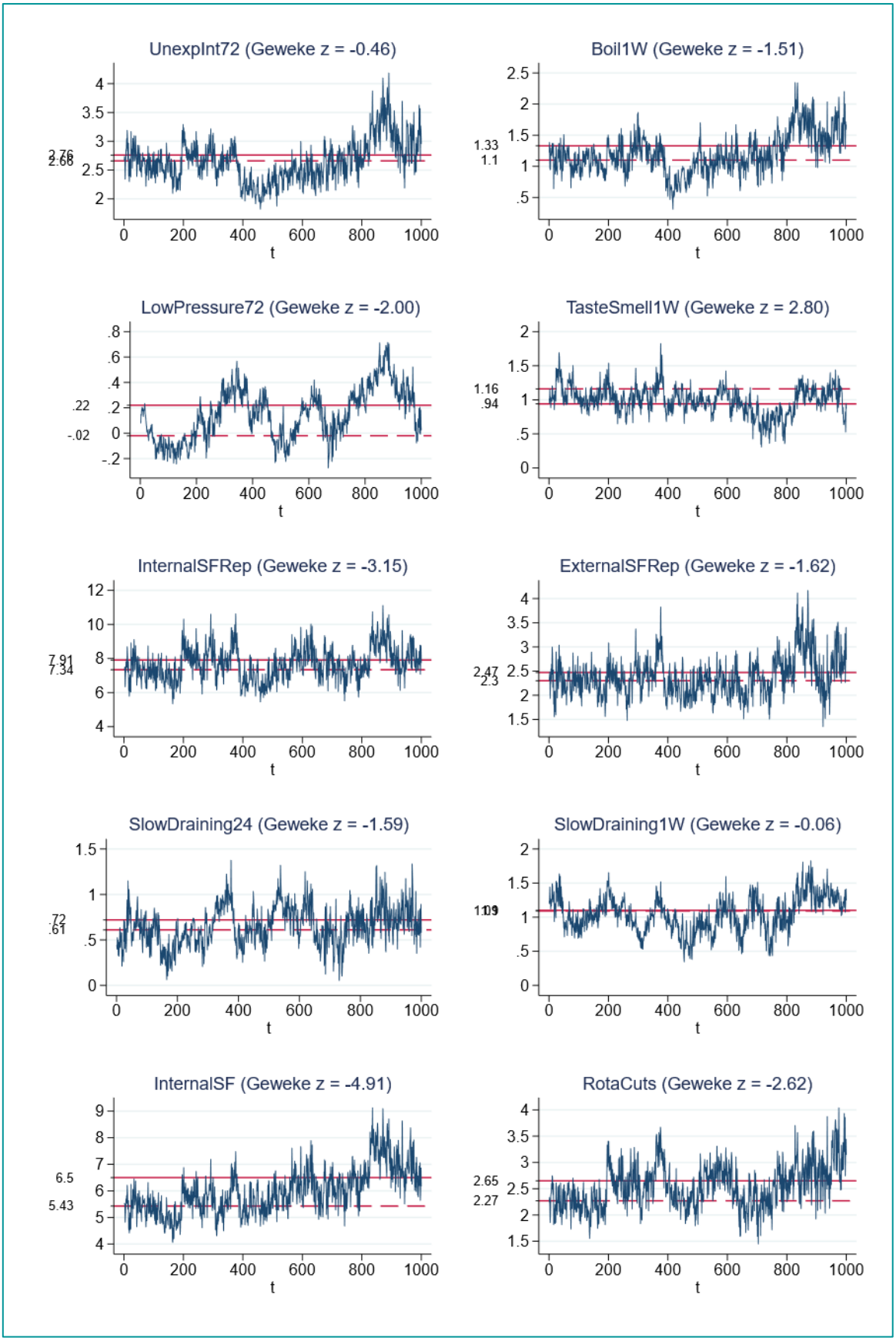
[12] Plummer M., Best N., Cowles K., Vines K. (2006). "CODA: Convergence Diagnosis and Output Analysis for MCMC." R News, 6(1), 7–11.

Figure 5: Trace plot (household model)



Note: The dashed horizontal line indicates the mean of the first 10% of post burn-in draws, while the solid line shows the mean of the last 50%.

Figure 6: Trace plot (non-household model)



Note: The dashed horizontal line indicates the mean of the first 10% of post burn-in draws, while the solid line shows the mean of the last 50%.

Calculation of impact scores

Conversion to an impact scale relative to the base, omitted, service issue was achieved by calculating weighted coefficients from the above models, applying a scaling factor to calibrate to the Collaborative ODI research models, and then exponentiating them.

- First, for each sample (households/non-households), the individual-level posterior coefficients from the Bayesian mixed logit procedure were used to compute weighted means for each service issue coefficient, by applying the survey weights calculated as described in sections 3.4 and 4.4 for households and non-households respectively (see also Appendix F). Let i, t, and p index service issues, iterations, and participants, respectively, and let b denote individual-level coefficients. N_S indicates the sample size. The weighted mean coefficients were calculated as

$$\overline{\boldsymbol{\beta}}_{i,t} = \frac{\mathbf{1}}{N_S} \sum\nolimits_{p \in S} b_{i,t}^{p} \, w_p \qquad (4)$$

- Second, the weighted mean coefficients were rescaled to adjust for differences in the variance of the random component of the impact function (see equation (3)) between the present research for the bespoke ODIs and the Collaborative ODI research[13]. Let the mean coefficient

$$\overline{\overline{\boldsymbol{\beta}}}_{i} = \frac{\mathbf{1}}{\mathbf{1000}} \sum\nolimits_{t=1}^{1000} \overline{\boldsymbol{\beta}}_{i,t} \qquad (5)$$

  denote the mean over iterations of the weighted average of individual-level coefficients. For each of the three pairs of pivot service issues, a scaling factor λ was calculated such that the impact ratio of the two pivot service issues based on rescaled mean coefficients was equal to the ratio of valuations from the Collaborative ODI research. For example, for the pair 'Internal sewer flooding (one-off)' and 'Rota cuts',

$$\lambda_1^{\text{Eng\&Wls}} = \frac{\ln \text{WTA}_{\text{InternalSF}}^{\text{Eng\&Wls}} - \ln \text{WTA}_{\text{RotaCuts}}^{\text{Eng\&Wls}}}{\overline{\overline{\boldsymbol{\beta}}}_{\text{InternalSF}} - \overline{\overline{\boldsymbol{\beta}}}_{\text{RotaCuts}}} \qquad (6)$$

  The mean $\bar{\lambda}$ of the three scaling factors was used to rescale the mean coefficients. The Collaborative ODI research provided results for the whole of England and Wales as well as valuations for United Utilities specifically. Both of these sets of results were used for the purpose of rescaling, yielding two sets of rescaled mean coefficients, and, hence, two sets of bespoke impact scores and valuations.

- Exponentiating the rescaled mean coefficients resulted in an impact value of 1 for the omitted service issue, with the remaining exponentiated coefficients interpreted as reflecting the service issue's impact relative to this. For example, a value of 0.5 for a

[13] These differences in scale may arise from differences in the set of services issues between the bespoke ODI and the Collaborative ODI surveys, as well as differences between the respective samples.

service issue would be interpreted as that issue having half the impact of the omitted service issue, while a value of 2 would be interpreted as having twice the impact.

Two retransformations of this scale were then applied in the analysis:

- First, the scale was transformed to make each of the pivot service issues a base, by dividing through each exponentiated (rescaled) mean coefficient by the exponentiated (rescaled) mean coefficient of the pivot service issue in question. This resulted in scales with an impact value of 1 for the pivot service issue, and with the remaining transformed coefficients reflecting the impact relative to this. For example, the impact of 'Boil water notice (1 week)' relative to 'Internal sewer flooding (one-off)' was calculated as

$$\exp\left(\bar{\boldsymbol{\lambda}}\left(\overline{\overline{\boldsymbol{\beta}}}_{\text{Boil1W}} - \overline{\overline{\boldsymbol{\beta}}}_{\text{InternalSF}}\right)\right) \qquad (7)$$

  The purpose of this transformation was to provide the scales to multiply by the pivot service issue valuations from the Collaborative ODI research in order to obtain consistent valuations for the new, bespoke, service issues.

- Second, separately, the scale was transformed to sum to 100 over the full set of service issues included in the survey. This transformation involved multiplying the exponentiated (rescaled) coefficients by 100 divided by the sum of the exponentiated (rescaled) coefficients. The resulting values are labelled 'impact scores' (IS) and were used to compare relative impacts across segments, holding the sum of scores constant to ensure a sensible comparison. For example,

$$\text{IS}_{\text{Boil1W}} = \mathbf{100} \cdot \frac{\exp\left(\bar{\boldsymbol{\lambda}} \cdot \overline{\overline{\boldsymbol{\beta}}}_{\text{Boil1W}}\right)}{\sum_{\boldsymbol{i}} \exp\left(\bar{\boldsymbol{\lambda}} \cdot \overline{\overline{\boldsymbol{\beta}}}_{\boldsymbol{i}}\right)} \qquad (8)$$

Confidence ranges around the pivot values were constructed by first deriving the lower and upper bounds of the 95% statistical confidence interval around the (rescaled) coefficient differences, and then exponentiating these. This approach essentially treats the sampling distribution around the original coefficients as approximately normal, with the sampling distribution around the impact scores as accordingly log-normal. Whilst the exponentiated coefficients as well as the coefficients themselves will both be asymptotically normal (Cramer, 1986), meaning that the normality of either could be legitimately assumed for the purposes of calculating confidence intervals, the choice to treat the coefficients themselves as having normal sampling distributions carries the advantage that the confidence range will be bounded to lie above zero, which must always be true.

The approach of using the exponential of the means, as described above, as opposed to using the means of the exponentials, yields median estimates of the pivot values (relative impacts), which is consistent with the approach taken in the Collaborative ODI research.

Calculation of monetary values

A set of monetary valuations was constructed for each pivot by multiplying the pivot valuations from the Collaborative ODI research, shown in Table 24, by the corresponding relative impacts in Table 17 to Table 20. These pivot-based valuations are shown in Table 32 to Table 35. Our main valuation estimates, shown in Table 25 and Table 26, were derived by combining the three pivot-based valuations for each service issue as an inverse variance-weighted average, as explained in Section 5.6.

Sensitivity analysis

Sensitivity analysis was conducted to test alternative sample restrictions, including the dropping of participants who self-reported issues with respect to their understanding or ease of completing the stated preference exercise, the dropping of participants who completed the survey very quickly, and the dropping of participants who had a cellar/basement.

Heteroscedastic conditional logit models were estimated allowing for differences in the scale parameter between those who gave negative ('Disagree' or 'Strongly disagree') feedback and those who did not. The scale parameter is inversely related to the variance of random component of the impact function (see equation (3)). This means that the models essentially test whether those that gave negative feedback answered the choice questions with less internal consistency, or equivalently, a higher error variance.

Table 36 and Table 37 show the heteroscedastic conditional logit models. For both household and non-household models, whilst taking the expected negative sign, indicating lower scale, the scale parameter did not statistically differ ($p>.05$) between those who gave negative feedback and those who did not.

Hence, while we did find a greater variance, i.e., greater response variability among those who gave negative feedback, the difference in the scale parameter between those who did/did not give negative feedback was not statistically significant ($p>.05$), suggesting that it is appropriate to pool the two subsamples in the analysis.

Table 32: Household customers' valuations (based on Collaborative ODI research pivot valuations for England and Wales)

Bespoke service issue	Pivot 1: Internal sewer flooding (1 month)			Pivot 2: Emergency drought restriction (2 months)			Pivot 3: Discoloured water (24h)		
	Value	95% conf. int.		Value	95% conf. int.		Value	95% conf. int.	
		Lower	Upper		Lower	Upper		Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	£1,064.2	£956.8	£1,183.5	£1,383.4	£1,173.6	£1,630.8	£1,165.8	£972.4	£1,397.6
Sewer flooding: in your cellar/basement once every 3 years (1 month)	£353.4	£313.3	£398.6	£459.4	£406.2	£519.4	£387.1	£347.2	£431.6
Sewer flooding: in your cellar/basement (1 month)	£294.0	£243.4	£355.1	£382.2	£341.8	£427.3	£322.0	£291.0	£356.4
Sewer flooding: outside your property once every 3 years (1 week)	£223.7	£194.9	£256.8	£290.8	£269.5	£313.7	£245.0	£225.4	£266.4
Unexpected water supply interruption (72h)	£197.6	£171.0	£228.4	£256.9	£241.3	£273.6	£216.5	£202.2	£231.8
Water taste and smell (1 week)	£116.3	£99.0	£136.6	£151.2	£141.2	£161.9	£127.4	£120.8	£134.3
Boil water notice (1 week)	£110.9	£93.6	£131.5	£144.2	£134.2	£155.0	£121.5	£114.2	£129.4
Slow draining wastewater (1 week)	£109.2	£91.6	£130.3	£142.0	£132.2	£152.6	£119.7	£113.0	£126.7
Slow draining wastewater (24h)	£82.8	£70.2	£97.7	£107.7	£100.1	£115.8	£90.7	£84.8	£97.1
Unexpected low pressure (72h)	£76.4	£64.3	£90.9	£99.3	£93.0	£106.2	£83.7	£78.8	£88.9
Ofwat/CCW pivot service issue									
Sewer flooding: inside your property (1 month)	£1,038.8			£1,350.5	£1,157.9	£1,575.0	£1,138.0	£955.4	£1,355.6
Emergency drought restrictions (2 months)	£181.3	£155.4	£211.4	£235.6			£198.6	£185.7	£212.3
Discoloured water (24h)	£71.6	£60.1	£85.3	£93.1	£87.1	£99.6	£78.5		

Note: Value measured in pounds per household per incident. The confidence intervals were calculated treating the three pivot values as 'fixed' (non-random) on the basis that these are set by Ofwat.

Table 33: Household customers' valuations (based on Collaborative ODI research pivot valuations for United Utilities)

Bespoke service issue	Pivot 1: Internal sewer flooding (1 month)			Pivot 2: Emergency drought restriction (2 months)			Pivot 3: Discoloured water (24h)		
	Value	95% conf. int.		Value	95% conf. int.		Value	95% conf. int.	
		Lower	Upper		Lower	Upper		Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	£808.2	£730.7	£893.8	£1,097.8	£939.3	£1,283.0	£899.0	£757.0	£1,067.5
Sewer flooding: in your cellar/basement once every 3 years (1 month)	£284.3	£253.6	£318.7	£386.2	£343.7	£433.9	£316.2	£285.3	£350.6
Sewer flooding: in your cellar/basement (1 month)	£238.8	£199.7	£285.7	£324.4	£291.9	£360.6	£265.6	£241.3	£292.5
Sewer flooding: outside your property once every 3 years (1 week)	£184.3	£161.8	£210.1	£250.4	£233.0	£269.0	£205.0	£189.5	£221.9
Unexpected water supply interruption (72h)	£163.9	£142.9	£188.0	£222.7	£209.8	£236.4	£182.4	£170.9	£194.5
Water taste and smell (1 week)	£99.2	£85.2	£115.5	£134.7	£126.3	£143.8	£110.3	£104.9	£116.0
Boil water notice (1 week)	£94.9	£80.8	£111.4	£128.8	£120.3	£137.9	£105.5	£99.4	£111.9
Slow draining wastewater (1 week)	£93.5	£79.1	£110.5	£127.0	£118.6	£135.9	£104.0	£98.5	£109.8
Slow draining wastewater (24h)	£71.9	£61.5	£84.1	£97.7	£91.2	£104.6	£80.0	£75.0	£85.3
Unexpected low pressure (72h)	£66.6	£56.5	£78.5	£90.5	£85.0	£96.4	£74.1	£70.0	£78.5
Ofwat/CCW pivot service issue									
Sewer flooding: inside your property (1 month)	£789.9			£1,073.0	£927.5	£1,241.4	£878.7	£744.4	£1,037.1
Emergency drought restrictions (2 months)	£151.0	£130.5	£174.7	£205.1			£168.0	£157.7	£179.0
Discoloured water (24h)	£62.7	£53.1	£74.0	£85.1	£79.9	£90.7	£69.7		

Note: Value measured in pounds per household per incident. The confidence intervals were calculated treating the three pivot values as 'fixed' (non-random) on the basis that these are set by Ofwat.

Table 34: Non-household customers' valuations (based on Collaborative ODI research pivot valuations for England and Wales)

	Pivot 1: Internal sewer flooding (1 month)			Pivot 2: Emergency drought restriction (2 months)			Pivot 3: Discoloured water (24h)		
		95% conf. int.			95% conf. int.			95% conf. int.	
Bespoke service issue	Value	Lower	Upper	Value	Lower	Upper	Value	Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	£122,304	£71,635	£208,812	£136,534	£71,178	£261,900	£124,789	£53,061	£293,480
Unexpected water supply interruption (72h)	£8,729	£4,834	£15,761	£9,744	£7,129	£13,319	£8,906	£6,301	£12,589
Sewer flooding: outside your property once every 3 years (1 week)	£7,618	£4,240	£13,687	£8,504	£6,197	£11,670	£7,772	£5,380	£11,229
Boil water notice (1 week)	£4,080	£2,207	£7,546	£4,555	£3,407	£6,091	£4,163	£3,091	£5,607
Slow draining wastewater (1 week)	£3,737	£1,869	£7,473	£4,172	£3,013	£5,777	£3,813	£2,973	£4,890
Water taste and smell (1 week)	£3,652	£1,650	£8,083	£4,077	£2,821	£5,892	£3,726	£3,085	£4,502
Slow draining wastewater (24h)	£3,045	£1,461	£6,348	£3,400	£2,434	£4,748	£3,107	£2,544	£3,794
Unexpected low pressure (72h)	£2,342	£1,169	£4,691	£2,614	£1,901	£3,594	£2,389	£1,952	£2,924
Ofwat/CCW pivot service issue									
Sewer flooding: inside your property (1 month)	£50,340			£56,197	£30,303	£104,216	£51,363	£22,911	£115,147
Emergency drought restrictions (2 months)	£8,246	£4,446	£15,291	£9,205			£8,413	£5,825	£12,152
Discoloured water (24h)	£2,164	£965	£4,850	£2,415	£1,672	£3,489	£2,208		

Note: Value measured in pounds per organisation per incident. The confidence intervals were calculated treating the three pivot values as 'fixed' (non-random) on the basis that these are set by Ofwat.

Table 35: Non-household customers' valuations (based on Collaborative ODI research pivot valuations for United Utilities)

	Pivot 1: Internal sewer flooding (1 month)			Pivot 2: Emergency drought restriction (2 months)			Pivot 3: Discoloured water (24h)		
		95% conf. int.			95% conf. int.			95% conf. int.	
Bespoke service issue	Value	Lower	Upper	Value	Lower	Upper	Value	Lower	Upper
Sewer flooding: inside your property once every 3 years (1 month)	£187,695	£106,885	£329,599	£150,709	£75,921	£299,167	£180,315	£73,298	£443,578
Unexpected water supply interruption (72h)	£11,659	£6,260	£21,716	£9,362	£6,737	£13,008	£11,201	£7,781	£16,123
Sewer flooding: outside your property once every 3 years (1 week)	£10,102	£5,452	£18,719	£8,112	£5,813	£11,318	£9,705	£6,589	£14,295
Boil water notice (1 week)	£5,237	£2,742	£10,002	£4,205	£3,097	£5,708	£5,031	£3,677	£6,882
Water taste and smell (1 week)	£4,660	£2,019	£10,753	£3,741	£2,539	£5,513	£4,476	£3,669	£5,462
Slow draining wastewater (1 week)	£4,773	£2,302	£9,900	£3,833	£2,721	£5,399	£4,586	£3,529	£5,958
Slow draining wastewater (24h)	£3,848	£1,776	£8,338	£3,090	£2,174	£4,393	£3,697	£2,996	£4,563
Unexpected low pressure (72h)	£2,918	£1,404	£6,065	£2,343	£1,676	£3,276	£2,804	£2,266	£3,468
Ofwat/CCW pivot service issue									
Sewer flooding: inside your property (1 month)	£73,730			£59,201	£30,903	£113,413	£70,831	£30,282	£165,681
Emergency drought restrictions (2 months)	£10,981	£5,732	£21,036	£8,817			£10,549	£7,164	£15,534
Discoloured water (24h)	£2,685	£1,148	£6,282	£2,156	£1,464	£3,175	£2,580		

Note: Value measured in pounds per organisation per incident. The confidence intervals were calculated treating the three pivot values as 'fixed' (non-random) on the basis that these are set by Ofwat.

Table 36: Household heteroscedastic logit model: feedback

	Coef.	Std. err.	z	p	[95% conf. interval]	
Service issue						
Unexpected water supply interruption (72h)	1.363	0.073	18.58	0.00	1.219	1.507
Boil water notice (1 week)	0.607	0.069	8.86	0.00	0.473	0.741
Unexpected low pressure (72h)	0.075	0.067	1.11	0.27	-0.057	0.207
Water taste and smell (1 week)	0.729	0.060	12.06	0.00	0.611	0.848
Sewer flooding: inside your property once every 3 years (1 month)	2.320	0.108	21.45	0.00	2.108	2.532
Sewer flooding: outside your property once every 3 years (1 week)	1.282	0.078	16.37	0.00	1.128	1.435
Slow draining wastewater (24h)	0.187	0.067	2.78	0.01	0.055	0.319
Slow draining wastewater (1 week)	0.585	0.066	8.80	0.00	0.455	0.715
Sewer flooding: inside your property (1 month)	2.509	0.113	22.3	0.00	2.288	2.730
Emergency drought restrictions (2 months)	1.071	0.074	14.39	0.00	0.925	1.217
Sewer flooding: in your cellar/basement (1 month)	1.556	0.187	8.32	0.00	1.190	1.923
Sewer flooding: in your cellar/basement once every 3 years (1 month)	2.099	0.238	8.84	0.00	1.634	2.565
Scale heteroscedasticity						
Feedback: disagree	-0.195	0.108	-1.80	0.07	-0.407	0.018
No of observations	32,304					
No of participants	2,019					

Note: heteroscedastic conditional logit model. Standard errors clustered by participant.
Base (omitted) service issue: Discoloured water (24h)

Table 37: Non-household heteroscedastic logit model: feedback

	Coef.	Std. err.	z	p	[95% conf. interval]	
Service issue						
Unexpected water supply interruption (72h)	1.793	0.244	7.35	0.00	1.315	2.271
Boil water notice (1 week)	0.962	0.218	4.40	0.00	0.533	1.390
Unexpected low pressure (72h)	0.171	0.201	0.85	0.39	-0.222	0.565
Water taste and smell (1 week)	0.863	0.182	4.74	0.00	0.506	1.220
Sewer flooding: inside your property once every 3 years (1 month)	2.834	0.362	7.83	0.00	2.125	3.543
Sewer flooding: outside your property once every 3 years (1 week)	1.597	0.246	6.50	0.00	1.116	2.079
Slow draining wastewater (24h)	0.517	0.208	2.48	0.01	0.109	0.926
Slow draining wastewater (1 week)	0.732	0.220	3.32	0.00	0.300	1.164
Sewer flooding: inside your property (1 month)	3.154	0.360	8.75	0.00	2.447	3.860
Emergency drought restrictions (2 months)	1.509	0.235	6.42	0.00	1.049	1.970
Scale heteroscedasticity						
Feedback: disagree	-0.392	0.395	-0.99	0.32	-1.167	0.383
No of observations	3,216					
No of participants	201					

Note: heteroscedastic conditional logit model. Standard errors clustered by participant.
Base (omitted) service issue: Discoloured water (24h)

The sensitivity to completion times of the SP questions was analysed by excluding from the estimation samples:

- Participants whose completion time of the SP questions was less than the 10th percentile of the distribution of completion times (households: 91 seconds; non-households: 89 seconds);

- Participants whose completion time of the SP questions was less than the 25th percentile of the distribution of completion times (households: 128 seconds; non-households: 119 seconds)

Because of the computationally intensive nature of the estimation of the Bayesian mixed logit models, the sensitivity analysis was carried out using the simpler conditional logit model as a baseline for comparison. Table 38 and Table 39 show how sample exclusions based on completion time affect the impact scores for household and non-household customers, respectively.

Looking across the 'conditional logit' columns of Table 38 shows that the impact scores for household customers are not very sensitive to sample exclusions. In fact, the scores are more sensitive to modelling approaches. The conclusions are similar for non-households.

Based on this analysis, we conclude that the impact scores are not substantively sensitive to exclusion of those with short completion times.

A heteroscedastic conditional logit model was estimated allowing for differences in the scale parameter between those whose home did/did not have a cellar/basement. The difference in the scale parameter is small, and it is far from being statistically significant as shown in Table 40. Additionally, we estimated a model allowing each coefficient to differ between the no-cellar sample and the cellar sample as shown in Table 41. None of the 'cellar' interaction terms are statistically different from zero. This provides further support for pooling the two subsamples in the analysis.

Table 38: Household impact scores: sensitivity to exclusions based on completion times

Service issue	Bayesian MXL	Conditional logit		
			Completion time	
	Full sample	Full sample	> 10th percentile	> 25th percentile
Sewer flooding: inside your property once every 3 years (1 month)	27.15	18.25	18.43	19.88
Sewer flooding: inside your property (1 month)	26.50	22.10	22.52	24.13
Sewer flooding: in your cellar/basement once every 3 years (1 month)	9.01	14.58	18.01	17.35
Sewer flooding: in your cellar/basement (1 month)	7.50	8.71	8.63	9.03
Sewer flooding: outside your property once every 3 years (1 week)	5.71	6.65	6.16	6.16
Unexpected water supply interruption (72h)	5.04	7.22	6.52	5.77
Emergency drought restrictions (2 months)	4.62	5.43	5.18	5.06
Water taste and smell (1 week)	2.97	3.91	3.31	2.71
Boil water notice (1 week)	2.83	3.47	3.04	2.70
Slow draining wastewater (1 week)	2.79	3.40	2.99	2.75
Slow draining wastewater (24h)	2.11	2.29	1.97	1.78
Discoloured water (24h)	1.83	1.92	1.54	1.24
Unexpected low pressure (72h)	1.95	2.06	1.70	1.45
Total	**100**	**100**	**100**	**100**

Bayesian MXL: Impact scores calculated as explained in Section 5.3 (rescaled based on Collaborative ODI research valuations for England and Wales).
Conditional logit: Impact scores calculated as exponentiated coefficients, rescaled to sum to 100.

Table 39: Non-household impact scores: sensitivity to exclusions based on completion times

Service issue	Bayesian MXL	Conditional logit		
			Completion time	
	Full sample	Full sample	> 10th percentile	> 25th percentile
Sewer flooding: inside your property once every 3 years (1 month)	56.56	24.21	26.72	31.80
Sewer flooding: inside your property (1 month)	23.28	34.23	33.83	34.80
Unexpected water supply interruption (72h)	4.04	9.29	8.59	7.66
Emergency drought restrictions (2 months)	3.81	7.08	7.30	6.61
Sewer flooding: outside your property once every 3 years (1 week)	3.52	7.57	7.08	6.34
Boil water notice (1 week)	1.89	4.22	4.15	3.37
Slow draining wastewater (1 week)	1.73	3.32	3.00	2.65
Water taste and smell (1 week)	1.69	3.79	3.53	2.54
Slow draining wastewater (24h)	1.41	2.71	2.61	1.97
Unexpected low pressure (72h)	1.08	1.94	1.70	1.21
Discoloured water (24h)	1.00	1.64	1.48	1.05
Total	**100**	**100**	**100**	**100**

Bayesian MXL: Impact scores calculated as explained in Section 5.3 (rescaled based on Collaborative ODI research valuations for England and Wales).
Conditional logit: Impact scores calculated as exponentiated coefficients, rescaled to sum to 100.

Table 40: Household heteroscedastic logit model: no-cellar vs cellar

	Coef.	Std. err.	z	p	[95% conf. interval]	
Service issue						
Unexpected water supply interruption (72h)	1.325	0.070	18.93	0.00	1.188	1.462
Boil water notice (1 week)	0.591	0.067	8.87	0.00	0.460	0.722
Unexpected low pressure (72h)	0.072	0.066	1.09	0.28	-0.057	0.201
Water taste and smell (1 week)	0.710	0.059	12.10	0.00	0.595	0.825
Sewer flooding: inside your property once every 3 years (1 month)	2.253	0.102	22.16	0.00	2.054	2.452
Sewer flooding: outside your property once every 3 years (1 week)	1.243	0.075	16.58	0.00	1.096	1.390
Slow draining wastewater (24h)	0.175	0.065	2.67	0.01	0.047	0.303
Slow draining wastewater (1 week)	0.571	0.065	8.83	0.00	0.444	0.698
Sewer flooding: inside your property (1 month)	2.445	0.107	22.94	0.00	2.236	2.653
Emergency drought restrictions (2 months)	1.041	0.072	14.52	0.00	0.900	1.181
Sewer flooding: in your cellar/basement (1 month)	1.515	0.182	8.30	0.00	1.157	1.872
Sewer flooding: in your cellar/basement once every 3 years (1 month)	2.041	0.234	8.73	0.00	1.583	2.499
Heteroscedasticity						
Feedback: disagree	-0.017	0.142	-0.12	0.91	-0.294	0.261
No of observations	32,304					
No of participants	2,019					

Note: heteroscedastic conditional logit model. Standard errors clustered by participant.
Base (omitted) service issue: Discoloured water (24h)

Table 41: Household conditional logit model including 'cellar' interactions terms

Service issue	Coef.	Std. err.	z	p	[95% conf. interval]	
Unexpected water supply interruption (72h)	1.324	0.070	18.93	0.00	1.187	1.461
Boil water notice (1 week)	0.564	0.068	8.34	0.00	0.432	0.697
Unexpected low pressure (72h)	0.074	0.068	1.09	0.27	-0.059	0.207
Water taste and smell (1 week)	0.696	0.059	11.75	0.00	0.580	0.812
Sewer flooding: inside your property once every 3 years (1 month)	2.246	0.103	21.74	0.00	2.043	2.448
Sewer flooding: outside your property once every 3 years (1 week)	1.259	0.075	16.74	0.00	1.112	1.406
Slow draining wastewater (24h)	0.169	0.067	2.55	0.01	0.039	0.300
Slow draining wastewater (1 week)	0.542	0.066	8.23	0.00	0.412	0.671
Sewer flooding: inside your property (1 month)	2.419	0.108	22.36	0.00	2.207	2.631
Emergency drought restrictions (2 months)	1.051	0.072	14.51	0.00	0.909	1.193
Cellar x Unexpected water supply interruption (72h)	0.025	0.380	0.07	0.95	-0.719	0.770
Cellar x Boil water notice (1 week)	0.389	0.340	1.15	0.25	-0.277	1.055
Cellar x Unexpected low pressure (72h)	-0.007	0.295	-0.02	0.98	-0.586	0.571
Cellar x Water taste and smell (1 week)	0.273	0.330	0.83	0.41	-0.374	0.920
Cellar x Sewer flooding: inside your property once every 3 years (1 month)	0.111	0.434	0.26	0.80	-0.739	0.962
Cellar x Sewer flooding: outside your property once every 3 years (1 week)	-0.199	0.379	-0.52	0.60	-0.942	0.545
Cellar x Slow draining wastewater (24h)	0.150	0.325	0.46	0.65	-0.486	0.786
Cellar x Slow draining wastewater (1 week)	0.430	0.321	1.34	0.18	-0.198	1.059
Cellar x Sewer flooding: inside your property (1 month)	0.342	0.398	0.86	0.39	-0.437	1.122
Cellar x Emergency drought restrictions (2 months)	-0.158	0.343	-0.46	0.65	-0.830	0.514
Cellar x Sewer flooding: in your cellar/basement (1 month)	1.614	0.350	4.61	0.00	0.928	2.300
Cellar x Sewer flooding: in your cellar/basement once every 3 years (1 month)	2.143	0.381	5.63	0.00	1.397	2.889
No of observations	32,304					
No of participants	2,019					

Note: standard errors clustered by participant.
Base (omitted) service issue: Discoloured water (24h)

Appendix H

Peer review reports and responses to recommendations

Peer review reports

Final peer review report, 16 March 2023

United Utilities Bespoke ODI rates research

Final review by Professor Stephane Hess

1. On 12 February 2023, I provided a review that summarised my appraisal of the work carried out by Accent & PJM economics for the above project. Notwithstanding my overall positive view of the work carried out, my initial review raised a number of separate points, mainly asking for details, clarifications and additional robustness checks.
2. On 13 March 2023, I was provided with a revised version of the report, a detailed response to all my comments, and explanations of how they had been addressed in the revised version.
3. I am pleased to now state that all remaining points have been addressed to my satisfaction. I reiterate that this research study was conducted in a very robust manner, and that the decisions taken to address key specification issues are justified and likely to produce the most robust results possible.

Stephane Hess

16 March 2023

Peer review of draft final report, 12 February 2023

United Utilities Bespoke ODI rates research

Review by Professor Stephane Hess

Background

4. This review summarises my appraisal of the work carried out by Accent & PJM economics for the above project. I am an expert in choice modelling and stated preference survey design and am familiar with the background of the project as well as the state-of-practice in the field. I am also familiar with the Collaborative ODI research where I have a similar expert role. I am thus well positioned to provide this review.
5. I have had a number of meetings with the project team during which I provided feedback at intermediate stages of the work. This feedback has been taken on board in revisions made to the methodology and I commend the project team for their engagement with my feedback.

Study approach

6. The aim of the of the UU bespoke ODI rates research is to provide valuations for a number of bespoke performance commitments (PCs). Rather than repeating the entire approach of the Collaborative ODI project, the current study focussed on estimating relative impact scores for the different PCs and computing monetary valuations for these by applying multipliers to the Collaborative ODI valuations, where this is made possible by the inclusion of a number of shared PCs as pivot values. This approach has the advantage of reducing the complexity of the survey of the UU study, while also guaranteeing a consistency of monetary valuations across studies, with the valuations drawing from the large sample Collaborative ODI research. Of course, an assumption of consistency of valuations is then made, but the inclusion of UU in the Collaborative study is helpful in this context. On balance, I was supportive of this approach from the start.

Sampling, survey design and testing

7. I have no specific comments on the sampling. I feel that the best possible effort was used to obtain representative and high-quality samples, given the constraints such as the lack of regulatory powers for obtaining non-household customer lists.
8. The survey was well designed and administered, drawing on the experience from the earlier Collaborative ODI research. I find the testing that was conducted to be of high quality, ensuring reliable data.
9. I also commend the project team on engaging with the state-of-the-art in stated choice surveys by making use of efficient designs and using the results from the pilot to generate priors for improving the design.
10. I believe the inclusion of the third pivot (discoloured water) was helpful to increase the robustness of the work and am pleased that the research team followed my advice on this issue. Other changes made after the pilot are also beneficial, and show good engagement with my feedback at those stages of the research.
11. The exclusion of the cellar impact options for respondents without a cellar makes sense, ensuring that valuations for cellar flooding would only come from respondents who currently have a cellar. Some additional tests could be reported to determine whether these respondents are in any other way systematically different from those without cellars, and more importantly, whether the relative impact scores for the other PCs are affected by the presence or absence of the cellar related PCs.
12. I am on board with the approach in relation to weighting. In section 3.4, the text says that *"these weights correct for non-response bias, i.e. lower response rates among some groups"*, but I assume another factor is the sampling. The raking procedure used is appropriate, but I feel a bit more detail could be provided in the report, including a mathematical description, even if in the appendix. It would also be good to discuss the implication of not trimming the non-household weights, while the household ones were trimmed.

Modelling work

13. I would drop the description in footnote 6 about the organisation of the data as it makes it sound like the modelling work treated each binary choice task as two independent choice tasks (which is an inappropriate approach used in some fields).
14. While I appreciate the computational demands of the study, the use 5,000 burn-in iterations would by some be seen as being on the low side, and some discussion of stability tests (e.g. Geweke test) could be included.

15. The report says *"This resulted in 1,000 draws from which the means and standard deviations across draws can be interpreted as the means and standard errors of the estimated parameters."* It should be acknowledged that standard errors are a frequentist concept, not a Bayesian concept, and the interpretation of standard deviations across iterations is not necessarily consistent with standard errors.
16. The calculations in the appendix (under *"Calculation of impact scores"*) are sound, but mathematical details could be added, with the same applying to the rescaling part on the next page.
17. The exponential of the conditional means was used for the impact scores. This is thus the exponential of the most likely value from the posterior distribution for each individual, and some discussion is warranted to contrast this approach with instead using the mean of the exponential of the distribution.
18. I was pleased with the detail and care used in the sensitivity analysis which adds some reassurance about the robustness of the work, including the work on heteroskedastic logit.
19. The key decision of course relates to the choice of pivot, and the difference between the overall and UU sample of the Collaborative ODI research. The relative values for the three pivots in the two different Collaborative ODI samples and in the new UU work are given in the table below. Overall, especially when comparing the UU study to the overall Ofwat study, the relationships are reassuringly close across studies/samples. Of course, differences exist, and I believe the inverse variance-weighted average approach used is appropriate in this context.

Households			Non-households		
Ofwat			Ofwat		
all	UU	UU study	all	UU	UU study
1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
0.2268	0.2597	0.1911	0.1829	0.1196	0.1759
0.0756	0.0882	0.0718	0.0439	0.0350	0.0436

20. I also had extensive discussions with the research team about the calculation of confidence intervals, and believe that the approach used is the most appropriate solution in this context.

Conclusion

21. I believe that this research study was conducted in a very robust manner, and that the decisions taken to address key specification issues are justified and likely to produce the most robust results possible.

Stephane Hess

12 February 2023

Responses to peer reviewer recommendations

Date	Source	Peer Review Recommendation	Action
08/11/2022	Design review with United Utilities and Accent	To increase pilot sample from 50 to 100	Sample was increased as instructed
		To include 3 pivots rather than 2	The decision was made to include 'Discoloured water (24h)' as the third link attribute
21/11/2022	Pilot review with United Utilities and Accent	To keep the 3 pivots in throughout project due to success in pilot	3rd pivot remained in
		Suggest a qualitative question at the end of the survey, regarding repeating flooding and why it could potentially have the same impact as one off flooding as uncovered in the pilot	A decision was made between Accent and United Utilities that instead of a qualitative question, the text on the attributes would be reworded and formatted in bold to highlight repeat flooding vs one off.
		Recommended running analysis halfway through the fieldwork to sense check	Accent ran analysis half way through fieldwork to check on results and any anomalies.
13/02/2023	Draft report written feedback	The exclusion of the cellar impact options for respondents without a cellar makes sense, ensuring that valuations for cellar flooding would only come from respondents who currently have a cellar. Some additional tests could be reported to determine whether these respondents are in any other way systematically different from those without cellars, and more importantly, whether the relative impact scores for the other PCs are affected by the presence or absence of the cellar related PCs.	PJM believe it is theoretically correct to pool the two subsamples in the analysis in order to obtain WTA values that are valid for the customer base as a whole. However, PJM did test for differences in preferences between the two groups by estimating a heteroscedastic conditional logit model and by including a set of 'cellar' interaction terms in a conditional logit model. These models, which were included in the 'Sensitivity analysis' section of the 'Econometric modelling' appendix (v6 of the final report), indicate that the preferences are relatively homogeneous between the two groups
		I am on board with the approach in relation to weighting. In section 3.4, the text says that "these weights correct for non-response bias, i.e. lower response rates among some groups", but I assume another factor is the sampling. The raking procedure used is appropriate, but I feel a bit more detail could be provided in the report, including a mathematical description, even if in the appendix. It would also be good to discuss the implication of not trimming the non-household weights, while the household ones were trimmed.	A sentence was added in sections 3.4 and 4.4 (v6 of the final report) stating that the weighting procedure corrects for non-response bias only, as the sample design did not involve any deliberate over- or undersampling. A detailed description of the raking procedure was included in Appendix F (v6 of the final report). The previous version of the report (v5) erroneously stated in section 3.4 that 'The weights were trimmed to the interval [0.25-4]'. In fact, the weighting procedure was set up to trim weights to the interval [0.25-4], but the weights are effectively untrimmed as the weights did not fall outside the interval. This applies to both the household and non-household samples. The report was amended accordingly in v6 (Appendix F).

Date	Source	Peer Review Recommendation	Action
		I would drop the description in footnote 6 about the organisation of the data as it makes it sound like the modelling work treated each binary choice task as two independent choice tasks (which is an inappropriate approach used in some fields)	The footnote was deleted in v6 of the final report.
		While I appreciate the computational demands of the study, the use 5,000 burn-in iterations would by some be seen as being on the low side, and some discussion of stability tests (e.g. Geweke test) could be included.	The number of burn-in iterations was increased to 50,000 for both the household and the non-household samples, and all estimates of impact-scores, relative impacts and WTA values were updated in v6 of the final report based on the new models. A 'Diagnostics' section was added in the 'Econometric modelling' appendix showing trace plots and Geweke test statistics. The trace plots do not show any clear upward or downward trend. While the Geweke test rejects the equality of the means in around half of all cases (both for households and non-households), the differences between the means are practically small in most cases, especially if translated into differences in relative impacts.
		The report says *"This resulted in 1,000 draws from which the means and standard deviations across draws can be interpreted as the means and standard errors of the estimated parameters."* It should be acknowledged that standard errors are a frequentist concept, not a Bayesian concept, and the interpretation of standard deviations across iterations is not necessarily consistent with standard errors.	Actioned (PJM) – A caveat was added in a footnote acknowledging that our interpretation is only valid if the sample size is large enough (v6 of the final report).
		The calculations in the appendix (under *"Calculation of impact scores"*) are sound, but mathematical details could be added, with the same applying to the rescaling part on the next page.	Mathematical expressions were added in v6 of the final report to help clarify the transformations made at each step.
		The exponential of the conditional means was used for the impact scores. This is thus the exponential of the most likely value from the posterior distribution for each individual, and some discussion is warranted to contrast this approach with instead using the mean of the exponential of the distribution.	The focus of the valuation analysis is on median values, in line with the approach taken in the Collaborative ODI research. The approach of using the exponential of the means was preferred because it yields median estimates of the pivot values. This is explained in v6 of the final report under 'Calculation of impact scores' in the 'Econometric modelling' appendix.