Anglian Water

12G. ANGLIAN WATER'S PR19 SOCIETAL VALUATION PROGRAMME

Appendix: Anglian Water's PR19 Societal Valuation Programme

Introduction

This section provides a detailed overview of the Societal Valuation programme which forms a key part of the wider Customer Engagement programme. A high level non-technical summary of the societal valuation work can be found in the main sections on customer engagement.

Societal valuations seek to measure customer preferences through estimating the economic value that customers give to aspects of water and wastewater services. These customer valuations can then inform the benefits of investments that improve or maintain service levels, feeding into cost-benefit analysis and helping to prioritise investments across the range of services provided as part of PR19 investment planning and the WRMP. In addition, evidence on customer valuations informs - alongside other evidence and key considerations - the performance ranges for ODIs (Outcome Delivery Incentives).

The structure of this section is set out as follows:

1. Strategy for PR19 societal valuation programme
2. Improved design and use of Stated Preference studies
3. Incorporating and exploring a range of valuation methods
4. Approach to triangulation
    a. Steps in triangulation
    b. Overview of triangulation of valuation evidence
    c. Our approach to customer segmentation
5. Recommended societal values
    a. Overview of recommended values
    b. Use of valuation in cost benefit analysis
    c. Use of valuation in ODIs
6. Peer review and assurance
7. Conclusions
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1. Strategy for PR19 societal valuation programme

Delivering a "robust, balanced and proportionate" societal valuation programme

Valuation is a key part of the overall engagement programme of work, and alongside our customer engagement strategy, we developed our valuation strategy during 2016-17. Completing this important step before commissioning any studies enabled us to focus effort proportionally on service attributes of high value to customers and to us.

The overall methodology and approach for delivery of societal valuations required for the PR19 business planning has been informed by a range of background work including reviewing the approach taken in PR14 and taking into account stakeholder views in this area including Ofwat, and CCW and UKWIR (see Box 1 below). For example, reflecting on the PR14 valuation research programme, which was well received by Ofwat, there was recognition of the need for greater triangulation and utilisation of information from different sources to improve the reliability of valuation estimates including the need to build stronger links with on-going customer engagement.

Box 1: Water industry views on improvements to PR19 societal valuations

Ofwat highlighted in their May 2016 publication "Water 2020: our regulatory approach for water and wastewater services in England & Wales", the following key points for the PR19 societal valuation approach:

- Look to develop a richer evidence base and reduce the reliance on stated preference WTP survey-based approaches.
- Welcomes the work that has been carried out by stakeholders around suggested improvements to Stated Preference techniques; where these techniques are used, companies should consider how they could be improved.
- Would like to see companies generally making better use of customer intelligence and exploring the alternative and complementary tools available, for example, by using revealed preference WTP techniques and evidence from day to day contact with customers.

CCW report on Improving WTP research in the water sector (July 2017) provided:

- a range of key recommendations on the use and application of stated preference and revealed preference research and improvement in stated preference survey design.

UKWIR study (post PR14-Customer Engagement) highlighted that:

- Use of multiple sources of data to cross check analysis, validate results and provide a more detailed and balanced picture will improve the quality of engagement in future price reviews.

Ofwat's PR19 Final Methodology reiterates that customer engagement is a central part of PR19 and expectation of a step change in customer engagement with companies using a wider range of techniques where it is proportionate to do so. The final methodology also highlights the role of WTP and customer valuations as a key input when setting performance commitments and calculating rewards and penalties.

A key step in this early stage of the process was to commission NERA to undertake work on "Developing a PR19 Valuation Strategy" (completed February 2017). This study reviewed the range of customer valuation techniques that could be deployed to deliver the societal valuations required by the business, and to develop a strategy for selecting those methods to obtain the required valuations. This included an assessment of the strategic importance of each of the attributes that require a valuation for the development of the WRMP and the wider Business Plan at PR19 in terms of:

- whether the attribute is a customer and/or a stakeholder priority;
- the size of the investment quantum that depends on the societal valuation of the attribute;
- the sensitivity of the investment decisions to the societal valuation of the attribute; and
- the level of uncertainty over the societal valuation of the attribute, given the challenges experienced in obtaining valuations in the past.

Figure 1
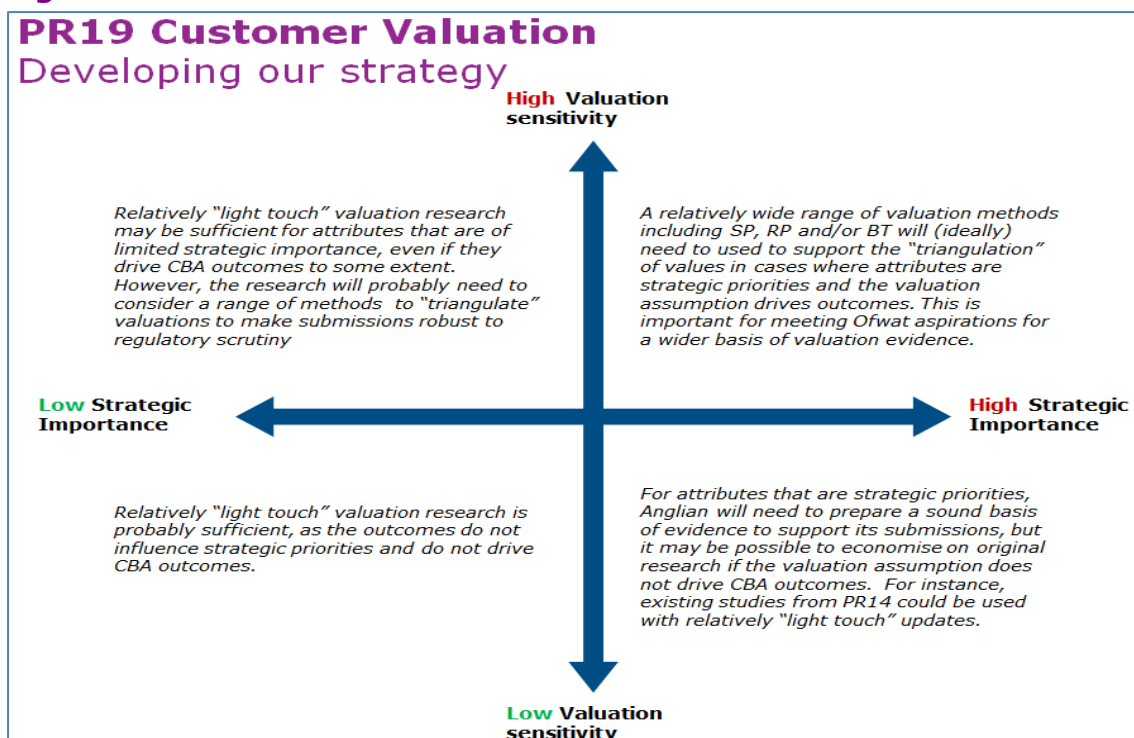
Source: NERA (2017)

Figure 1 illustrates how this assessment of service attributes can be mapped to identify the services of particular importance to focus on for new primary valuation evidence in PR19. The NERA report underpinned the final strategy and the development of the detailed societal valuation framework (SVF). We have prioritised customer valuation evidence for attributes requiring a relatively strong basis of valuation evidence and been proportionate in the valuation effort invested. This is shown in **Figure 2** overleaf which highlights that for the higher priority service attributes we looked to develop multiple valuation evidence.

As part of the societal valuation strategy, we have focused on ensuring our studies provide **robust societal valuation evidence** through application of:

- **Multiple sources:** while stated preference has continued to play an important role, we have also looked to introduce a wider set of valuation approaches where possible and also seek innovation in new valuation methods and customer insight such as:
  - Wellbeing valuation assessing the impact of flooding and roadworks on the subjective wellbeing of our customers – the first application of this method to the UK water industry
  - Environment study that uses a natural capital and ecosystem services framework
  - A first of its kind UEA study that integrates subjective views on river water quality with a choice experiment on improving river water quality in the Anglian region
  - Value transfer from other studies including application of previous revealed preference studies
  - Use of market data where feasible
- **Improvements** in stated preference including:
  - survey design and testing and use of comparative performance data
  - Testing of alternative choice task approaches
- **Reflecting our customer base** using traditional and our customer behavioural segmentation work
- **Triangulation** of all evidence into a single narrative
  - Building on PR14 but making this much more transparent and robust
  - Delivering recommended values through the valuation completion process.

## Figure 2: PR19 societal valuation studies for key service attributes

Summary Overview of PR19 Societal Valuation Studies

Service	Measure	PR19 Valuations				
Supply Interruptions	£ per property affected	AW PR14 Benefit Transfer	PR19 Water Resources Study	PR19 Main Stage Study	Macro/Insurance Study	
Discolouration	£ per property affected	AW PR14 Benefit Transfer	PR19 Water Resources Study	PR19 Main Stage Study	Revealed Preference Household Value for Tap Water (PR14)	PR09 Water Services Study: Weightings Update
Taste & Odour	£ per property affected	AW PR14 Benefit Transfer	PR19 Water Resources Study	Revealed Preference Household Value for Tap Water (PR14)		
Water Restrictions	£ per property affected	AW PR14 Benefit Transfer	PR19 Water Resources Study	PR19 Main Stage Study	Macro/Insurance Study	
Leakage	£ per ML per day	AW PR14 Benefit Transfer	PR19 Water Resources Study	PR19 Main Stage Study *(Leakage)*		
Water Sources	£ per ML per day	AW PR14 Benefit Transfer	PR19 Water Resources Study			
Water Flooding Internal	£ per property	AW PR14 Benefit Transfer	PR09 Flooding Study: Weightings Update	PR19 Main Stage Study	PR19 Wellbeing Study *(Household)*	
Waste Flooding Internal	£ per property	AW PR14 Benefit Transfer	PR09 Flooding Study: Weightings Update	PR19 Main Stage Study	PR19 Water Resources Study	PR19 Wellbeing Study *(Household)*
Water Flooding External	£ per property affected	AW PR14 Benefit Transfer	PR09 Flooding Study: Weightings Update	PR19 Main Stage Study	PR19 Second Stage Environment Study	
Waste Flooding External	£ per area	AW PR14 Benefit Transfer	PR09 Flooding Study: Weightings Update	PR19 Main Stage Study	PR19 Wellbeing Study *(Household)*	
Odour and Flies	£ per property	AW PR14 Benefit Transfer	PR19 Main Stage Study			
Pollution	£ per incident	AW PR14 Benefit Transfer	PR19 Main Stage Study	PR19 Water Resources Study		
River Water Quality	£ per km improved	AW PR14 Benefit Transfer	PR19 Main Stage Study	PR19 Second Stage Environment Study		
Bathing Water	£ per site improvement	AW PR14 Benefit Transfer	PR19 Main Stage Study	PR19 Second Stage Environment Study		
Habitats	£ per hectare	AW PR14 Benefit Transfer	PR19 Second Stage Environment Study			
Customer Contact	£ per contact solved first time	AW PR14 Benefit Transfer	PR19 Main Stage Study			
Congestion	Number of Incidents	AW PR14 Benefit Transfer	PR19 Wellbeing Study			

In choosing valuation methods, we recognise there is, in principle, a hierarchy of preferred valuation approaches led by market prices and revealed preference (RP) approaches (Green Book 2018). The CCW report on improving WTP in the water sector (July 2017) notes that in practice there are few opportunities for water companies to observe market choices that reveal the customer valuations of use in business planning and these approaches will not capture the full range of values including non-use values. Where possible, we have incorporated use of

these market and revealed preference approaches including undertaking a macroeconomic study of the impact of drought restrictions and use of a PR14 RP study on household value for tap water. In addition, we have looked to undertake innovation in use of alternative valuation methods such as wellbeing valuation which is of particular relevance as it provides societal values directly linked to the experience of the incident and the impact this has on subjective wellbeing.

Figure 3 sets out the full range of valuation studies undertaken as part of the societal valuation programme for PR19.

Figure 3: Overview of PR19 valuation studies
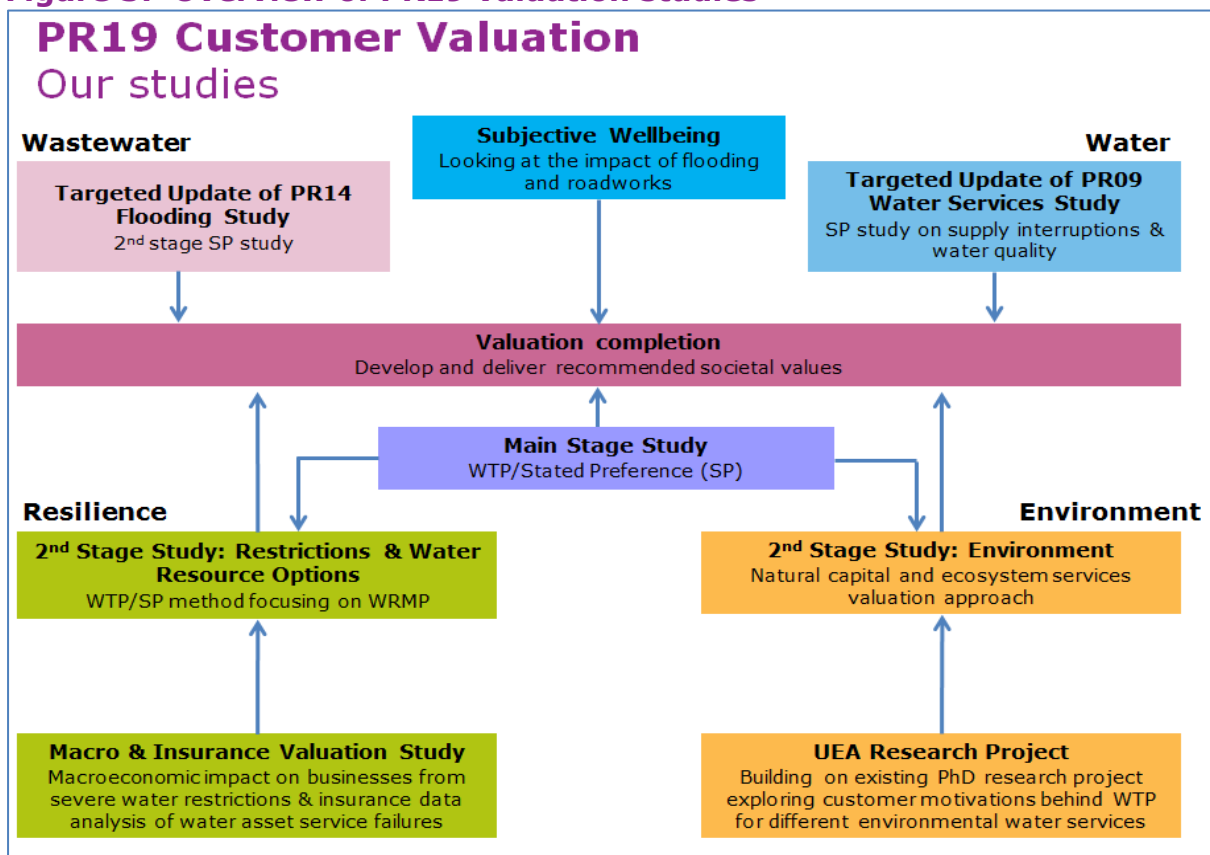
2. Improved design and use of Stated Preference studies

Stated preference studies have remained an important component of the valuation programme for eliciting customer priorities and preferences for changes in service levels. **Box 2** below provides an overview of the main stage study and our second stage water resources study.

Box 2: Overview of PR19 stated preference surveys

Main Stage Study
The study elicited customers' willingness to pay for service levels of core service attributes (so-called "anchor values") from across the business. The survey builds on our PR14 valuation research and addresses issues and concerns around stated preference methods. There was a focus on developing the survey to be engaging and meaningful to customers to obtain robust and credible results and develop a richer picture of customer values across different customer groups. The survey covered Anglian, Hartlepool (water only), Cambridge, Affinity and Essex & Suffolk (wastewater only) areas, with a total of 1,353 household customers and 500 non household customers interviewed through a combination of in-person and online interviews. The samples are representative of our customer base, meeting the sampling quota for gender, age and socioeconomic group (SEG) and geographic distribution across our region.

Second Stage Water Resources Study
The study elicited customers' willingness to pay for water resource options and drought restrictions helping to inform the WRMP and PR19 business planning process. The study developed two integrated stated preference willingness to pay surveys; one focusing on water resource and demand management options and the other focusing on different types of water use restrictions and levels of service. Both studies dovetailed together to provide a clear narrative.

The survey built upon research undertaken at PR14 and used best practice stated preference methods to ensure the approach overcomes valuation challenges. In total, 1,008 household customers and 408 non-household customers were interviewed online with sampling quotas met for age, gender and SEG.

A key focus has been on improvements to survey design in simplifying the presentation of service levels and attributes, making the surveys more interactive. This included various features such as an improved visual design and animations to complement the service descriptions as well as step through instructions demonstrating the choice tasks. We have extensively tested our stated preference surveys including comprehensive testing with customers to ensure the surveys were engaging to customers to promote understanding and considered responses. The survey design and testing followed a good practice iterative process through multiple rounds of cognitive interviews, hall tests and pilot testing with customers. The survey design also built in the use of

comparative performance data to inform respondents of our relative performance within the industry using consistent definitions across the sector[1]. See **Box 3** below providing an overview of the use of comparative data and feedback on respondent views and impact on choices.

Box 3: Use of comparative information

Respondents in the main stage study were shown comparative information taken from the Discover Water[2] website detailing Anglian Water's current service levels relative to other water and sewerage companies in England & Wales. This information was used as part of the warm up questions to the choice tasks, helping respondents consider, alongside other information, whether service levels were satisfactory or what was 'best' or 'worst' in terms of services provided. The findings set out in the final report suggest that customers have more nuanced views on company performance than simply how a company ranks relative to its peers. The self-reported influence of comparative information highlighted there was roughly an equal split between household respondents who considered comparative information important and those who did not. For non-households, marginally more considered the information important. Overall, while respondents considered information comparing Anglian Water to other companies was interesting, only a minority of respondents stated they used the information during the choice tasks.

In the main stage survey, two alternative stated preference approaches have been applied: discrete choice experiments (DCE) - the more traditional approach used previously in PR14 - and trialling best-worst scaling (BWS) techniques. These formats are illustrated in **Figure 4** and **Figure 5** below. The use of the BWS format was taken forward to respond to stakeholder feedback on the perceived complexity of DCE surveys as discussed in the CCW report on improving WTP (2017).

For the DCE, respondents are asked to select their preferred 'option' for water and sewerage services from 3 options. Each choice features a 'no change' option, offering the current service levels with no bill change and two alternatives featuring different service levels and bill impacts. In a BWS[3] format, respondents are asked to make choices between specific changes in service level rather than the overall package. In each scenario, respondents choose their more preferred (best) and least preferred (worst) option. BWS is not consistent with estimating customer valuations by itself, so this needs to be supplemented by a paired comparison (PC) question, which presents respondents with trade-offs against changes in their annual bill, eliciting customer values for maintained and improved service levels.

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[1] In its Water 2020 consultation, Ofwat advocated and increased use of comparative information on company performance to allow customers to make more informed choices.

[2] https://discoverwater.co.uk/

[3] For BWS, this was a household only survey.

Figure 4: Illustration of DCE choice card

	No change	Option A	Option B
Unplanned interruptions Number of properties affected by unplanned interruption to water supply (6-12 hours) each year	NO CHANGE 18,000 properties (1 in 100 properties)	WORSE 22,000 properties (1 in 80 properties)	BETTER 10,000 properties (1 in 170 properties)
Severe water restrictions (Rota cuts) How often severe water restrictions could be experienced	NO CHANGE Every 100 years (25% chance in the next 25 years)	NO CHANGE Every 100 years (25% chance in the next 25 years)	WORSE Every 50 years (50% chance in the next 25 years)
Discolouration Number of properties affected by discolouration of tap water each year	NO CHANGE 30,000 properties (1 in 60 properties)	WORSE 50,000 properties (1 in 30 properties)	WORSE 50,000 properties (1 in 30 properties)
Leakage Percentage of water lost due to leakage each year	NO CHANGE 65% (approx. 85 liters per property per day)	BETTER 6% (approx. 25 liters per property per day)	WORSE 19% (approx. 85 liters per property per day)
Water bill Change in annual water bill from 2020	NO CHANGE	£30 increase	£40 decrease
Which option do you prefer?	○	○	○

Figure 5: Illustration of BWS choice cards

	CURRENT SITUATION	SCENARIO 1	BEST (change in service level)	WORST (change in service level)
Sewer flooding inside properties Number of properties affected by internal sewage flooding each year	260 properties (1 in 6,700 properties)	BETTER 60 properties (1 in 29,000 properties)	○	○
Sewer flooding to external areas Number of properties affected by external sewage flooding each year	5,100 properties (1 in 340 properties)	NO CHANGE 1 in 5,100 years (1 in 340 properties)	○	○
Odour from sewage treatment Number of properties affected by odour from sewage treatment each year	2,900 properties (1 in 600 properties)	WORSE 3,900 properties (1 in 450 properties)	○	○

	OPTION A	OPTION B
Sewer flooding inside properties Number of properties affected by internal sewage flooding each year	NO CHANGE 260 properties (1 in 6,700 properties)	BETTER 60 properties (1 in 29,000 properties)
Sewer flooding to external areas Number of properties affected by external sewage flooding each year	NO CHANGE 5,100 properties (1 in 340 properties)	NO CHANGE 1 in 5,100 years (1 in 340 properties)
Odour from sewage treatment Number of properties affected by odour from sewage treatment each year	NO CHANGE 2,900 properties (1 in 600 properties)	WORSE 3,900 properties (1 in 450 properties)
Water bill Change in annual bill from 2020	No change	£15 increase
Which option do you prefer?	○	○

In terms of the main results, a key message has been that the BWS survey provided a complementary set of results and valuable comparator to the DCE survey. This has proved helpful for cross-checking and validating customer

preferences and valuations. Overall, the results from the two surveys were found to be largely consistent and reinforcing with respect to customer priorities and values. This has provided useful evidence to support the process of triangulation of our valuation evidence for PR19 by providing a further triangulation point and cross-check for the key 'anchor' services.

Respondent feedback on the ease/difficulty of the choice tasks for the two surveys show that whilst the majority found the DCE choice task to be 'very easy' or 'fairly easy', slightly less (41% compared to 59%) found the BWS choice tasks to be 'very easy' or 'fairly easy'. This was consistent with findings from the testing phase where respondents found it slightly easier to compare service levels between alternative packages (DCE) than comparing between different service areas (BWS). An interesting finding from the trialling of BWS formats has been to confirm that the DCE approach is not inherently more complex or difficult to understand than the BWS approach.

Table 1: Validity testing in main stage survey

Validity tests	Key results
'Content'	o Testing phases indicated a good understanding of the survey and purpose, demonstrating good engagement which followed through to the main survey. o Motivations for choices appear to be primarily driven by valid considerations. Consistent with a strong preference to maintain service levels, very few indicated packages with lower service levels acceptable. o Relatively small number of protest votes (15% DCE, 26% BWS, 12% non-household). o High proportions of respondents stated survey was interesting, relatively small proportions found it difficult to understand or not credible.
'Construct'	o DCE: All results in line with expectations with expected signs and statistically significant at 1% level. o Customers more sensitive to deteriorations in services than improvements (gains-loss asymmetry) and place more weight on initial improvement compared to higher improvements diminishing marginal benefit). Results provide assurance respondents were providing considered responses that accounted for actual service levels presented. o BWS: Consistency in the marginal rates of substitution between BWS and PC choice tasks indicating consistency in customer preferences.

Across both stated preferences surveys (including both DCE and BWS in the main stage survey), the analysis of the results demonstrated strong validity in terms of both 'content validity' and 'construct validity. 'Content' validity is a more qualitative exercise to assess respondent understanding and motivations for their choices. 'Construct' validity refers to the robustness of the choice models and how well they explain respondents' preferences based on reasonable expectations, for example in relation to economic theory. Key results from the validity testing of the main survey are provided in **Table 1** above.

In summary, for both stated preference surveys, the respondents had a high degree of engagement, understood the consequences of the survey (i.e. responses matter), and provided considered responses. The approach in the PR19 stated preference surveys has been able to significantly improve on the PR14 valuation research including building in innovation through:

- A clear design of surveys that is more visually engaging and interactive for customers, including the use of comparative information
- Trialling alternative valuation formats (DCE, BWS) in the main stage survey which provided insight on how format choice affects complexity for the respondent;
- In the second stage study an innovative feature of the study was the use of post-survey customer focus groups to test and validate the results (see **Box 4** below).

Box 4: Use of post survey focus groups

Two post survey focus groups were used in the second stage water resources study to explore the surveys findings with customers and ensure the right messages and conclusions were drawn from the study. This was a key step in validating and triangulating the proposed applications of the values in business planning. The key objective was to find out whether customers understood the concept of reliability for different water resource options and to obtain feedback on the preferred water resource options including testing three additional options.

This innovative feature of the study was praised in the independent peer review and seen as "exceptional" noting that "it is rarely undertaken in SP studies, despite being an extremely useful tool to corroborate and endorse the findings".

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3. Incorporating and exploring a range of valuation methods

In addition to stated preference, a number of studies in the societal valuation programme have applied alternative and innovative valuation approaches.

We undertook an assessment of the impact of flooding and road works on the wellbeing of Anglian Water customers. This the first time that the subjective wellbeing impacts of these water industry related incidents have been analysed in the UK and provides a foundation for applying the wellbeing valuation method to other types of water-related incidents. We have also applied a natural capital framework to help analyse the impacts and dependencies of investments on natural capital assets and ecosystem services to inform recommended societal values relating to the environment. Research was also conducted exploring the economic impacts on non-household customers of severe water restrictions and separately a first of its kind research study applying a mixed-methods approach by converging qualitative and quantitative data.

Wellbeing valuation study

We commissioned Simetrica to undertake an innovative study assessing the impact of flooding and road works on the subjective wellbeing of our customers. The study was the first of its kind in the water industry to assess the subjective wellbeing impact of flooding and roadworks.

The Wellbeing Valuation approach calculates the value of each type of incident by estimating the impact on subjective wellbeing for customers who have experienced the incident. The equation below illustrates the relationship between subjective wellbeing (using life satisfaction as the measure) and flooding/roadwork incidents.

- **Wellbeing** regression (OLS): $LS_i = \alpha Incident_i + X_i \beta + u_i$
- Key outcome variable (LS): **Life satisfaction**
- **Control variables (X)**: Age, gender, employment, income, education, ethnicity, marital status, smoking, benefits, number of children, rurality, local authority dummies (best practice based on academic literature)
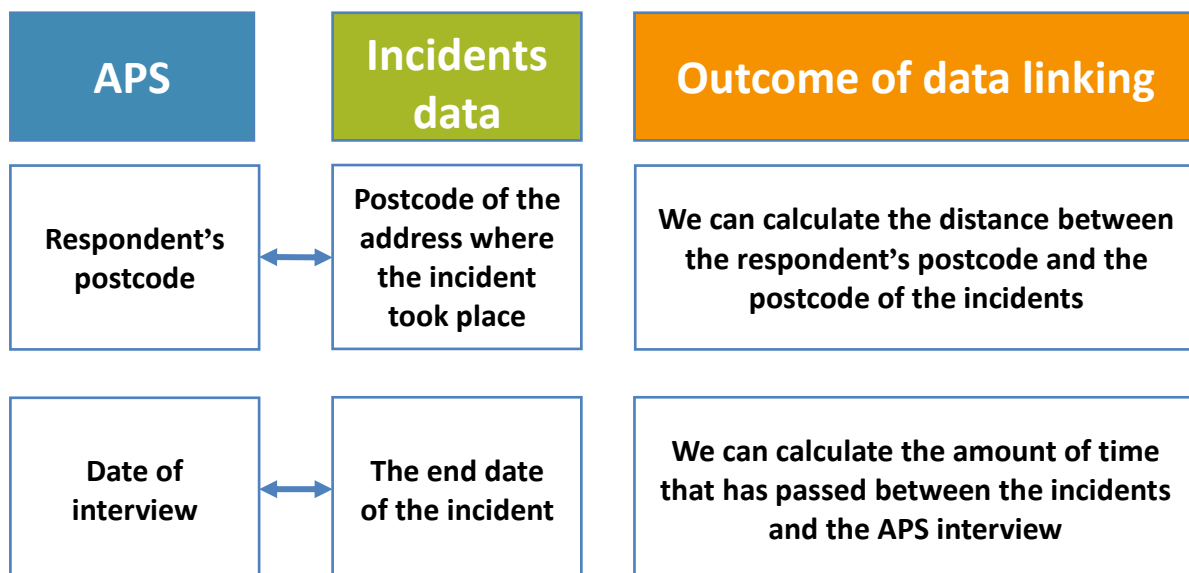
This impact is then converted into a monetary value by estimating the equivalent amount of money the customer would be willing to pay to avoid the incident (see **Figure 6** below).

Figure 6: Approach to deriving wellbeing values
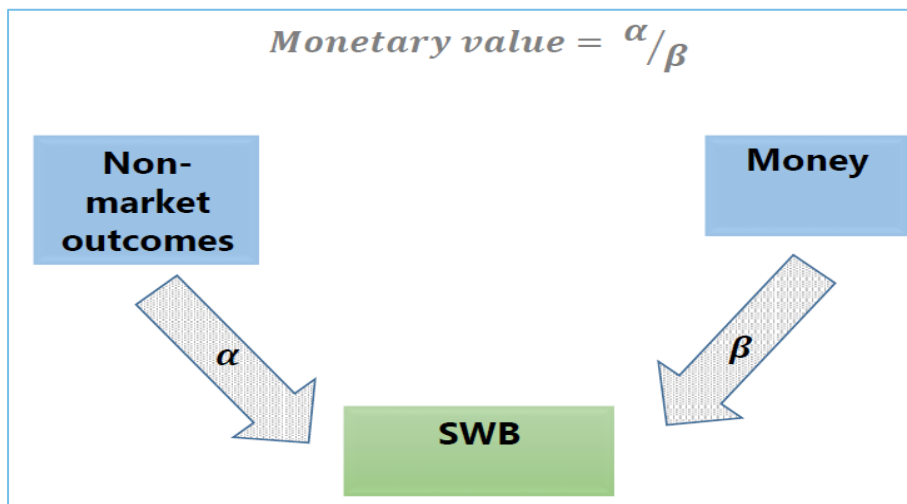
The analysis was conducted by merging information on Anglian Water flooding and roadwork incidents in the region with the Annual Population Survey (APS), a continuous household survey containing information on wellbeing and a wide range of socio-economic characteristics. The two datasets were merged and respondents were identified as being potentially affected if an incident had occurred within a specified distance of their postcode and in a specific time after their survey response. The figure below illustrates the link between the APS data and the incidents data.

Figure 7: Linking Anglian Water incident data with national datasets

APS	Incidents data	Outcome of data linking
Respondent's postcode	Postcode of the address where the incident took place	We can calculate the distance between the respondent's postcode and the postcode of the incidents
Date of interview	The end date of the incident	We can calculate the amount of time that has passed between the incidents and the APS interview

The analysis estimated values for; all types of flooding incidents recorded, internal water flooding, internal (domestic) sewer flooding, external sewer flooding and roadworks.

The values derived from this study for internal and external sewer flooding and roadworks have been taken through our triangulation process to inform the final recommended values, taking into account the differences in valuation approach, the types of value captured and how the values best align with the existing societal values.

Environment studies

We undertook two studies that have taken on board the latest thinking in terms of application of natural capital as well as using innovative new approaches:

- The Environment study applied a natural capital framework to help analyse the impacts and dependencies of investments on natural capital assets and ecosystem services to inform recommended societal values relating to the environment
- We commissioned UEA to integrate a choice experiment on customer willingness to pay for river water quality improvements with an analysis of Anglian Water's customers' subjective preferences, trialling a more holistic approach to economic valuation.

Environment second stage study

We commissioned eftec to undertake an environment study to develop a practical approach for estimating the values of changes in service levels across key environmental attributes. The report sets out a natural capital framework to help analyse the impact and dependencies of investments on natural capital assets and ecosystem services (see **Figure 8** below). It also provided recommended values for investment appraisal, which where appropriate have been incorporated into the valuation completion report and hence our final set of recommended societal values.

Figure 8: Integrating natural capital into the Anglian Water investment process
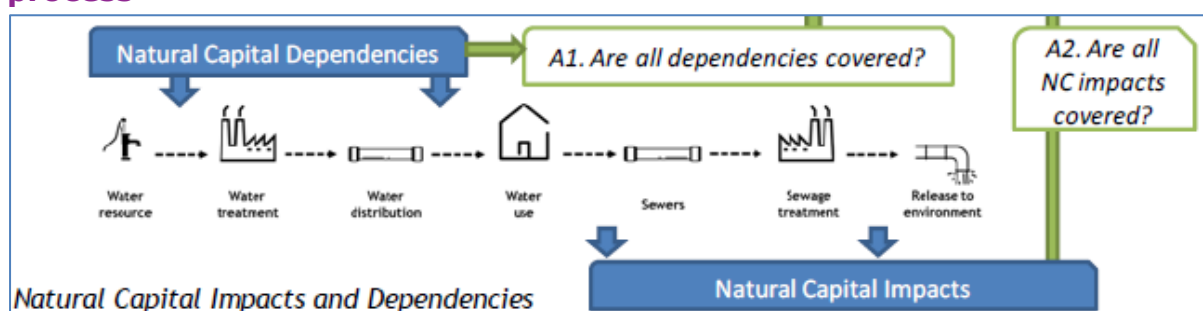
The main output of the report has been a natural capital framework which has been used to develop 12 impact pathways representing the range of investments that have impacts and dependencies on natural capital including traditional waste water treatment as well as catchment management approaches. 3 case studies were also undertaken to illustrate the approach in practice. The report identified further impacts that could be potentially valued include air quality

regulation and climate regulation by vegetation, avoided treatment costs from investing in natural solutions, and aesthetic benefits.

The study is the starting point for helping develop a longer-term direction of travel in applying natural capital and ecosystem service approach to our delivery strategy; these may require a more complex appraisal process than traditional solutions but could provide a wider range of environmental benefits. We are also in the process of developing an internal guide for the use of natural capital and environment values in investment planning appraisal which draws upon the key findings from the study.

Combining Anglian Water's customers' subjective preferences with their willingness to pay for river water quality improvements - UEA

The main objectives of this study were to:
- Characterise the different subjective preferences for river management held by the general public, a range of river users and relevant water quality experts, enabling a greater understanding of the diversity of viewpoints held by, and motivating, people;
- Improve our understanding of the role psychological subjectivity has in shaping customers' willingness to pay for river water quality improvements.

This was an innovative study which we believe to be the first of its kind within the water industry in providing a mixed-methods approach by converging qualitative and quantitative data. The quantitative data comes from a choice experiment that assesses customers' willingness to pay for river water quality improvements[4]. This is integrated with an analysis of Anglian Water's customers' subjective preferences for river water quality using Q-methodology[5]. We use the respondents' Q factor associations to incorporate their subjective preferences into the Choice Experiment analysis of their WTP for river improvements. The results suggest significant heterogeneity across Q respondents' choice behaviour, attributable solely to their subjectivity. The small sample size linked to the valuation model means that we cannot claim model transferability across the Anglian Water region. However, the study provides proof of concept that this approach can deliver useful insights. By triangulating between quantitative and qualitative research methods to engage customers, we demonstrate a novel mixed-methods research strategy that may be used to better understand economic analysis.

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[4] The choice experiment relates to a 20km stretch of the River Yare in the Norwich area.
[5] Q methodology scientifically structures respondents' subjectivity and allows the quantification of highly qualitative data. It combines numerical analysis and qualitative interpretation to increase the level of research reliability and validity. This enables the method to bridge the divide between qualitative and quantitative approaches to policy research. This enables a fuller range of viewpoints on the subject of river water management to be revealed.

Research into the economic impacts on non-household customers of severe water restrictions including use of insurance data

NERA were commissioned to conduct a study which looked to estimate the amount of economic output that would be lost following water use restrictions and investigated the potential use of insurance data to value the avoidance of drought restrictions.

Macroeconomic data was used to estimate the loss of economic output linked to various levels of water restrictions. This applied methods used in previous work by NERA for Water UK and estimated the average percentage of output that may be lost in the event of a water restrictions for each economic sector and for different durations of the restrictions.

The study also investigated the use of insurance data to value avoided drought restrictions, including the potential for using AW operational data on flood damage insurance claims. Literature and insurance market information, including the FHRC's Multi- Coloured Manual, was also reviewed to assess what market evidence existed which could be of use to value water supply interruptions. This identified the existing benefits transfer evidence available that could be used to support the value of leakage reduction relative to other supply/demand side management options.

The results of the study have helped to inform the values within the WRMP and were taken through the triangulation process of the valuation completion report to inform the final set of societal values.
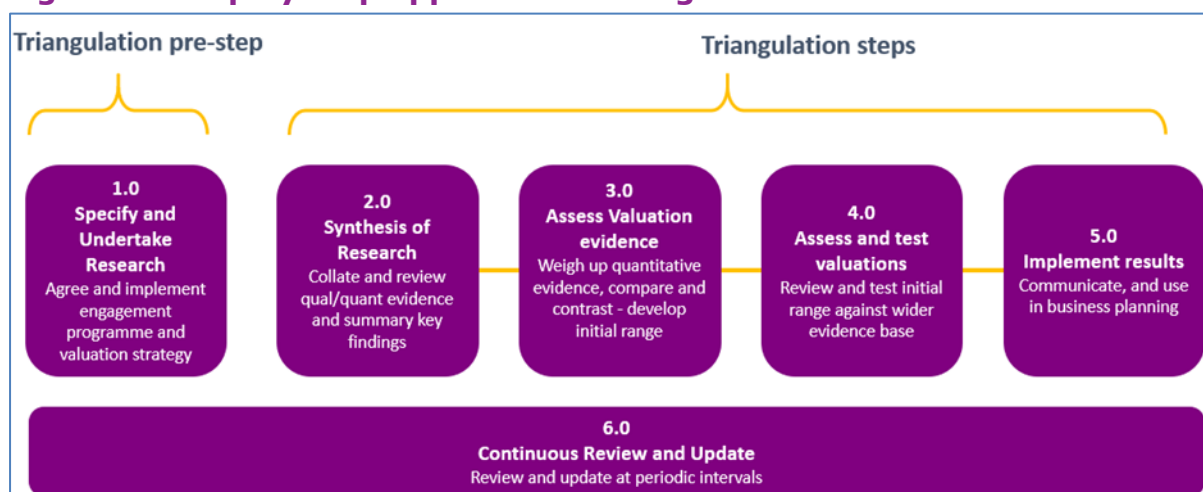
4. Approach to triangulation

a. Steps in triangulation

The CCWater report, "Defining and applying triangulation in the water sector", July 2017, defines triangulation in practice as "using multiple and independent measures to examine a hypothesis or conclusion being investigated, with the intent of using multiple perspectives to minimise bias and maximise validity."

In the context of valuation, triangulation has involved the seeking of views and preferences of customers on service improvements, gaining valuations through different methods and understanding different customer segments' views. These valuations are then triangulated in order to define the values to use within the cost benefit analysis.

Our valuation triangulation process is set out in **Figure 8** and is aligned to the CCWater report published in 2017. The results in terms of recommended societal values are set out in our Valuation Completion Report.

Figure 8: Step by step approach to triangulation

The Valuation Completion report focuses in detail on steps 2 and 3 but also including step 4 relating to assessing and testing the valuations. Further details on each of the steps are provided below:

Step	Approach
1	Pre-step to the triangulation process and is completed through the Societal Valuation Framework (SVF) setting out the approaches to sourcing and estimating customer, wider societal and environmental valuations.
2	Collates available relevant studies, research and customer insight, documents the results and synthesises the findings including assessing each evidence source for robustness and relevance (see **Box 5** below).
3	Compares the data to produce a recommended range by comparing the values and customer preference data to provide a range that reflects the valuations' scope, taking into account how robust and relevant each source is.

4	Covers a number of testing processes including a comparison with wider customer evidence and implications of the triangulated values on the investment plan.
5	Involves implementing and communicating the results for the recommended values, through the business plan development.
6	Final step in the process and requires the results to be revisited throughout the business planning and delivery processes as new data becomes available and customer engagement continues, and make updates as appropriate.

Box 5: Criteria for evaluating valuation evidence

A key part of step 2 (synthesis of research) in the triangulation process is the evaluation of each evidence source in terms of robustness and relevance. This determines the extent to which each source is favoured or weighted prior to feeding into step 3. A set of critical questions to assess each source was developed based on the HM Treasury Magenta Book, CCWater triangulation process and Defra benefit transfer guidance.

Robustness
To assess the robustness of the source, specific questions were developed to understand the methodology & sampling (what values were captured, was the sample representative, was the study peer reviewed), estimation (were statistical tests used, are the results robust) and evaluation (is there a formal assessment of validity, is the research part of a repeat studies) of the sources.

Relevance
To understand the relevance of the studies results to our values a number of critical questions around the similarity of definitions used, the service levels and ranges explored, customer base and age of research were used to assess each source.

The use of these critical questions provides a transparent assessment of how much each evidence source should be favoured in the triangulation process. Our PR19 research values are the most relevant and robust and as such are defined as 'primary' values. Older Anglian Water studies from PR14 and PR09 also form part of this primary evidence, whilst other data sources such as other companies' studies are less favoured and are defined as 'secondary' values which are more appropriate to use as a cross-check.

b. Overview of triangulation of valuation evidence

This section expands on steps 3 and 4 of the triangulation process. For step 3, the valuation completion report uses two main evidence sources:

- Primary/core data for the anchor measures sourced from our valuation studies both at PR19 and PR14
- Secondary data available in the public domain from other companies/areas.

Figure 8 illustrates the process of step 3 in deriving the recommended values. The VCR focuses on triangulating 'anchor' or key measures where valuation data tends to be more widely available. These triangulated 'anchor' measures are then used to populate the wider framework. A range of evidence is used in this step; primary data from our valuation studies and secondary data available in the public domain from other companies which is used as a crosscheck on the recommended values.

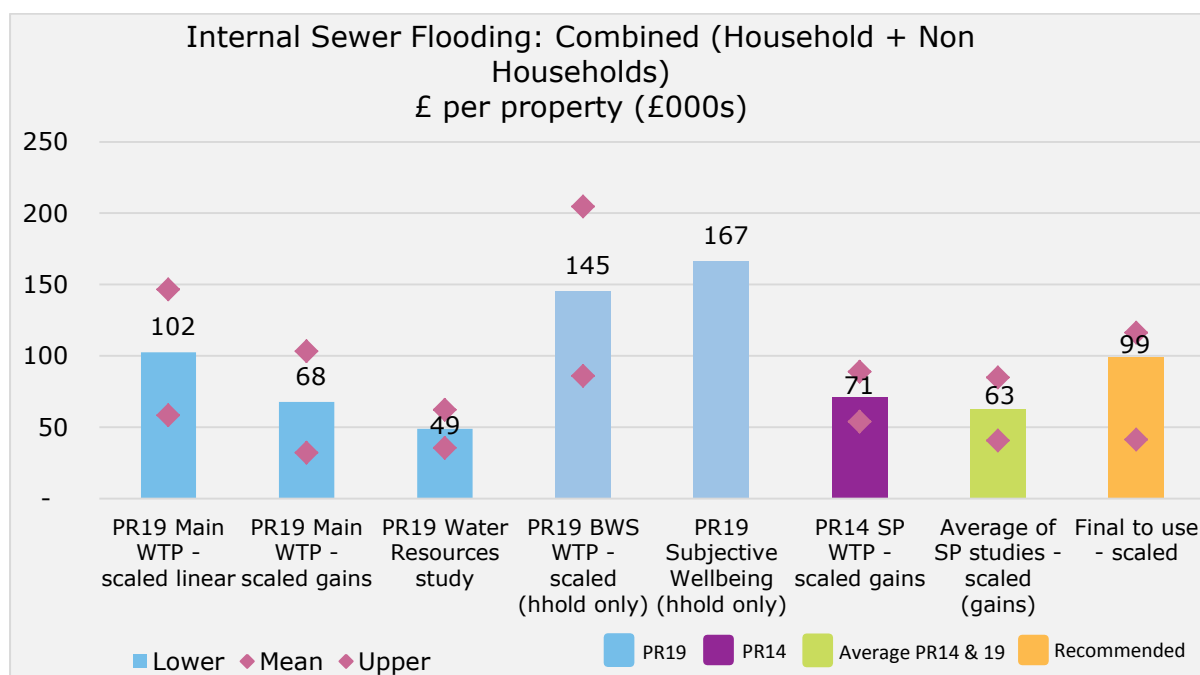**Figure 8: Step 3 for deriving recommended values**
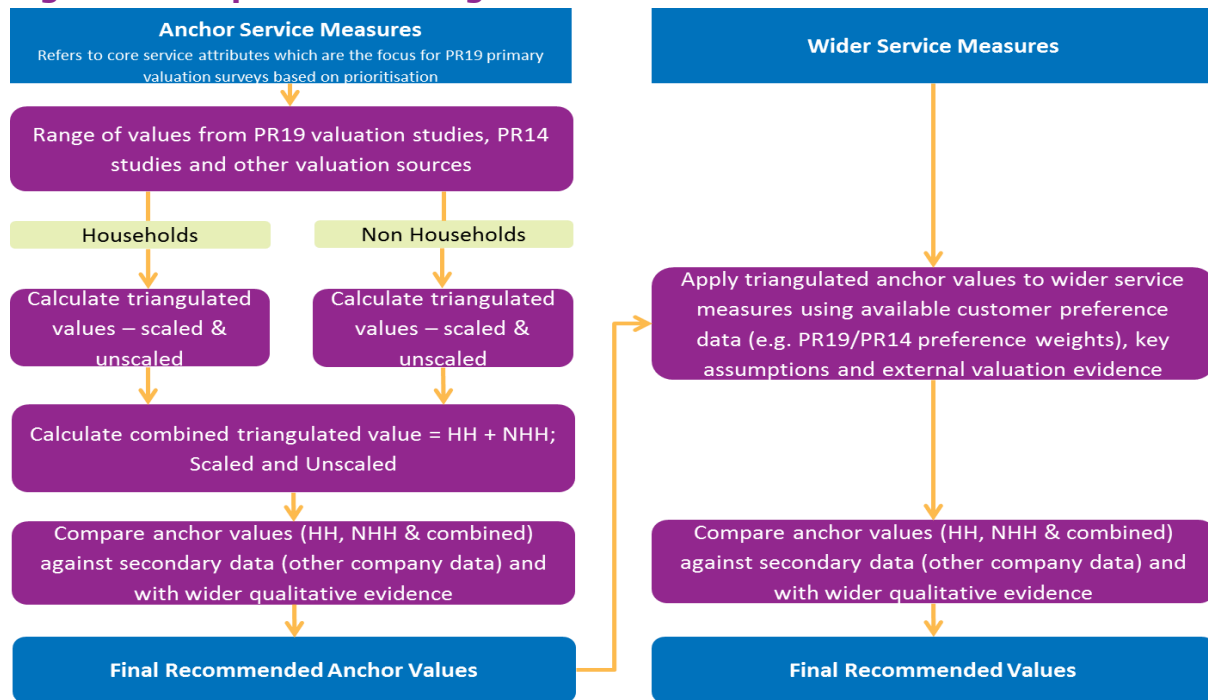
Figure 9 illustrates the primary evidence used in our triangulation process to determine the recommended values to use within the cost benefit analysis (orange bar) for internal sewer flooding.

Figure 9: Example of triangulation of PR19 values

The recommended values are then reviewed against secondary data including PR14 values from other companies and, currently in progress, more up to date comparisons for PR19[6]. This was used as a cross-check to understand where our recommended values are situated across the water sector, while recognising there are differences in context and other factors that can drive the range of values.

Step 4 in the process is to carry out a triangulation against wider customer views to ensure consistency. This phase was focused on more detailed and specific questions designed to close the triangulation loop by gaining more insight into areas where valuations were not within expected ranges or there was a need for further testing of assumptions, an example of which is discussed in **Box 6** below.

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[6] Anglian Water are a participant company in a current Accent/ PJM economics study on Comparative Review of PR19 WTP results [draft report, May 2018]..

Box 6: Triangulation of pollution incidents

The interim values showed a sharp upward increase compared to PR14 which we tested in our online community (March 2018) to see how customers interpret the definition used in the valuation studies. The results showed the definition better aligned with a category 2 incident (not a category 3). As a result, we have linked the pollution anchor category to a category 2 in line with customers' interpretation which has meant that the values for pollution incidents for categories 1 to 3 have all been reduced. However, these values are still showing an increase compared to PR14 values which is consistent with the wider customer evidence that confirms that pollution is still (and increasingly) a customer priority.

c. Our approach to customer segmentation

The purpose of the WTP research has been to produce average valuations across all customers. However, it is recognised that not all customers may be well represented by the 'average' viewpoint or value so there is a need to understand how the priorities of customer groups vary. This has been explored through the main stage and second stage water resources study. An illustration of this is provided in **Figure 10**, drawn from the second stage water resources study.

Figure 10: WTP values by customer segments

Figure 4.8: Household - Segmentations

SEGMENTATION	RESTRICTIONS SURVEY			OPTIONS SURVEY		
SEG	WTP £/hh/yr	Is estimate significantly different to zero?	Is segment estimate significantly different to 'All' estimate?	WTP £/hh/yr	Is estimate significantly different to zero?	Is segment estimate significantly different to 'All' estimate?
All Respondents	34.23	✓✓✓		29.45	✓✓✓	
C2 & DE	26.45	✓✓✓	✗	17.71	✓✓✓	✗
C1	29.53	✓✓✓	✗	36.68	✓✓✓	✗
AB	50.78	✓✓✓	✓✓	43.05	✓✓✓	✗
Anglian Water Segments						
All Respondents	34.23	✓✓✓		29.45	✓✓✓	
Protective Provincials & Eco-Economisers	23.83	✓✓✓	✓	22.48	✓✓✓	✗
Comfortable & Caring / Family First / Tech-savvies	48.97	✓✓✓	✓✓	37.58	✓✓✓	✗
Metering						
All Respondents	34.23	✓✓✓		29.45	✓✓✓	
Non metered	45.72	✓✓✓	✗	20.72	✓✓✓	✗
Metered	30.01	✓✓✓	✗	32.89	✓✓✓	✗
Service Experience						
All Respondents	34.23	✓✓✓		29.45	✓✓✓	
Issue experienced in last 5 years	32.44	✓✓✓	✗	37.95	✓✓✓	✗
Issue Experienced > 5 years or Never	38.19	✓✓✓	✗	11.88	✓	✗

Key:
✓ Significant at p < 0.1
✓✓ Significant at p < 0.05
✓✓✓ Significant at p < 0.01
✗ Not significant

Note: Results based on combined data for Scenario +1 and Scenario +2. Restrictions survey: Combined n = 508 respondents. Options survey: Combined n = 499 respondents.

The Valuation Completion Report pulls together an overarching analysis and summarises where there are differences in valuations between customer segments. In line with Ofwat methodology, the focus has been on exploring

differences around future generations, affordability and vulnerability. The main customer segments which have been analysed include: socio-economic groups (SEG); age; WaterSure; disability; Anglian Water customer behaviour segments and Hartlepool.

Overall, whilst differences in opinion exist amongst customers, preferences or values for core services do not vary across different customer groups that often. The main differences in WTP were found to be between SEG DE and the customer behaviour segment 'Protective Provincials'. The analysis has confirmed that the average WTP values are representative across a wide range of customer segments with only a few exceptions for consideration.

5. Recommended societal values

a. Overview of recommended values

The recommended values provided in the Valuation Completion Report have been used in the PR19 business planning and WRMP appraisal processes.

The Valuation Completion Report sets out the detailed methodology and approach that underpins the recommended PR19 societal values including the triangulation principles and key steps as well as how we have used key information from the valuation data. This has helped to ensure we apply a credible and robust approach to triangulating the customer valuation evidence.

For each service attribute, three values have been provided (mid, low and high) along with a full set of both scaled and unscaled values for the gains (WTP) and losses (WTA) values. Key factors considered in the development of the values are summarised below:

- The approach to identifying the ranges for each service varies depending on the information available. Factors that are common to the approach for setting values and ranges include the use of confidence intervals to inform the low to high range, mainly basing the values on PR19 sources taking into account the type of value each source covers and checking against PR14 sources.
- The scaled values have been calculated to address the 'package' effects that are observed when multiple improvements to services are proposed[7]. In this context, the application of scaled values can be considered to be more appropriate to apply in cost benefit analysis.
- Both WTP values for improvements in service (gains) and WTA for deterioration in service (losses) have been calculated. In the majority of cases, WTA a loss in service is greater than WTP for an improvement. In general, the investment programme is focused on improvements and so the gains values represent a sensible starting point. In a few cases, for example, looking at an investment case to avoid a deterioration in service, it may be appropriate to use the WTA (losses) values for further sensitivity testing.
- The recommended values have been reviewed against the wider customer engagement evidence and in general look consistent. The evidence on customer segments, in general, do not suggest that the values vary much from the average apart from a few key areas (e.g. SEG DE values for leakage are lower than average). There is the opportunity to use these results where appropriate in sensitivity analysis.

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[7] In the context of multiple improvements in services, scaled values account for customer income constraints and how improvements in one area can 'substitute' for improvements in others.

b. Use of valuation in cost benefit analysis

Overall, the scaled gains values are seen to be a reasonable and conservative starting point for use in applying to cost benefit analysis.

The investment appraisal system has incorporated ranges for mid, low and high and so offers the opportunity for sensitivity analysis in appraisal of investment options with respect to the value ranges and to understand the impact of the range of values on investment decisions.

c. Use of valuation in ODIs

The set of recommended societal values has also provided evidence to support the development of ODIs. Consistent with the investment appraisal system, the scaled gains values have been used as the starting point to inform the setting of our ODIs.

We have used bottom up willingness to pay and cost information to set incentive rates in line with Ofwat's guidance. The starting point for the willingness to pay evidence is our set of recommended societal values (scaled gains values). However, the use of this bottom up evidence from customers is also assessed in the context of the appropriate scale of the overall incentive package.

For some performance commitments, there is a direct translation of the societal valuation to the ODI whilst for others, some calibration is necessary. We have sought additional customer evidence through an ODI survey to understand the appropriate scale of ODIs and preparedness of customers to accept reducing or increasing bills. This provides a safeguard to the use of societal valuations driving significant penalties or rewards not envisaged by the original studies[8].

Further detail on the setting of performance commitments and ODIs are set out in Chapter 13 of our Plan.

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[8] See CCWater Improving willingness to pay report (2017) for a detailed discussion of these issues of applying WTP values in the context of ODIs.

6. Peer review and assurance

The societal valuation programme and triangulation process has been subject to extensive assurance and peer review processes throughout. This is linked to step 6 of the triangulation process (see Figure 8) which is described as 'continuous review and update' and is an important aspects at all stages of the process. This is illustrated as we have moved through the steps of our triangulation process:

Assurance activities linked to specific steps of triangulation process:	
Step 1	NERA societal valuation strategy report
Step 2	Primary valuation studies have been through various built in assurance processes including; • pre and post customer testing of the surveys • extensive validity testing • independent peer reviews of the stated preference studies (main and second stage study)
Step 3-4	Further testing of results and independent peer review of triangulation approach presented in Valuation Completion Report, which was found to be a *"thoughtful and comprehensive analysis of triangulation"*
General assurance processes:	
• PR19 Programme Board assurance of societal valuation plan • Internal CITWG (Customer Insight Technical Working Group) to ensure the programme of work met the required needs of the business, aligned with regulatory expectations and utilised the most up to date academic thinking • CEF and CEF valuation sub-group; engaged in the development of the work throughout and their feedback was incorporated into the final design of the surveys. CEF sub-group have reviewed and commended on the studies, triangulation process and use of values • Halcrow assurance review; phase 1 (completed in January 2018) looked at the societal valuation work in response to Ofwat's requirements and phase 2 (completed in June 2018) looked into our approach to triangulation	

7. <u>Conclusions</u>

Overall, the Societal Valuation Programme has successfully delivered the full suite of societal valuations required for the PR19 business planning process with a focus on delivering evidence that is robust, balanced and proportionate. The PR19 valuation programme has built on lessons learnt from PR14 while incorporating a range of key improvements and innovation.

Developing our societal valuation strategy in 2016-17 enabled us to focus effort proportionally on service attributes of high value to customers and the business.

Stated preference studies have remained an important component of the valuation programme. A key focus has been on improvements to survey design, making the surveys more interactive and use of comparative performance data to inform respondents of our relative performance within the industry. In the main stage survey, alternative valuation methods have been trialled.

In addition to the stated preference techniques we have used, a number of studies in the societal valuation programme have applied innovative valuation approaches. We undertook an assessment of the impact of flooding and road works on the wellbeing of Anglian Water customers. This is the first time that the subjective wellbeing impacts of these water industry related incidents have been analysed in the UK and provides a foundation for applying the wellbeing valuation method to other types of water-related incidents. We have also applied a natural capital framework to help analyse the impacts and dependencies of investments on natural capital assets and ecosystem services to inform recommended societal values relating to the environment. We also conducted research into effects on non-household customers of severe water restrictions and the innovative application of a mixed-methods approach converging qualitative and quantitative data.

Our approach to triangulation is aligned with the steps set out in the CCW report on triangulation. This builds on the approach taken in PR14 but has developed a more transparent and robust approach. The final triangulated values have been used within the PR19 investment appraisal process and have also informed the performance ranges for the ODIs and helped to shape both the common performance and company specific measures.

8. <u>References</u>

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