

Anglian Water 12E. DEVELOPING A PR19 SOCIETAL VALUATION STRATEGY





Developing a PR19 Societal Valuation Strategy

Prepared for Anglian Water

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Executive Summary

Anglian Water Services Limited (Anglian) has commissioned NERA Economic Consulting to support its programme of work to deliver the societal valuations required for the PR19 business planning process. Specifically, we have been asked to review the range of customer valuation techniques that could be deployed to deliver the societal valuations required by the business, and develop a strategy for selecting those methods that should be deployed to obtain the required valuations.

To meet these objectives, we have drawn on a range of evidence, including a review of the PR14 valuation programme undertaken by both Anglian and the wider industry. We have also conducted a review of literature to identify appropriate valuation methods and potential improvements to traditional SP techniques, held detailed discussions with Anglian in-house experts to identify evidence on strategic priorities for the upcoming price review, and assessed a range of statements from regulators on upcoming priorities.

Based on the findings from our review, we have assessed 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 around four dimensions:

- 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.

Drawing on this strategic assessment, and on our evaluation of the available methods for each type of attribute, we have developed our recommended Societal Valuation Framework for Anglian Water at PR19, which maps each attribute of service to a set of recommended valuation studies.

Table 1.1 and Table 1.2 summarise our proposed valuation strategy by showing the attributes of service to be covered by each recommended study, as well as the deadline for which valuations are needed in each case.¹

¹¹¹ Note, the service attributes listed in the table correspond to those attributes for which the business requires a valuation. Of course, some attributes are relatively technical in nature, so further consideration will need to be given when implementing each valuation study to how service attributes/levels are presented to customers.

Table 1.1 Mapping of Attributes of Service to Recommended Studies (Part 1)

Research Package:	Main "Stage 1" Stated Preference	"Stage 2" SP on Resilience	"Stage 2" SP on Options	"Stage 2" on Output Loss	Broad "Sliding Scales" SP	"Sliding Scales" on Options	Deliberative Workshops	Complaints/ Social Media Analysis
Brief Description:	Improved broad SP	Improved SP focused on restrictions/interruptions	Improved SP method controlling for other factors	Macro study (based on findings from other studies)	Laying grounds for ongoing research	Laying grounds for ongoing research	Educating respondents, then ask SP	Analysis of customer data "warehouse"
Deadline:	Aug 2017	Apr 2017	Jun 2017	Apr 2017	Aug 2017	Jun 2017	Aug 2017 (*)	Aug 2017
Attributes Covered:								
Drought Resilience		✓		✓			(*) Apr 2017	
Resilience to Others	✓	✓		✓			✓	
Supply Interruptions	(x2)	✓		✓	✓			✓
Demand Mgmt. Strat.			✓			✓	(*) Jun 2017	
WR Options								
Wastewater Solutions			✓				✓	
WRC Growth								
River Water Quality	✓				✓		✓	
SSSI Habitats and Recreation Sites								
Sewer Flooding	(x2)				✓			
Water Flooding	✓							
Customer Contacts							✓	✓
Water Quality Notices	✓				✓		✓	
Discolouration; Taste&Odour	✓				✓		✓	
Water Hardness								
Carbon							✓	
Odour and Flies	✓							
Coastal Waters	✓							
Low Pressure								
Traffic Disruption	?							✓
Others								

Table 1.2 Mapping of Attributes of Service to Recommended Studies (Part 2)

Research Package:	Survey to Customers Affected	Data Analysis of Insurance Compensation	"Indirect" Hedonic Pricing	"Travel Costs" RP Research	Assessment of Externalities	Ecosystem Services Assessment	BT from PR14/PR09 and Others
Brief Description:	On costs of damage/mitigation measures	Collect data and analyse if feasible	Interviewing estate agents on house price effects	Lay grounds for ongoing surveys to visitors	Then decide whether further research is needed	Qualitative, then monetise where possible & proportionate	Adjustment/adaptation/translation
Deadline:	Aug 2017 (*)	Aug 2017 (*)	Aug 2017	Aug 2017	Feb 2017	Feb 2017	Aug 2017
Attributes Covered:							
Drought Resilience	(*) Feb 2017	(*) Feb 2017					✓
Resilience to Others	(*) Feb 2017	(*) Feb 2017					✓
Supply Interruptions	(*) Feb 2017	(*) Feb 2017					✓
Demand Mgmt. Strat.							✓
WR Options					✓	✓	✓
Wastewater Solutions					✓		✓
WRC Growth					✓		✓
River Water Quality			✓	✓		✓	✓
SSSI Habitats and Recreation Sites			✓	✓			✓
Sewer Flooding	✓	✓	✓				✓
Water Flooding	✓	✓	✓				✓
Customer Contacts				(opp. cost of time)			✓
Water Quality Notices	✓						✓
Discolouration; Taste&Odour	✓						✓
Water Hardness							✓
Carbon							✓
Odour and Flies	✓		✓				✓
Coastal Waters				✓		?	✓
Low Pressure	✓						✓
Traffic Disruption	✓			(opp. cost of time)			✓
Others							✓

1. Introduction

Anglian Water Services Limited (Anglian) has commissioned NERA Economic Consulting to support its programme of work to deliver the societal valuations required for the PR19 business planning process. Specifically, we have been asked to review the range of customer valuation techniques that could be deployed to deliver the required valuations, and develop a strategy for the appropriate application of those methods to deliver the required societal valuations.

In recommending an appropriate PR19 valuation strategy, we need to account for a range of important strategic considerations. In particular, we consider the needs:

- To ensure that the valuation programme addresses the needs and priorities of Anglian’s customers;
- To ensure the programme delivers the societal valuations required by the business;
- To give regulatory bodies comfort that the valuations used to calibrate the PR19 business plan are robust; and
- To ensure that the effort expended on the societal valuation programme is proportionate to the benefits it delivers for customers.

1.1. Regulatory Context

In its recent Water 2020 consultation, Ofwat stated that it expects to “see companies developing a robust, balanced and proportionate evidence base and [it] accept[s] that a one-size-fits-all approach will not work for customer engagement”.² Hence, companies will need to develop appropriate and proportionate customer engagement programmes that deliver the range of evidence required to robustly develop PR19 business plans.

In part, this reference to avoiding a one-size-fits-all approach, could represent a reaction to the customer valuation research conducted at PR14, which made a very substantial use of Stated Preference (SP) techniques, and mostly executed in accordance with a “rule book” set out in UKWIR’s 2011 guidance. For instance, Ofwat has stated that “[w]hile SP WTP approaches will continue to have an important role to play at PR19, it is also important for companies not to place sole or disproportionate reliance on such methods”.³ Ofwat encourages companies to “triangulate” results from SP surveys with evidence obtained through day-to-day contact with customers,⁴ innovative techniques such as Revealed Preference (RP) WTP experiments, and by applying behavioural economics insights to the design and interpretation of customers’ engagement, including possible enhancement to SP methods.

² Ofwat (May 2016) “Ofwat’s customer engagement policy statement and expectations for PR19”, p.10

³ Ibid, p.14

⁴ This may include data generated through complaints, general contacts or social media.

These suggestions are consistent with known limitations of SP surveys. For example, these studies tend to be less reliable when used to estimate the costs of unlikely, but high consequence events. Furthermore, the results tend to vary depending on the respondent's recent experiences, eg. if the survey is undertaken immediately after a drought, as well as on the type of questions posed to customers and the background information provided.⁵

In fact, a recent comparative study by Accent showed that, for most service measures, “the range of PR14 unit values across companies is large despite being based on superficially similar surveys”.⁶ They are also consistent with the findings in the 2014 study for UKWIR by Blue Marble Research, which identified a range of issues with respondent comprehension that may have affected the outcome of PR14 valuation research.⁷

1.2. Potential Enhancements to Customer Research

Market evidence on actual consumption decisions represents the most reliable basis for valuing changes in service, but for a wide range of services provided by (or influenced by) water companies, such market evidence is not available. In these circumstances, Revealed Preference (RP) methods represent a potential alternative. In contrast to SP, which uses specially constructed questionnaires to elicit estimates of respondents' WTP for (or willingness to accept) particular outcomes, RP observes behaviour and outcomes in *related* markets and uses this evidence to derive implied valuations for other goods or services:⁸

- RP has been used in the water industry in a number of previous studies. There have been a number of RP studies around the world using customer surveys to analyse the relationship between perceived tap water quality and demand for bottled water (or alternative products such as water filters), in order to estimate WTP for drinking water quality based on the price of these products.⁹ RP techniques have also been used to estimate WTP for the recreational use of water bodies with different levels of quality by analysing travel costs data.¹⁰ And another example of applied RP is an UKWIR study

⁵ HM Treasury / DWP (2011) “Valuation Techniques for Social Cost-Benefit Analysis: Stated Preference, Revealed Preference and Subjective Well-Being Approaches”, p.35

⁶ Accent (2014) “Comparative Review of Willingness to Pay Results”

⁷ Blue Marble Research (2014), Post-PR14 Customer Engagement, Communications and Education, UKWIR Report Ref 15/CU/03/1.

⁸ HM Treasury / DWP (2011) “Valuation Techniques for Social Cost-Benefit Analysis: Stated Preference, Revealed Preference and Subjective Well-Being Approaches”, p.7

⁹ Schram, C., Adamowicz, W. and Dupont, D. (2010) “At Odds with Water: Perceived Health Risks and Water in Canada”

Jakus, P. M., Shaw, W. D., Nguyen, T. N., & Walker, M. (2009), “Risk Perceptions of Arsenic in Tap Water and Consumption of Bottled Water”

Lee, Chung-Ki and Seung-Jun Kwak (2007) “Valuing drinking water quality improvement using a Bayesian analysis of the multinomial probit model”

¹⁰ Rolfe, J. and Dyack, B. (2010) “Valuing recreation in the Coorong, Australia, with Travel Cost and Contingent Behaviour Models”

Prayaga, P., Rolfe, J. and Stoeckl, N. (2010) “The value of recreational fishing in the Great Barrier Reef, Australia: A pooled preference and contingent behaviour model”

that analysed the impact of sewage treatment odour on house prices, but did not find any significant effect.¹¹

- RP techniques are also used in other sectors. In the airport industry, several studies have evaluated the costs of airport noise by analysing its relationship with real estate and land prices.¹² Similarly, Boxall et al. (2004) found that oil and sour gas facilities located within 4 km of rural residential properties significantly affect their sale price.¹³
- However, there are limitations associated with RP studies in the water industry. First, not all attributes of service have market goods associated with them which can be used to value water service. Furthermore, for attributes of service that can be associated with market goods, it may be difficult to separate the impact of water service provision from other influences (eg. in the case of analysing property prices).¹⁴

Water companies in the UK are also exploring possible opportunities for an increased use of continuous customer engagement and behavioural economics insights, which go beyond traditional SP and RP techniques:

- In its submission to the Water 2020 “Market Place for Ideas”,¹⁵ Southern Water states that there is a “huge potential for the sector to fully embrace social media to engage more effectively and responsively with customers”.¹⁶
- Yorkshire Water mentions that “[a]cross other sectors, customer engagement is seen as a continuous activity, not just undertaken to develop business plans”.¹⁷ For example, in the financial services sector, companies undertake longitudinal studies to monitor customer perception of value for money to highlight changing social and economic trends.
- United Utilities has also explored how findings from behavioural economics can be used in designing customer research and in recognising the limitations of any research and analysis.¹⁸ For example, understanding the psychological and cognitive implications of the context given in a SP survey can improve the performance of the research instrument. Likewise, the concept of “ease” or “habit” in customer behaviour can help interpreting the results from RP studies, eg. failure to take up insurance against water supply problems does not necessarily reflect low valuation of water supply.

¹¹ UKWIR (2008) “A Framework for Cost Benefit Analysis in Odour Control Projects”

¹² Shreurs, E., Verheijen, E. and Jabben, J. (2011) “Valuing airport noise in the Netherlands: Influence of noise on real estate and land prices”

Cohen, J. P. and Coughlin, C. C. (2005) “Changing Noise Levels and Housing Prices near the Atlanta Airport”

Gillen, D. (2004) “The Role of Noise Valuation in Assessing Infrastructure Investment and Management: A Case Study of Pearson International Airport”

¹³ Boxall, P., Chan, W. H., McMillan, M. (2004) “The Impact of Oil and Natural Gas Facilities on Rural Residential Property Values: A Spatial Hedonic Analysis”

¹⁴ United Utilities (2016) “Improving customer research and engagement”, p.10

¹⁵ <http://www.water.org.uk/policy/future-of-the-water-sector#Top>

¹⁶ Southern Water (2015) “Water 2020 – Customer engagement: lessons and opportunities”, p.9

¹⁷ Yorkshire Water (2015) “Issues Paper – Customer engagement, insight and service”, p.4

¹⁸ United Utilities (2016) “Improving customer research and engagement”, pp. 6-7.

There are therefore a wide range of techniques that could be deployed to potentially enhance the customer engagement and societal valuation programmes that companies deploy on a continuous basis and in the price review and business planning process.

1.3. The Role of this Study

Against this background, Anglian has commissioned NERA to study the potential role for this range of valuation methods in forming its customer engagement and valuation strategy for PR19. As we discuss further below, interactions between the customer valuation research and the operational and investment planning that will be required as part of the PR19 process (including the benefits required by Anglian’s “Service Measure Framework”) are also important as part of this process.

This report is structured as follows:

- Chapter 2 reviews the range of valuation methods used by Anglian Water and the wider industry at PR14, including some industry-led reviews published since then of potential improvements.
- Chapter 3 discusses the customer, business, and regulatory objectives that influence how Anglian will need to go about constructing a valuation programme for PR19.
- Chapter 4 summarises a review (shown in more detail in Appendix B) of the range of valuation methods that Anglian could deploy in performing the valuation research needed to inform the PR19 business planning programme.
- Chapter 5 reviews a range of possible improvements to SP research methods, including possible simplifications to the presentation of service attributes and levels, and more innovative valuation tools, including adaptive choice methods, the max-diff approach, and slider valuation tools.
- Chapter 6 sets out a proposed strategy for deriving the valuations that matter to Anglian’s customers and are required as part of the PR19 business planning process. It draws on the strategic considerations discussed in Chapter 3, drawing on both the range of valuation techniques in Chapter 4 and the improvements to SP research methods we discuss in Chapter 5.
- Chapter 7 summarises the main conclusions from this study.

2. Valuation Research Methods at PR14

This chapter reviews the range of valuation methods used by Anglian and the wider industry at PR14, including some industry-led reviews published since then of potential improvements.

2.1. Anglian's PR14 Valuation Programme

2.1.1. Overview of the valuation research programme

Anglian's Societal Valuation Strategy at PR14 was primarily carried out between 2012 and 2013, prior to the submission of Anglian's business plan in June 2014.

Anglian produced a document in July 2012 setting out the framework by which it planned to estimate societal valuations, and for what attributes and service areas it required valuations.¹⁹ This report also set out a number of valuations for which societal valuation would not be required, and a number of attributes which could be obtained from existing studies.

The majority of the valuations Anglian required were obtained using SP from one Main Stage survey and three "Second Stage" surveys, which were conducted by Eftec and ICS Consulting.²⁰ In all the SP studies, both domestic and non-domestic customers were sampled, and the results for both sets of customer were scaled and aggregated according to the relative number of each type of property in the Anglian region. Each survey employed an element of both online questionnaires and telephone interviews, except for the second stage environment survey, which employed online surveys exclusively (see Table 2.1). We discuss the differences between these methods further in Section 5.7 below.

The "Main Stage" survey covered a wide range of aspects of the business, while the functional design of the study allowed for Anglian's water only and wastewater only customers to be sampled alongside combined water and wastewater customers (who make up a majority of Anglian's customers. Hartlepool Water customers were distributed a separate survey tailored specifically to the region. The three second stage studies focused on specific service areas, allowing more detailed valuation research for attribute areas of particular importance. These focussed on environmental attributes, flooding disruption and preferences, and water resource options.

Twelve attributes were valued in the Main Stage survey, and WTP was estimated using choice experiments across four 'blocks' of attributes (presented in Table 2.1). Contingent valuation exercises were used to scale the estimates generated by the choice experiments downwards, to control for "package effects" which arise from substitutability between customer valuations of attributes.

The structure of survey Anglian used allowed for a range of tests to provide information on customers' preferences, as well as the impact of different survey methods. As we discuss

¹⁹ Anglian Water (2012), "*Societal Valuation Framework*".

²⁰ Fieldwork for the Main Stage survey was carried out by Accent, while the fieldwork for the Stage 2 surveys was carried out by Opinion Leader and FACTs International.

further in Appendix A, these studies allowed testing for non-linearities in customers' preferences (eg. higher values associated with deterioration than improvement), and the relative impact on estimated values from online/face-to-face survey methods.

Table 2.1
Choice Experiment Blocks and Attributes Valued in the Main Stage Survey

Water Services 1 (WS1)	Water Services 2 (WS1)	Wastewater Services (WW)	Environmental Services (ES)
Unexpected 6-12 hour interruptions	Taste and odour of tap water	Sewer flooding inside properties	Pollution incidents
Persistent low water pressure	Discoloured tap water	Sewer flooding in external areas	Coastal water quality
Hosepipe bans	'Boil water' notices	Nuisance from sewage treatment	River water quality

Source: Eftec and ICS Consulting²¹

After completing the Main Stage survey, Anglian carried out three second stage surveys:

- A Flooding Study, which focussed on the severity, frequency and type of properties affected by flooding;
- An Environment Study, which focussed on river quality and water pollution incidents of different categories; and finally
- A Water Resources Study, which focussed on water restrictions other than hosepipe bans, and customers' relative rankings of various water resource options.

These surveys were supported by a second stage study from PR09 on Supply Interruptions, which was used to set weights for the relative valuation of different water quality notices and supply interruptions of different lengths; these weights were then applied to the relevant attributes from the PR14 Main Stage survey to form a full set of valuations.²²

The samples sizes and the survey mode varied across the surveys Anglian undertook at PR14, although each survey sampled both domestic and non-domestic customers. Table 2.2 shows the sample sizes and interview modes used in Anglian's PR14 surveys. A larger sample was used for the Main Stage survey of 2500 respondents in total, while smaller samples of 900 customers were used for the second stage surveys. A combination of Computer Aided Telephone Interviews (CATI) and online questionnaires were used, allowing for a degree of comparison between the two modes. We provide further details in Appendix A.

²¹ Eftec and ICS Consulting (2012), p. 21.

²² Eftec and ICS Consulting (2012), p. 19.

Table 2.2
Sample Sizes and Modes for SP Studies Used by Anglian at PR14

SP Research Instrument	Domestic Customers		Non-domestic Customers
Main Stage Survey	1000 Online	1000 CATI	500 CATI
Environment Survey	300 Online	300 CATI	300 Online ¹
Flooding Survey	600 Online		300 CATI to Online
Water Resources Survey	300 Online	300 CATI	300 Online ¹

Source: Anglian Water. Note 1: Online respondents recruited via telephone.

The remaining valuations were sourced from previous studies, adapted from existing data sources, or applied to the business plan and other regulatory documents with zero external costs (i.e. assumed to incur “private costs” only). Examples of the use of these Benefits Transfer (BT) sources included:

- A PR09 second stage Supply Interruptions Study was used to discuss supply interruptions of durations other than 6 to 12 hours;²³
- An Environment Agency valuation into improvements to bathing water quality (coastal waters) across other categories;²⁴
- Market prices were used to estimate the impact of water quality on shellfish;²⁵
- A 1998 NERA report for UKWIR, updated in 2007 by RPS, was used for valuing traffic disruption and congestion;²⁶ and
- Visits to Specific Habitats, namely Anglian’s five Water Parks (located at reservoirs) were valued according to the travel cost method.²⁷

Appendix A discusses the methods and results of each of the PR14 surveys in more detail.

2.1.2. Regulatory response to Anglian’s valuation programme

Anglian Water’s valuation research programme was well received and commended by Ofwat at PR14.

In assessing the business plans, Ofwat tested each element of the business plan in detail against the following criteria:

²³ Eftec and ICS Consulting (2013e), “PR14 Customer Research: Completion Report”, p. 19.

²⁴ Eftec and ICS Consulting (2013e), p. 21.

²⁵ Eftec and ICS Consulting (2013e), p. 35.

²⁶ Eftec and ICS Consulting (2013e), p. 40.

²⁷ Eftec and ICS Consulting (2013e), p. 68.

- Effectiveness of the customer engagement strategy;
- Effectiveness of engagement with wider consumer interest; and
- A robust approach to WTP information gathering and mapping.

Following this evaluation, Anglian’s “customer engagement and WTP information” for retail customers received the highest score, exceptional.²⁸ Ofwat stated:²⁹

“there is comprehensive and exceptional evidence that Anglian followed an effective engagement process with customers. The company also presents robust information to demonstrate it has carried out effective engagement with wider stakeholders. It has also presented sufficient evidence to support its approach to gathering WTP information and mapping this to its performance commitments and outcome delivery incentives.”

For wholesale water customers, Anglian’s Customer engagement and WTP research was ranked acceptable, and for wholesale wastewater customers, it was ranked exceptional.³⁰ In particular, Ofwat noted that “there is clear evidence in the company’s business plan that an appropriate engagement process has been followed including for example that historic and qualitative research has been used to shape and inform subsequent research”.³¹

2.1.3. Anglian’s internal review of the PR14 valuation programme

As part of its preparations for PR19, Anglian has undertaken a review of the valuation methods employed at PR14.

Anglian noted as a success of the programme the alignment between the valuations obtained with Anglian’s Service Measure Framework (SMF). In addition, the mapping of attributes to the MoS (Measures of Success) was relatively straightforward. However, noting a possible area for improvement, Anglian applied an “either/or” approach with one valuation method per attribute, with limited triangulation and utilisation of information from different sources to improve the reliability of valuation estimates. (We discuss this topic further in Section 3.3.1 below.)

Another feature of the engagement programme that was beneficial was the ability to use studies from PR09 for robustness checks, particularly around WTP estimates for similarly defined attributes, helping to ensure “consistency of approach and results”. However, Anglian noted that the PR14 research programme was limited in the extent to which it involved “continuous engagement”. The programme also had a particular focus on the business plan submission, and consequently less consideration of the Water Resources Management Plan (WRMP) and other areas potentially requiring customer engagement.

²⁸ Ofwat (2014), “*Element categorisation scorecards: Anglian Water*”, p. 4.

²⁹ Ofwat (2014), “*2014 price review risk-based review – recommendation to Ofwat’s Board on Anglian Water’s business plan categorisation*”, p. 17.

³⁰ Ofwat (2014), “*Element categorisation scorecards: Anglian Water*”, p. 49.

³¹ Ofwat (2014), “*Element categorisation scorecards: Anglian Water*”, p. 24.

Anglian reported that its PR14 valuation programme included relatively innovative work to estimate customer views on solutions: for example, second stage surveys which estimated customer' ranking of various supply-side and demand-side water resource management options, and options for reducing and managing flooding.³²

One specific area for improvement relates to the flexibility that was built into the PR14 valuation programme. Specifically, by committing to a particular set of valuation studies early in the PR14 process, Anglian left itself relatively little flexibility to change its research programme in response to factors such as changing regulatory requirements.

2.2. Industry Led Reviews of PR14 Valuation Research

2.2.1. UKWIR Review of PR14

UKWIR commissioned a report, "Post PR14 Customer Engagement, Communication and Education" from Blue Marble Research in 2014. The report reflected on the customer engagement carried out during the course of the price control (2009 to 2014), and the way forward for improving the research companies' research programmes at the next price control.³³ The project was wide ranging and, amongst other areas, considered in detail the WTP research carried out by different water companies.

The report presents six principles for customer engagement in the water industry:³⁴

- **Real**, research should only be carried out if it is intended to be acted upon;
- **Inclusive**, research should engage with all groups affected by decision-making;
- **Appropriate** methods should be used;
- **Accessible**, participation should not be difficult;
- **Transparent**, it should be clear how engagement will influence decision making; and
- **Ongoing**, engagement should be a continuous process.

Most of the report's recommendations relate to the implementation of each of these principles. With regards to accessibility, the report suggests there are a number of "barriers to participation" which affect the extent to which people take part in engagement with water companies, including quantitative research, such as WTP surveys.³⁵

- **Time and cost barriers** may prevent certain participants from taking part, and incentives may be required to encourage participation from, for example, budget-constrained groups. (This will be a particular problem for focus group and pilot level research.)

³² Eftec and ICS Consulting (2013e), p. 6.

³³ UKWIR (2014), "*Post PR14 Customer Engagement, Communications and Education*", produced by Blue Marble, Executive Summary.

³⁴ UKWIR (2014), p. 26.

³⁵ UKWIR (2014), p. 49.

- **Language and culture barriers** may reduce the representativeness of a sample, although demographic techniques appear effective at alleviating these problems in WTP surveys.
- **Fears of participating** require reassurance to be provided about the purpose of market research and how the information customers provide will be treated/
- **Lack of interest** may require promotion of engagement, using new methods to engage customers (eg. social media), and efforts to make difficult concepts accessible “and even fun”.

The report argues there are currently issues with the reliability of WTP methods used as an industry standard, and “challenges the industry to develop a new WTP instrument that conveys choices in a way customers fully understand.”³⁶ It also notes the possibility of “‘false precision without validity’ in the design, interpretation and presentation of customer research”:³⁷ for example, presenting precise estimates of customers’ average marginal WTP when the confidence intervals of such estimates are known to be large, and where valuations generated are sensitive to the survey method employed.

The scope of this paper also extended to the ongoing customer engagement strategy employed at PR14, focussing on case studies from two water companies “who are leading the sector in this field”, Anglian Water and Dwr Cymru (Welsh Water).³⁸ The report recommends that Anglian’s brand position, for example, provides a platform from which to launch a wide series of “integrated communications”.

2.2.2. UKWIR Report on Future Customer Engagement

UKWIR commissioned a report, “The Future Role of Customer and Stakeholder Engagement in the Water Industry”, from First Economics in 2014. The report considered previous price controls in water and other industries in drawing recommendations for the nature of customer engagement at PR19.³⁹ The report primarily concerned the role of Customer Challenge Groups (CCGs), suggesting that CCGs should be the primary means by which customer views are heard in the price control process, which, the report believed, would give customers’ a better sense that their views contribute directly to Ofwat’s determinations.⁴⁰ The report suggested three possible models for CCGs at the next price control, each of which may have implications for the customer valuation programme:

- **CCGs as consultees.** CCGs would be consulted during the development of business plans as well as during any challenge to the business plans. Ofwat would be expected to draw on the CCG input, but critically evaluate their views with no formal commitment to follow CCGs’ views. The report recommends that such a model is beneficial in that it

³⁶ UKWIR (2014), p. 99.

³⁷ UKWIR (2014), p. 99.

³⁸ UKWIR (2014), p. 80.

³⁹ UKWIR (2015), “*The Future Role of Customer and Stakeholder Engagement in the Water Industry*”, Executive Summary.

⁴⁰ UKWIR (2015), p. 89.

relies of the “more informed perspectives offered by CCGs” compared to more traditional consultation document responses.⁴¹

- **CCG certification of customers’ preferences.** CCGs would be required to formally confirm whether or not companies have accurately taken into account customer preferences in their price control submissions, and reflected customer preference for specific local outcomes.⁴²
- **CCG-company agreements on overall plans.** In this model, Ofwat would expect companies to reach agreement on the full content of their plans with CCGs.⁴³

2.3. Conclusions

Our review of the PR14 engagement research suggests that Anglian’s customer valuation and engagement programme was largely successful. Ofwat’s risk based review also recognised the strength of the engagement programme, suggesting it was deemed to be more extensive and/or higher quality than ‘the average company’ at PR14.

However, as Anglian has recognised in its internal reviews, there is still a clear opportunity for improvements to be made for the upcoming programme. These include the need to build stronger links with ongoing customer engagement, the value of using a wider range of methods to evaluate each attribute through a process of “triangulation”, and the need for greater coherence with the WRMP process. This is in line with the emerging regulatory challenges for PR19, and various retrospective reviews of the wider industry’s PR14 valuation research.

In the following sections we analyse these challenges and opportunities in more detail, and we discuss how to address them by developing our recommendations for Anglian’s Societal Valuation Strategy at PR19.

⁴¹ UKWIR (2015), p. 90.

⁴² UKWIR (2015), p. 91.

⁴³ UKWIR (2015), p. 93.

3. Objectives in Formulating a PR19 Valuation Strategy

This chapter discusses the customer, business, and regulatory objectives that influence how Anglian will need to go about constructing a valuation programme for PR19. It also lists the various attributes of service for which the PR19 business planning process will require valuations, and makes an initial assessment of their relative strategic importance.

3.1. Priorities for the PR19 Business Planning Process

As part of the PR19 process, Anglian will need to prepare a Business Plan (BP) setting out the planned capital and operational investments for PR19. This BP will emerge from a thorough CBA modelling process that will evaluate a range of different investment and operational options corresponding to an extensive list of the company's target attributes of service throughout the value chain. The role of the societal valuation programme in this context is to quantify the value that customers place on changes in each attribute of service.

However, in order to ensure that the valuation programme is proportionate to the needs of Anglian and its stakeholders, it is important to understand which valuations will require the strongest basis of evidence to support them. Some attributes of service may require particularly robust evidence to support their societal valuations, such as in the following circumstances.

3.1.1. Attributes of service may be priorities for the valuation programme where they drive large amounts of expenditure

An improvement in (or even only the maintenance of) the level of service associated with an attribute of service requires large levels of capital and/or operational expenditure, or changes in the valuation result can influence materially the level of required expenditure:

When large amounts of expenditure are being targeted at maintaining or improving a particular attribute of service, it is important to ensure that the corresponding societal valuations are robust and adequately reflect customer preferences. This will ensure that customers only pay for improvements they value, and reductions in service levels are only made when they are justified by the resulting cost savings.

Similarly, when the levels of service provided by the business are likely to be sensitive to changes in the societal valuation, a higher standard of evidence may be required, even if the affected programmes of expenditure are relatively small.

From our discussions with Anglian, we understand that the attributes most likely to be driving significant levels of investment or operational expenditure to maintain or improve service are drought resilience (target level and options for delivery), sewer flooding (target level and options for delivery), supply interruptions, and effluent compliance. We have also obtained a list from Anglian's in-house experts of those attributes for which the valuation assumption is likely to materially influence the output of the CBA model (see the discussion in Table 3.1 below).

- The attribute is not associated with large amounts of expenditure, but maintaining or improving the service level is a customer and/or a stakeholder priority.

- In some cases, even if an attribute is not driving significant levels of investment, it may still be a priority for stakeholders, which may justify expending greater effort to ensure robust valuation research. For instance, some attributes (even if they are not linked to large expenditure programmes) may be identified as a customer priority following the findings from qualitative research and engagement with the CEF or CC Water. Similarly, some attributes of service may be linked to Outcome Delivery Incentives (and therefore are of particular interest for Ofwat). Other attributes may be scrutinised by specific regulatory institutions (eg. the Environment Agency or Drinking Water Inspectorate). Other attributes may be of strategic importance internally within Anglian given their associated private costs in the case of failure.
- From our discussions with Anglian, we understand the attributes most likely to represent stakeholder priorities (for reasons other than their link to large amounts of investment or operational expenditure) are water quality notices, discolouration, hardness, low pressure, river water quality, sewer flooding and carbon. Figure 3.1 summarises the results from the PR14 qualitative engagement research to identify customers' priorities, though of course this will be updated in the coming weeks.
- In these cases, Anglian may need to find the “socially optimal” level of service, which may be beyond the “economic” level of service that emerges from an optimisation of business practices and investment choices based on cost. This requires a robust understanding of customer preferences, preferably for each relevant customer type.

3.1.2. Customers' priorities may warrant a large focus in the valuation programme

Independent from its importance to customers or in driving large amounts of expenditure, an attribute of service might also be a priority for the valuation programme if Anglian has experienced difficulties in obtaining a robust valuation for the attribute in the past. For instance, the valuation of some attributes may be sensitive to the valuation method used.

- Therefore, if Anglian intends to provide a robust valuation for that attribute, the method (or combination of methods) will need to be chosen and applied with greater care. In particular, some innovation may be required in order to improve on the traditional methods that have been associated with problems in the past.
- A clear example is the valuation of rare events, which has historically been challenging to evaluate using traditional SP surveys, since customers find it difficult to engage in hypothetical and abstract situations. Environmental attributes such as river water quality are also challenging, given the difficulty in properly defining the different levels of quality, and in helping respondents take into account all the benefits from the environment (which they may value unconsciously, but not be aware of it when choosing between options).

Figure 3.1
Customer Priorities Ranking Identified in Anglian's PR14 Focus Groups



Source: Anglian

3.1.3. We have assessed a range of attributes against these criteria

We have appraised each of the service attributes that Anglian requires for business planning at PR19 against the criteria above. The results of this review, summarised in Table 3.1, are based on our review of materials received from Anglian, and further discussions with internal stakeholders. It also draws on the findings from the PR14 focus groups on customer priorities (see Figure 3.1), though this will need to be updated in light of the results of Anglian's PR19 engagement programme, including the findings from the ongoing customer engagement programme.

We have also been provided with an initial analysis of how sensitive the Anglian CBA modelling results are likely to be to changes in societal valuations for each of the key attributes required for the business planning process. We understand this was based on a mix of expert judgment, and previous sensitivity analysis conducted at PR14. This analysis is useful for targeting valuation research on those attributes that are going to be particularly important drivers of the business plan, and thus the subsequent dialogue with regulators through the PR19 process. However, as yet it does not represent a formalised sensitivity analysis for PR19. Hence, as we discuss further in Chapter 6 below, we consider there will be value in ongoing sensitivity analysis (to run parallel with the valuation programme) as the PR19 business planning work progresses.

To bring together the assessment in Table 3.1, we have sought to represent the relative importance of each attribute using the diagram in Figure 3.2, which aims to illustrate our understanding of where each attribute of service required for the BP/WRMP sits with respect to the classification described above. Each attribute is placed at a different point on a two-dimensional grid:

- The horizontal axis represents the strategic importance of the attribute to either Anglian’s business plan or its stakeholders, and the difficulty of valuing the attribute in the past (ie. the criteria above).
- The vertical axis represents the likely sensitivity of Anglian’s BP or other CBA models to the valuation result.

Figure 3.2
Framework for Assessing the Relative Importance of Each Service Attribute for the Societal Valuation Programme

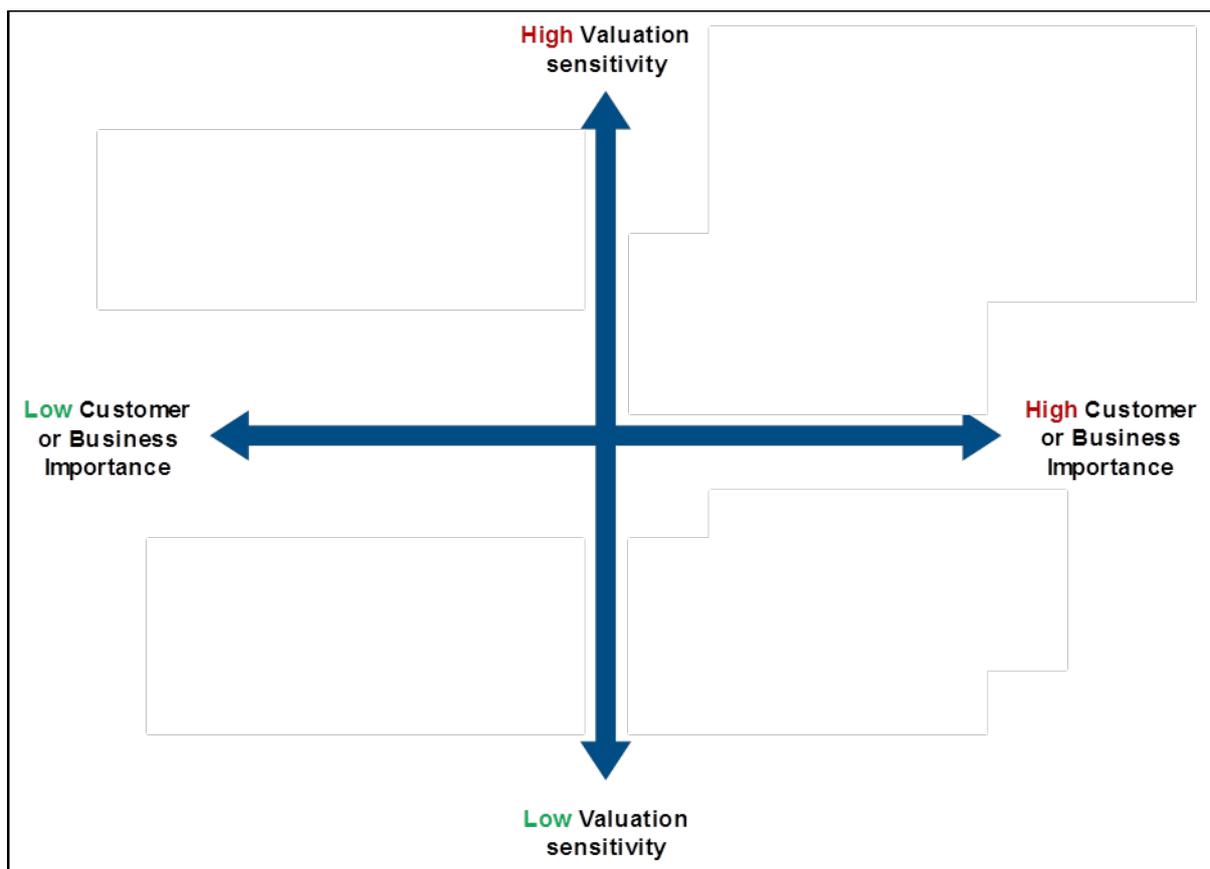


Table 3.1
Strategic Assessment of Anglian's Attributes of Service

Attribute	Assessment of its Relative Importance for the Valuation Programme
Resilience to Drought/ to “Catastrophic Events”	<ul style="list-style-type: none"> • <i>Avoidance of water use restrictions was identified as a relatively high customer priority during PR14 customer engagement, and restrictions involving standpipes and qualitative research suggested that customers considered rota cuts to be “unacceptable”.</i> • <i>Top priority for a wide range of stakeholders. Ofwat and Defra have identified long-term resilience of water supply as one of the main future challenges of the sector, and resilience represents a new duty for Ofwat.⁴⁴</i> • <i>This attribute drives the capital and operating expenditure decisions resulting from the WRMP process (see Section 3.2), as well as influencing capital maintenance decisions.</i> • <i>Customer valuations on water use restrictions have typically been associated with a high degree of uncertainty, with a large variation between companies’ valuations at PR14. There are a wide range of possible reasons for this, including the challenges customers face in valuing low probability events in SP, and so on (see Chapter 5).</i> • In Figure 3.3, we have therefore identified resilience as a high priority for customers and stakeholders, and noted that the outcomes of CBA are sensitive to changes in the valuation assumption.
Water Resource Options and Demand Management Strategy	<ul style="list-style-type: none"> • <i>The Environment Agency has set out a new guidance for WRMP19 where it has stated its recommendations for a more robust evidence base on the social and environmental costs of resource options, particularly on the optimal level of service of demand-side measures.⁴⁵</i> • <i>To a large extent, the societal costs and benefits of water resource options relate to impacts on other dimensions of service (eg. reduced leakage may improve reliability) and the environment (eg. lower leakage may improve river flows), which we discuss below.</i> • <i>However, customers may also value certain alternatives “for their own sake”, and customer engagement research across the industry certainly identifies leakage reduction as a high profile area of customers’ interest.</i> • <i>These societal valuations of options “for their own sake” may be challenging to discern from the other attributes of service that customers may associate with certain demand or supply side measures.</i> • In Figure 3.3, we have therefore identified water resource options and demand management strategy as a high priority for customers and stakeholders, and noted that the outcomes of CBA are sensitive to changes in the valuation assumption.
Wastewater Capacity Solutions	<ul style="list-style-type: none"> • <i>The development of innovative sustainable alternatives to traditional wastewater solutions is a strategic priority in the industry, with a potential need to move the beyond economic levels, if supported by societal valuation evidence.</i> • <i>High stakeholder priority. Ofwat’s recently established “Resilience Task & Finish Group” recommended the development of national wastewater and sewerage plans (in a similar format to the WRMP).⁴⁶</i>

⁴⁴ <http://www.ofwat.gov.uk/regulated-companies/improving-regulation/resilience/>

⁴⁵ Environment Agency (October 2016) “Environmental valuation in water resources planning - additional information”

⁴⁶ http://www.ofwat.gov.uk/wp-content/uploads/2015/12/rpt_com20151201resiliencetaskfinish.pdf

Attribute	Assessment of its Relative Importance for the Valuation Programme
	<ul style="list-style-type: none"> <i>The implementation of these solutions may become a driver of significant amounts of expenditure, so a strategic priority for the valuation programme will be to understand social preferences regarding these solutions.</i> <i>Investment decisions around these options may also affect the probability of flooding or pollution incidents, which is another high customer priority.</i> In Figure 3.3, we have therefore identified wastewater capacity solutions as a high priority for customers and stakeholders, and noted that the outcomes of CBA are sensitive to changes in the valuation assumption.
Supply Interruptions	<ul style="list-style-type: none"> <i>One of the highest customer priorities in the PR14 focus groups, and the fact that it is associated with an ODI indicates that it is a stakeholder priority to some extent.</i> <i>The maintenance of Anglian’s current level of service (in terms of frequency and duration) is typically a large driver of capital and operational expenditure, since it involves the ongoing maintenance of Anglian’s water mains.</i> <i>Customers are relatively familiar with the concept, so some of the challenges in using SP methods associated with complexity of service attributes and valuing low probability events (see Chapter 5) do not apply.</i> <i>However, there is typically some uncertainty around the differences in valuations depending on the length of the interruption, or the time of the day when it occurs.</i> In Figure 3.3, we have therefore identified supply interruptions as a high priority for customers and stakeholders and noted that there is medium-to-low uncertainty around the valuations that drive CBA outcomes.
Water Recycling Centre Growth	<ul style="list-style-type: none"> <i>Investment in additional wastewater treatment capacity is one of Anglian’s internal priorities, given the strong demand growth drivers in the region.</i> <i>However, Anglian has historically found it challenging to engage customers and other stakeholders in this topic.</i> In Figure 3.3, we have therefore identified water recycling centre growth as a medium strategic priority and noted that the outcomes of CBA may be sensitive to changes in the valuation assumption.
River Water Quality	<ul style="list-style-type: none"> <i>Effluent compliance, WRC quality and wastewater pollution incidents are a high priority for Anglian’s customers, as well as for other stakeholders such as the Environment Agency, who sets compliance standards.</i> <i>We understand that these attributes have historically been Anglian’s largest capital expenditure areas.</i> <i>Anglian has a large number of Water Recycling Centres, each of them with different environmental impacts. Hence, asking customers to value “generic” improvements in environmental impact (eg. improving river water from “medium” to “high” quality) is of limited value when applying the results to evaluate individual investments.</i> In Figure 3.3, we have therefore identified water river quality as a high priority for customers and stakeholders, and noted that there is high uncertainty around the valuation assumptions.
Sewer Flooding	<ul style="list-style-type: none"> <i>Internal sewer flooding was identified as one of the highest customer priorities at PR14, potentially due to the serious consequences for affected individuals.</i> <i>Furthermore, this attribute is associated with large amounts of investment. Apart from being a driver of investment in wastewater capacity solutions, it is also a driver of expenditure in sewer maintenance.</i>

Attribute	Assessment of its Relative Importance for the Valuation Programme
	<ul style="list-style-type: none"> We understand that Anglian's sewer flooding investment programme is <i>typically highly reliant on CBA findings</i>, which are very sensitive to the results from societal valuation research. In Figure 3.3, we have therefore identified sewer flooding as a high priority for customers and stakeholders, and noted that the outcomes of CBA are sensitive to changes in the valuation assumption.
Water Mains Flooding	<ul style="list-style-type: none"> Water flooding was identified as a lower customer priority than sewer flooding. However, <i>the consequences for the customer can sometimes be almost as high.</i> In Figure 3.3, we have therefore identified water mains flooding as a slightly lower priority for customers and stakeholders than sewer flooding, and noted that the outcomes of CBA are sensitive to changes in the valuation assumption.
Customer Contacts	<ul style="list-style-type: none"> The number of customer contacts received by Anglian constitutes a <i>cost for customers, in terms of the opportunity cost of the time they spend contacting Anglian, as well as a private cost for the business.</i> The number of customer contacts is currently related to SIM incentives. In its recent consultation on the PR19 Outcomes framework, <i>Ofwat proposes to replace SIM incentives with a common Performance Commitment on customer experience.</i> In Figure 3.3, we have therefore identified customer contacts as a medium-to-low priority for customers and stakeholders, and noted that there is high uncertainty around the valuations that drive CBA outcomes.
Water Quality Notices	<ul style="list-style-type: none"> The avoidance of water quality notices is a <i>high customer priority and a relatively high driver of expenditure.</i> <i>Attributes related to water quality are a stakeholder priority</i>, since they are regulated by the Drinking Water Inspectorate and are related to ODIs. <i>Anglian has valued these attributes relatively successfully through SP in the past, potentially given the relatively good customer understanding of the concept.</i> In Figure 3.3, we have therefore identified water quality notices as a high priority for customers and stakeholders, and noted that there is relatively low uncertainty around the valuation assumptions.
Discolouration; Taste and Odour	<ul style="list-style-type: none"> While not significant drivers of investment, these attributes were identified as <i>high customer priorities at PR14.</i> <i>Attributes related to water quality are a stakeholder priority</i>, since they are regulated by the Drinking Water Inspectorate and are related to Ofwat's ODIs. It is important to ensure that customers understand the difference between these attributes and attributes that affect the safety of drinking or using tap water. In Figure 3.3, we have therefore identified discolouration, taste and odour as a medium strategic priority, and noted that there is relatively low uncertainty around the valuation assumptions.
Traffic Disruption	<ul style="list-style-type: none"> Ongoing social media analysis undertaken by Anglian indicates that traffic disruptions is one of the most recurrent topics, suggesting that it may be a <i>relatively high customer priority.</i> Incorporating the social cost of traffic disruptions into the CBA models may affect investment decisions, or the amount of resources dedicated to each investment programme (thereby affecting the length of the disruption). In Figure 3.3, we have therefore identified traffic disruptions as a

Attribute	Assessment of its Relative Importance for the Valuation Programme
	medium customer and stakeholder priority, and noted that there is relatively low uncertainty around the valuation assumptions.
Carbon	<ul style="list-style-type: none"> • <i>Customers identify “pollution” as a relatively high priority, and investment decisions can be sensitive to the value of CO₂ applied in CBA modelling.</i> • <i>Valuing reductions in carbon and other greenhouse gas emissions has not been challenging, as there is extensive government guidance on how these attributes of service should be valued.</i> • However, to the extent that CO₂ emissions arise through consumption of electricity, it is <i>important to ensure there is no double-counting</i>. Specifically, a range of policy measures are in place in the UK electricity industry to “internalise” the externalities associated with CO₂ emissions, including a tax on CO₂ emissions by generators and a range of “green levies”, the costs of which are recovered from consumers (including water utilities). We also understand that Anglian is already taking extensive measures to reduce carbon emissions. • In Figure 3.3, we have therefore identified carbon as a medium-to-low strategic priority, and noted that the outcomes of CBA are sensitive to changes in the valuation assumption.
Persistent Low Water Pressure	<ul style="list-style-type: none"> • While affecting only 257 customers in the whole Anglian region, altruistic valuation results from PR14 indicated it was a <i>high customer priority</i>. • We understand that the associated investment programme is relatively reliant on CBA findings. However, changes in valuation assumptions are unlikely to change the business strategy, given that the programme to address the issue is already underway. • In Figure 3.3, we have therefore identified persistent low water pressure as a medium strategic priority, and noted that the outcomes of CBA are unlikely to be sensitive to changes in the valuation assumptions.
Coastal Waters; Odour and Flies	<ul style="list-style-type: none"> • While customers identified these attributes as a low priority at PR14, these attributes are associated with investment programmes that are relatively reliant on CBA and therefore <i>subject to valuation sensitivity</i>. • In Figure 3.3, we have therefore identified coastal waters, odour and flies as relatively low priorities for customers and stakeholders, but noted that the outcomes of CBA are sensitive to changes in the valuation assumption.
SSSI Habitats, Recreation Sites	<ul style="list-style-type: none"> • These attributes are related to environmental quality, which is a high business and stakeholder priority. However, these attributes in particular are related to specific compliance programmes that do not require significant amounts of investment and that are less sensitive to societal valuation. • In Figure 3.3, we have therefore identified SSSI habitats and recreation sites as medium-to-low strategic priorities, and noted that the outcomes of CBA are relatively unlikely to be sensitive to changes in the valuation assumptions.
Others	<ul style="list-style-type: none"> • These attributes are not identified as a customer or a stakeholder priority, and Anglian has not experienced any significant valuation problems in the past. • In Figure 3.3, we have therefore identified the rest of the attributes as a relatively low customer and stakeholder priority, and noted that the outcomes of CBA are unlikely to be sensitive to changes in the valuation assumptions.

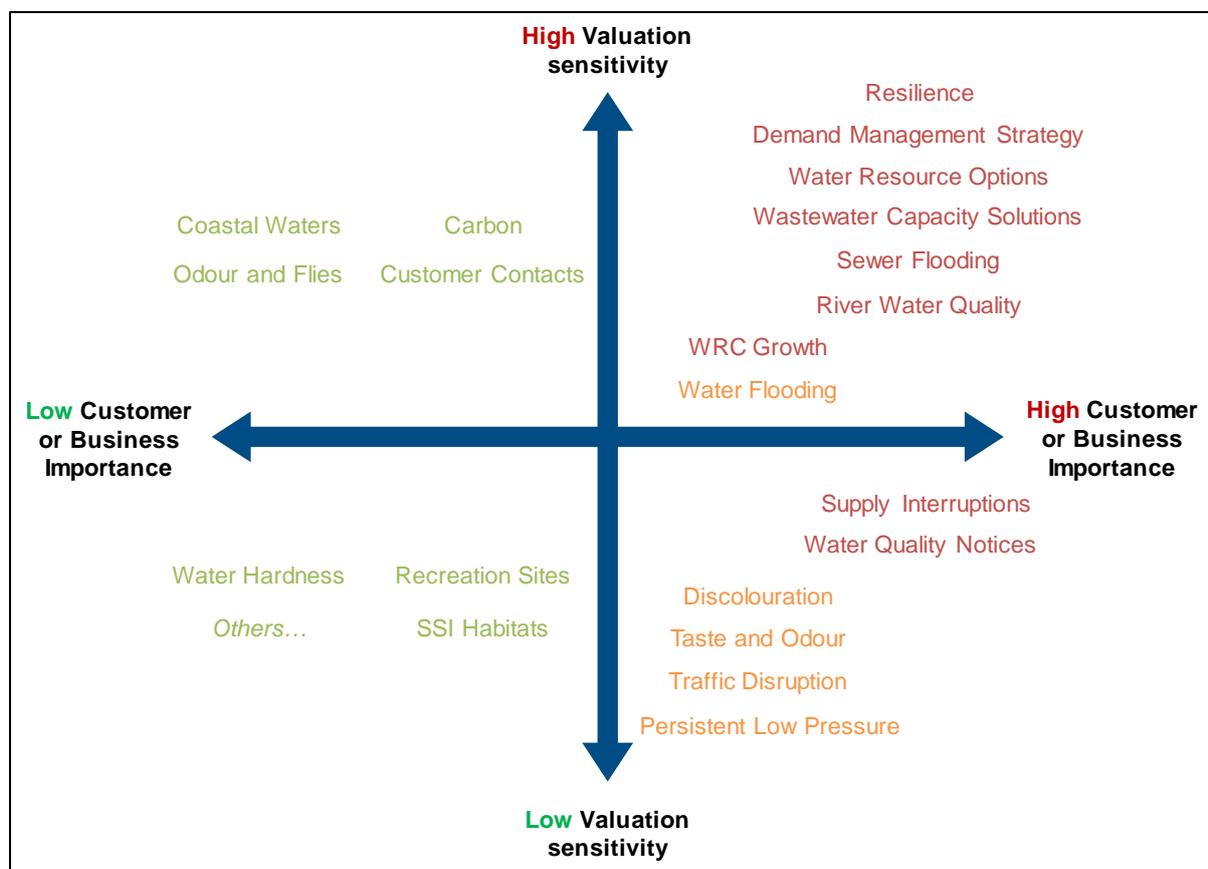
Source: Summary of NERA discussions with Anglian.

The conclusions as to where on these axes each attribute sits explained in Table 3.1 are presented in Figure 3.3 below. In addition to the two axes described above, the colour of the font in Figure 3.3 indicates those attributes that are typically associated with significant amounts of expenditure (red font), and those that are likely to be a stakeholder priority (orange font).

It is important to note that the placement of each attribute along the horizontal axis in Figure 3.3 is based on a holistic assessment of whether or not an attribute is a customer/business priority. We have placed the relevant attributes according to the importance of valuation evidence (for the business or customers) in formulating the WRMP or BP:

- For instance, we understand that reducing carbon emissions *is* a priority for Anglian. However, we understand that Anglian makes significant efforts to reduce carbon emissions as a matter of policy for the business, so the precise valuation would not materially affect the (already extensive) measures Anglian takes to reduce emissions. Moreover, government guidance provides valuation evidence that Anglian can use should it require a valuation for CBA modelling, so obtaining new valuation evidence as part of the PR19 research programme is not a high priority.
- Another example is water hardness. Even though customers identified it as a high priority in the past, we understand that the costs of addressing it are prohibitively high. As such, valuation evidence would not materially influence the CBA case for addressing water hardness so it is not identified as a priority.

Figure 3.3
Classification of Service Attributes by Importance and Valuation Sensitivity



Source: NERA illustration based on discussions with Anglian

Legend: Red – Large Investment Requirement; Orange – Stakeholder Priority; Green – Low Strategic Importance.

3.2. Delivering the Valuations Required for the WRMP

3.2.1. Overview of the WRMP process

The key objective of the Water Resource Management Plan is to ensure water companies take the right investment decisions in order to secure reliable, sustainable and affordable supplies of water for their customers in the long-term. As discussed below and summarised in Figure 3.4, the process of preparing the WRMP places a range of requirements on the societal valuation programme.

In the development of the plan, companies aim to find the optimal combination of investment solutions to bridging a forecast supply-demand deficit over a minimum planning horizon of 25 years.⁴⁷ This deficit profile will depend on forecast demand (eg. based on population and economic growth), as well as on forecast supply, which is subject to a range of uncertainty.

⁴⁷ While companies are encouraged to plan for a longer time horizon if they consider it appropriate, 25 years is the statutory minimum set out by Defra and the Environment Agency.

As such, the supply-demand deficit may be relatively large or small depending on the drought scenario against which the plan is developed. For instance, the WRMP can be constructed to make water supply resilient to a 1-in-100 drought, a 1-in-200 drought, and so on. Therefore, each drought scenario is associated with a deficit profile, and the size of the deficit changes over time as demand grows.

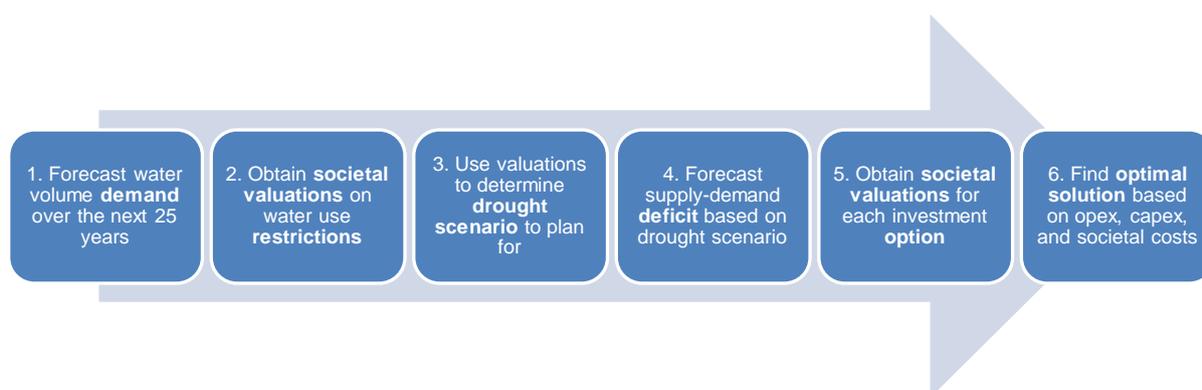
Hence, Anglian (like other companies) faces a choice as to the degree of drought resilience it provides. In other words, Anglian must choose which drought scenario to plan for when constructing the WRMP by balancing the cost of procuring supply-side measures to increase drought resilience (or taking demand-side measures), against the economic benefits of drought resilience. This economic benefit of drought resilience is essentially determined by the societal value of avoiding severe water use restrictions (standpipes or rota cuts) that would be required in cases of droughts more severe than the company planned for.⁴⁸

Making this trade-off is a cornerstone of the WRMP process, as it determines the “level of drought resilience” Anglian wishes to plan for. Specifically, Anglian needs to identify the most severe drought scenario for which it is cost-beneficial to make the necessary investments to avoid the need for any standpipes or rota cuts.

Once the target level of drought resilience has been identified, the next task is to find the optimal combination of investment options, each of which can solve part of the deficit either by increasing available supply (eg. building a reservoir, a desalination plant, a water re-use facility) or by reducing demand (eg. leakage reduction, increasing “dumb” meter penetration, introducing “smart” meters, or supporting water efficiency options for customers).

Each investment option is associated with a profile of benefits, in the form of supply-demand deficit reduction, as well as costs. The associated costs will be a combination of capital expenditure (capex), operating expenditure (opex), and environmental and social costs. In order to find the most socially cost-beneficial combination of options, all types of cost need to be taken into consideration.

Figure 3.4
Summary of the Role of Societal Valuations in Preparing the WRMP



Source: NERA Illustration.

⁴⁸ Anglian Water’s customer engagement at PR14 suggests customers find standpipes and rota-cuts “unacceptable”.

3.2.2. The role of societal valuations in determining the target level of drought resilience

We understand that Anglian Water is considering twelve potential drought scenarios for the next 25 years, each of which is associated with a different probability, and a different profile of available supply. In contrast with previous WRMPs, and in line with Defra's 2016 Guiding Principles,⁴⁹ Anglian Water is considering drought scenarios that are more severe than any historic records, given the potential future effects of climate change.

In assessing the benefits of each level of drought resilience under consideration, Anglian Water therefore will need to evaluate customers' Willingness to Pay (WTP) to avoid the profile of severe water use restrictions (standpipes and rota-cuts) over the durations for which they would need to be deployed in each of the twelve drought scenarios. Therefore, the required societal valuation inputs for this task should be in the form of "£/(household * expected day, week or month of restriction * year)":

- We envisage that WTP to avoid drought restrictions will not increase linearly per day, week, etc. In the event of a severe water use restriction, the first few days are likely to have the highest effect on customers, while each additional day is likely to have declining marginal effect. Therefore, it would be recommendable to take account of these potential non-linearities by obtaining valuation results for different durations of water use restrictions.
- Furthermore, standpipes and rota-cuts may affect a range of different stakeholders, each of which may suffer the effects in a different way and at different costs. First, some household customers may be more severely affected than others, eg. because they have young children, mobility problems, or medical conditions that require a higher level of hygiene and/or water availability. These more vulnerable customers would be prioritized by Anglian Water in its provision of bottled water and other services in the case of a restriction event. However, these customers are more likely to be affected emotionally and psychologically by such a situation, and therefore may be willing to pay a higher amount to reduce the likelihood of drought restrictions.
- In the case of non-household customers, the effect of severe restrictions may differ significantly by sector, depending on how essential water is as an input to the production process. For some businesses, long restrictions may even be a reason to change the location of their facilities. Furthermore, in the event of severe water use restrictions in the public supply, the Environment Agency would be likely to restrict private abstraction licences (at least to some extent). Therefore, it may be important to understand the views of such customers, and the implications of these considerations on the potential consequences for the economy at the macroeconomic level.

As we describe further in the following sections, there are a number of challenges associated with robustly quantifying these differences in valuations. However, the use of a wide range of valuation methods, including a mix of traditional SP, deliberative events and ongoing

⁴⁹ Defra (May 2016) "Guiding principles for water resources planning", p.2.

customer engagement, may help obtain a wider picture of this heterogeneity, even if in some cases it is only at the qualitative level.

Once the societal benefits of each target level of drought resilience are well understood, the costs of achieving them also need to be assessed. The Economics of Balancing Supply and Demand (EBSB) framework can help in providing an estimate of these costs. While this analytical tool can only provide a guide as to the most optimal set of investment options to achieve alternative target levels of drought resilience, we understand that it provides a sufficiently accurate approximation to allow Anglian to identify the optimal target level of drought resilience.⁵⁰

3.2.3. Appraising alternative demand-side options

Once the target level of drought resilience is determined, the next task is to find the optimal combination of investment or operational measures to achieve this level and meet supply demand deficits. Water resource investment options have traditionally been assessed using the EBSB framework. However, we understand that this framework has been criticised for being biased towards supply-side resource options, since it places more weight on finding the “least cost” solution, rather than the “best value” solution. Consequently, Anglian is not going to use the EBSB to determine its future demand management strategy.

The sustainable economic level of each demand-side solution (eg. the sustainable economic level of leakage, or SELL), only takes into account the benefits in terms of reduction of the supply-demand deficit (ie. in terms of volume of water saved), but does not include the social and environmental benefits, or intangible benefits (such as reducing leakage encourages customers to reduce their consumption) from such solutions with respect to other options.

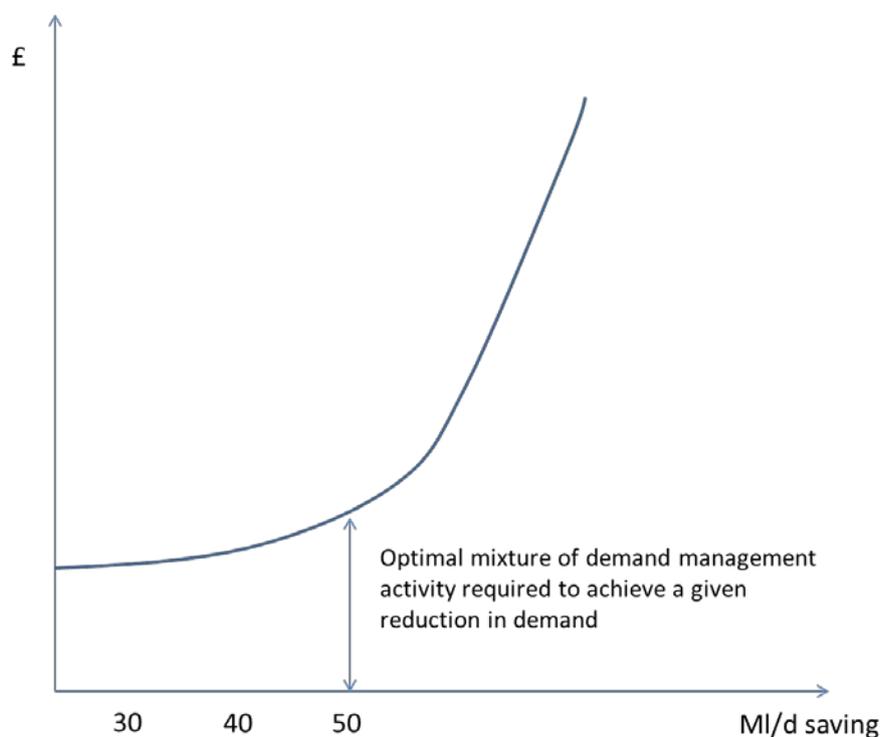
Therefore, to ensure a more robust appraisal of alternative demand side options, Anglian is planning to use the more sophisticated C55 software, which is also used in the business planning process:

- This software will optimise the combination of demand management options, taking into account not only capital and operating expenditure, but also the environmental and social costs associated with each option. It will produce a “cost curve” of achieving given levels of demand reduction in Ml/day as illustrated below in Figure 3.5.
- C55 will also determine the optimal mix of demand management options to achieve a level of demand reduction. For example, to achieve given Ml/day reduction, the optimal mixture of solutions will include a certain amount of leakage reduction, a certain amount of smart metering, and so on.

Anglian’s Demand Management Strategy Task and Finish Group will then use this information to inform its future demand management strategy.

⁵⁰ Anglian Water’s experience at PR14 suggests that the determination of the target level of resilience is not significantly sensitive to the set of investment options considered.

Figure 3.5
Cost Curve of Demand Management Options - Illustrative Example



Source: Anglian Water.

3.2.4. Obtaining societal valuations for the range of supply and demand side measures

The societal valuation input required for this assessment will be a marginal social and environmental cost (eg. in £/ML/day) for each of the options under consideration. Therefore, Anglian will need to obtain valuations for a wide range of levels of leakage, water efficiency and metering options.⁵¹

For instance, demand side measures may have some environmental benefits compared to supply-side measures, as they potentially allow more water to be left in the environment than supply-side measures, which improves river flow levels, and they may involve less energy consumption (and hence CO₂ emissions) than supply-side measures. As such, environmental benefits will need to feed into the valuation of alternative supply-demand side measures. There may also be some other societal costs or value associated with some supply-side measures, for instance because new reservoirs can have recreational uses and their construction may create or destroy habitats and communities.

Additionally, consumers may have preferences regarding alternative options that are separate from these environmental benefits. However, valuing these additional benefits can be

⁵¹ We understand that at PR14 the range of LoS evaluated for leakage was excessively narrow, so that Anglian Water could not support higher levels of leakage reduction due to a lack of valuation estimated for those levels.

challenging, as it is important to ensure that customers understand the implications of alternative levels of demand reduction measures:

- For example, respondents may believe that a higher level of leakage reduction is going to reduce their bills, whereas in reality this is not the case if Anglian chooses to go beyond the economic level of leakage as the additional maintenance costs outweigh the resulting cost savings. When asked about leakage reduction and other conservation measures, customers may also assume that more conservation leads to higher drought resilience, fewer interruptions, or environmental improvements. Hence, it will be important to tease out the value that customers associate with individual conservation measures “for their own sake” rather than because they assume (possibly incorrectly) such measures will affect bills, the environment or interruptions/drought resilience.
- Customers’ may also have concerns regarding the principle of water metering (for reasons such as equity considerations). They may also have preferences regarding alternative types of smart meter installed (eg. functionality to receive email updates, having an in-house display unit, or different frequencies of data collection). These factors may all influence customers’ WTP for alternative measures. In some cases, a specific aspect of the service may even have a negative value for the customer, eg. due to concerns about the anonymity of data collected by smart meters.

Hence, it is clear from the above that the WRMP process requires valuations for a range of environmental and service attributes that populate the C55 modelled service assessments, in order to inform the choice between alternative supply and demand options. In addition, it will be important to quantify the value that customers assign to alternative supply and demand options “for their own sake”.

3.2.5. Assessing the environmental costs and benefits of each water resource option

As part of the WRMP (and wider business planning) process, Anglian needs to appraise the range of demand and supply side measures that it could deploy to improve drought resilience and/or maintain the supply-demand balance. As discussed above, associated with each option will be a range of operating and capital costs, as well as environmental and social costs/benefits that the societal valuation programme will need to deliver.

At WRMP14, Anglian used BT methods to evaluate the environmental costs of each option, following the Environment Agency’s Benefits Assessment Guidance (BAG). This guidance set out standardised approaches to valuation assessment, using data that were readily available.

In October 2016, the Environment Agency published new guidance on environmental valuation of water resource options.⁵² This guidance encourages companies to undertake their own assessment of the environmental costs and benefits of each option they are

⁵² Environment Agency (October 2016) “Environmental valuation in water resource planning – additional information”

considering for the WRMP, and then decide how to measure each of these impacts, based on the following principles:⁵³

- *Principle 1: Use a method that is proportionate to the size of the problem.* For each environmental impact that the company identifies in its assessment of options, companies should decide whether to keep the measurement at the qualitative level, at the quantitative level, or at the monetised level.

This will depend on the strategic importance of each impact, based on factors such as the size of the supply-demand deficit in the water resource zone where the option is being considered, the size of the water resource zone population (ie. how many people the option has an impact on), how contentious the options are, and the level of “environmental sensitivity” of the water resource zone (eg. whether it contains protected sites, or sites subject to strong stakeholder interest).

- *Principle 2: Consider using an Ecosystem Services approach to environmental valuation.* When assessing the specific environmental impacts of each option on specific environmental sites, the EA recommends that companies use the Ecosystem Services approach. This approach provides a framework to evaluate the value of an ecosystem that interprets it as an asset for society, ie. as part of the country’s “Natural Capital”. The framework categorises the benefits of an ecosystem for society into four types of service: supporting, provisioning, regulating and cultural.
- *Principle 3: Use the best available evidence and develop new evidence if needed.* Once an environmental impact has been deemed strategically important, and therefore a monetisation is needed, Anglian will need to assess the robustness of the available sources for that specific valuation (eg. those included in the BAG and the other potential evidence sources listed in the new EA guidance).⁵⁴

During this assessment, Anglian will need to take into account factors such as whether the available evidence is spatially sensitive (ie. whether it can be applied to the ecosystem of interest, particularly for studies undertaken for an area geographically different from Anglian’s region), and whether it is temporally sensitive (ie. whether it is likely to have changed since the date it was obtained, particularly for old studies).

The EA also recommends testing the sensitivity of the WRMP decisions to changes in these valuations. Similar to the wider Business Planning process, there is therefore also a need to “triangulate” results from different sources for those environmental impacts that are of strategic importance and are subject to valuation sensitivity.

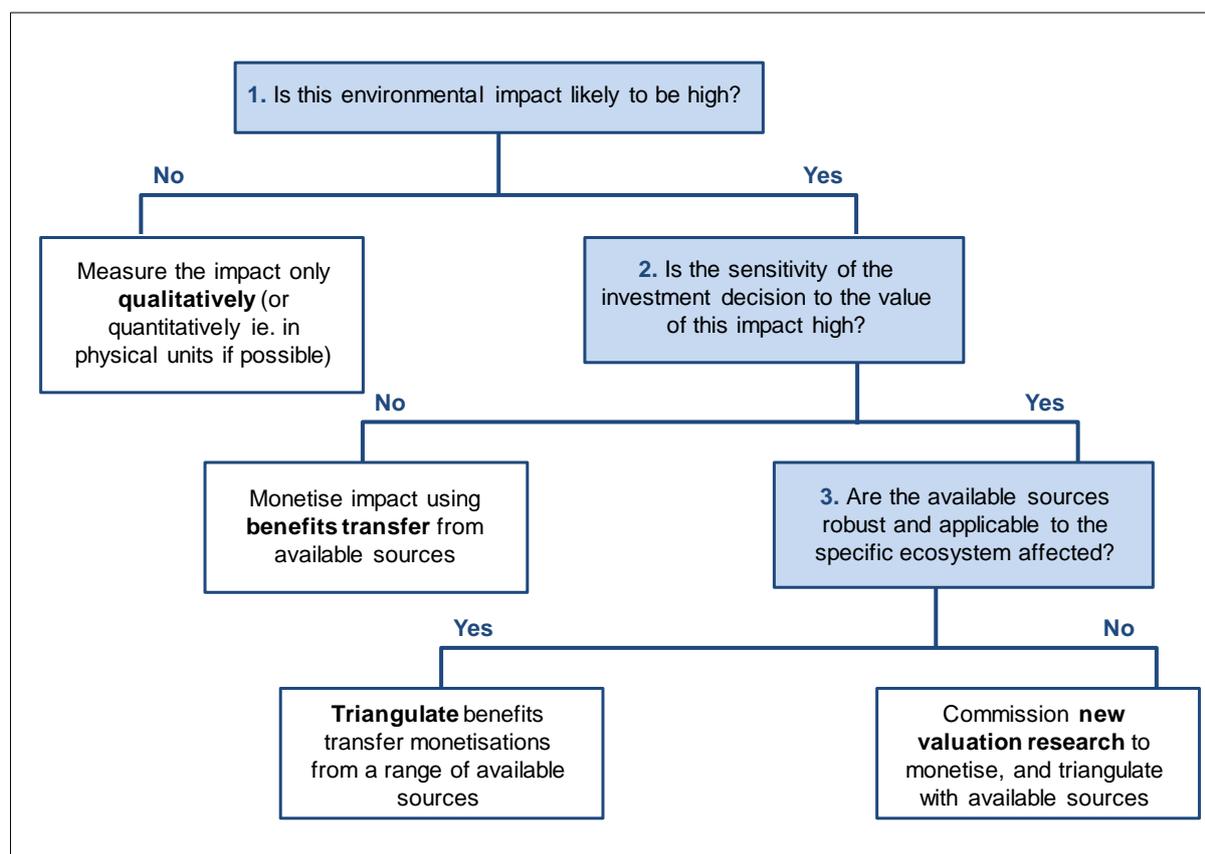
- *Principle 4: The appraisal process should be transparent.* In the draft WRMP19 submission, Anglian should include a clear explanation and audit trail from raw data to the final appraisal recommendations and results.

⁵³ Environment Agency (October 2016), p. 5

⁵⁴ Potential evidence sources listed in Section 4.1 of Environment Agency (October 2016) include the Environmental Value Lookup Tool (Summer 2016), the ORVal tool (Summer 2016), and PR19 valuations obtained for the relevant attributes also used in the Business Plan (eg. river water quality, flooding, carbon, traffic disruption).

Therefore, once Anglian has identified the (potentially site-specific) environmental impacts of each of the water resource options it is considering for the WRMP, we recommend following the strategic framework illustrated in Figure 3.6.

Figure 3.6
Strategic Framework for Valuing Environmental Impacts of Water Resource Options



Source: NERA, based on EA (October 2016)

3.2.6. Key dates in the development of the WRMP and the demand management strategy

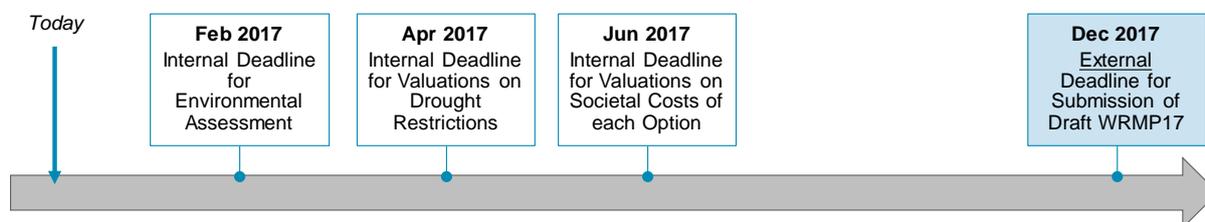
The deadline for submission the draft WRMP19 to the Secretary of State is 1 December 2017. As described above, societal valuations will be needed at different stages of the process, each of which with a different internal deadline:

- We understand that Anglian needs societal valuations of avoiding drought restrictions by April 2017 in order to determine the target level of drought resilience; and
- Once the target level of drought resilience has been set, Anglian will need the environmental and social costs of each alternative water resource option by June 2017.

As discussed above, Anglian will need to conduct a detailed assessment of each water resource option in order to identify, at a qualitative level, the specific environmental impacts associated with each option. This will be followed by a strategic assessment of these impacts and of the currently available societal valuations, which will inform any needs for primary research for a proportionate monetisation of these impacts. In order to ensure that Anglian

has sufficient time to commission this potential further research, we recommend that Anglian finalises this assessment by February 2017.

Figure 3.7
Key Dates in the Development of the WRMP



Source: NERA Illustration

3.3. Meeting Evolving Regulatory Challenges

Drawing from the experience from PR14, there has been a number of regulatory publications and industry discussions around potential ways to improve companies' customer engagement at PR19. In structuring the valuation programme, it is therefore important to take account of a range of recent regulatory recommendations for improvement, which we discuss below.

3.3.1. "Triangulating" valuations from a range of evidence

In its recent Water 2020 consultation, Ofwat stated that it expects to "*see companies developing a robust, balanced and proportionate evidence base and [it] accept[s] that a one-size-fits-all approach will not work for customer engagement*".⁵⁵

In part, this reference to avoiding a one-size-fits-all approach, could represent a reaction to the customer valuation research conducted at PR14. Most companies' made a very substantial use of SP techniques, and mostly executed in a way that interpreted the UKWIR 2011 guidance very narrowly as a "rule book" that defined the methods for conducting SP research.

In guiding companies about potential improvements to this approach for PR19, Ofwat has stated that "*[w]hile SP willingness to pay (WTP) approaches will continue to have an important role to play at PR19, it is also important for companies not to place sole or disproportionate reliance on such methods*".⁵⁶ Ofwat has encouraged companies to "triangulate" results from SP surveys with a wider range of valuation evidence obtained through day-to-day contact with customers,⁵⁷ innovative techniques such as RP WTP experiments, and by applying behavioural economics insights to the design and interpretation of customer engagement, including possible enhancement to SP methods.

⁵⁵ Ofwat (May 2016) "Ofwat's customer engagement policy statement and expectations for PR19", p.10

⁵⁶ Ibid, p.14

⁵⁷ This may include data generated through complaints, general contacts or social media.

Ofwat has therefore set out a wide-ranging spectrum of valuation evidence it would like to see companies producing. For instance, the extremely wide range of methodological choices on how valuation research can be conducted for each type of attribute (see Chapter 4 and Appendix B) means that meeting this challenge could involve expending a significant amount of time and effort on the valuation programme.

3.3.2. Balancing growth in the evidence base against the need to ensure “proportionality”

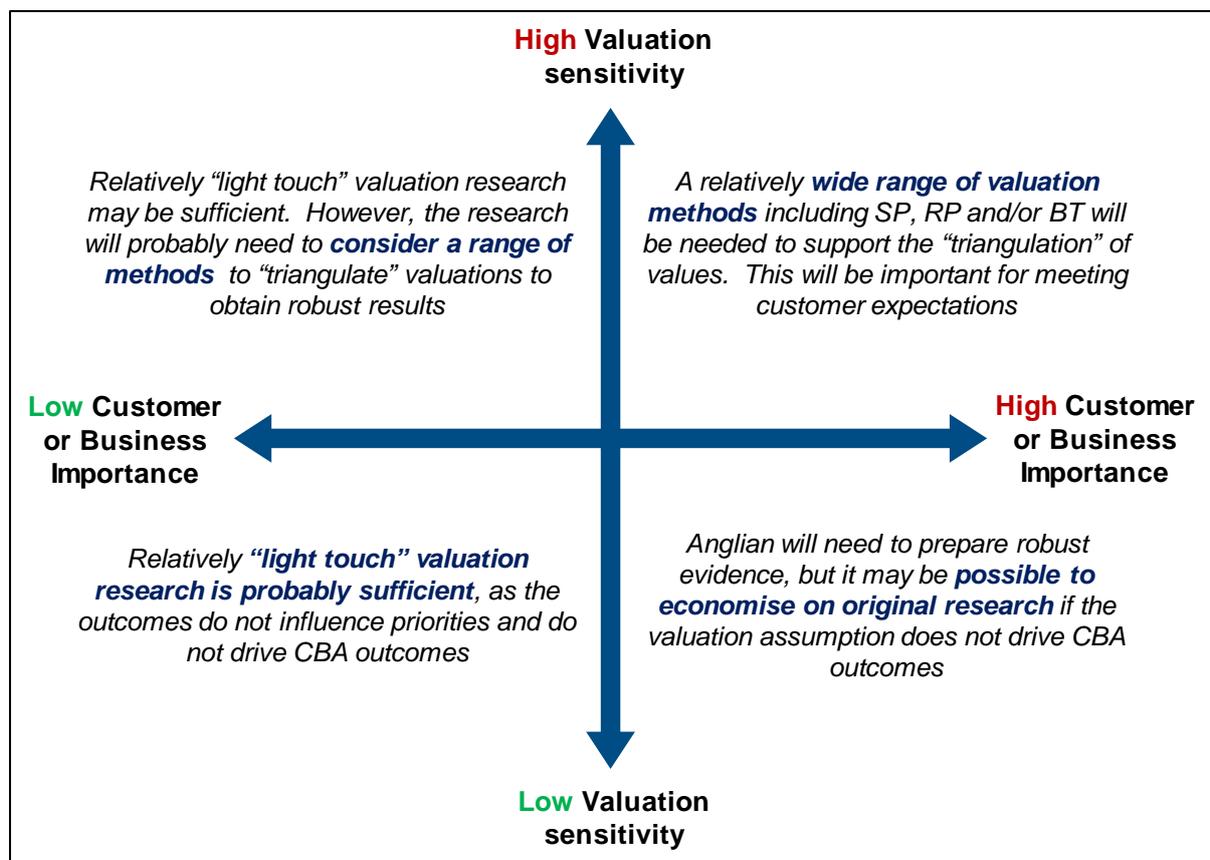
However, Ofwat’s statements also mention the need for proportionality.⁵⁸ Following the classification of attributes of service discussed in Table 3.1 and presented in Figure 3.3, the valuation effort Anglian invests in each attribute will therefore need to depend on its importance, and on the degree of uncertainty around the valuation estimate. Figure 3.8 below explains that:

- For those attributes in the top right of Figure 3.8 that are of strategic importance and are likely to drive CBA outcomes, a relatively strong basis of valuation evidence will probably be required to ensure that the PR19 investment programme meets customer expectations.
- By contrast, attributes in the bottom left of Figure 3.8 are of less strategic importance and do not tend to drive CBA outcomes, so it is less crucial to have a rigorous basis of evidence to support investment decisions.

We therefore need to ensure that the valuation programme is proportional to the importance of the valuation results in addressing strategic priorities or driving CBA (or WRMP) outcomes.

⁵⁸ Ofwat (May 2016) “Ofwat’s customer engagement policy statement and expectations for PR19”, p.10

Figure 3.8
Classification of Service Attributes by Strategic Importance and Valuation Sensitivity



Source: NERA illustration

3.3.3. Drawing on data from ongoing customer contacts

As noted above, one additional source from which Ofwat recommends companies draw more information is their ongoing contact with customers. Traditionally, the main source of information on companies’ ongoing interactions with customers comes from calls to the company and complaints. For instance, companies could gather data on the number of complains per service attribute to gather information on customer priorities for improvement.

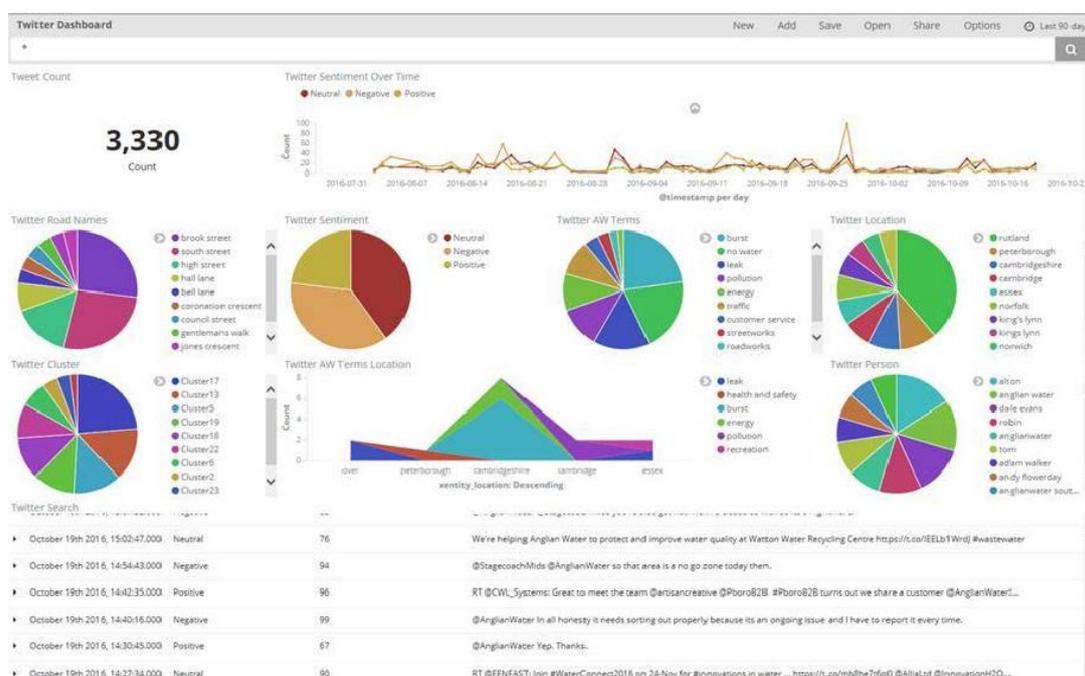
Increasingly, however, new forms of ongoing interaction data are available. For example, Anglian has been undertaking the same “Community Perception” survey quarterly since June 2015, which is enabling Anglian to build a time-series of responses for the same set of qualitative questions aimed at evaluating customer’s priorities and perceptions around different aspects of Anglian’s quality of service. Similarly, the “SIM Tracker System” provides an ongoing indicator of customers’ evaluation of Anglian’s customer service. Social media also provides a new source of information, as customers express their opinions on the performance of the water company.

We understand that Anglian has started to draw this evidence together through a “customer views data warehouse”, with a view to analysing information from all day-to-day contact points with the customer, including customer calls, complaints, online forums, or social media. Figure 3.9 shows an example of how this platform currently looks. In this case, the

source selected is Twitter, and the dashboard presents a thorough analysis of different aspects of all Twitter comments (“tweets”) that relate to Anglian Water: whether the tweet was positive, negative or neutral, the time of the day when it was published, the keywords it was related to (burst pipes, leaks, pollution, traffic disruptions), the location of the person who published it, etc.

This type of information could be used to obtain a deeper understanding of customer priority areas, and potentially be extended to analyse customer behaviour and attitudes towards these topics – eg. customer statements about the reason why a particular incident was a disturbance for them, which measures they had to take to mitigate the problem, in which time of the year (or the day) that type of event is more controversial, or the media response after a mitigating measure tested by Anglian Water in a particular region.

Figure 3.9
Sample Screenshot from Anglian's New Customer Views Data Warehouse



Source: Anglian Water.

Whilst these types of information do not lead to valuation information directly, they could be used to improve other analyses that do produce valuations. For example, learning more about customers’ reactions following a supply interruption from Twitter feeds could inform the design of SP instruments when they explain the consequences of service failure. They could also inform averted behaviour analyses that link RP valuation estimates to the types of measure customers take to mitigate the effects of service failure.

Hence, while there are a range of things that can be done to draw on ongoing customer contact information, the information available at present is capable of informing valuation research using other methods, the ongoing contact information does not provide valuation data by itself.

By taking these relatively simple measures, and explaining the link between the valuation programme and these sources of information from ongoing customer contacts, can claim to have risen to the challenge of making more use of ongoing customer contact information in the societal valuation programme. In particular, it will be important to explain how ongoing customer interactions has informed the design of any SP/RP valuation research you commission.

3.3.4. Developing tools to draw more valuation evidence from ongoing customer engagement

However, the data currently available on ongoing customer contacts is limited in its ability to provide valuation estimates directly. One way to address this particular challenge would be to develop new ways of interacting with customers that specifically ask them to value changes in service on a more continuous way that the current approach (followed by the industry more widely) of commissioning a programme of valuation research only as part of preparing business plans ahead of each price review.

Hence, Anglian might consider using the PR19 valuation programme to lay the groundwork for improved ongoing research that will produce valuation information from ongoing engagement more directly. This could require investing to develop innovative tools such as the “sliding scales” method described in Section 5.5.3 below, and other interactive online tools. Once these tools have been developed and thoroughly tested, the incremental cost of each new respondent is minimal. Therefore, these tools could be used more frequently than once in each price review, thereby building up a continuously growing database of time series valuation results that could be used in future price reviews. This would also allow Anglian to test how customer preferences change over time and in response to events.

3.3.5. Considering the use of comparative information

In its most recent Water 2020 consultation, Ofwat has advocated an increased use of comparative information on company performance in the customer challenge process at PR19.⁵⁹ It further stated that “[h]aving comparative information available will allow customers to make more informed judgements about, for example, service levels and PCs [...] and should also facilitate more powerful challenge from CCGs”.⁶⁰

We understand that Ofwat intends to publish a consultation on the use of comparative information at PR19 in November 2016, and expects companies to use comparative information that gets developed or published through that process. However, as we discuss in Section 5.6 below, considerable caution is required in the use of comparative information in direct customer engagement research. Cognitive testing will be required to evaluate the effect of providing customers with comparative information on survey instruments.

Irrespective of whether survey instruments include comparative information, we consider that it will be important to address the challenge of using more comparative information at the

⁵⁹ Ofwat (May 2016) “Ofwat’s customer engagement policy statement and expectations for PR19”, p.10

⁶⁰ Ibid, p.21

CEF level. In this forum it will be possible to explain to (relatively informed) members the reasons for differences in service across companies, and to engage in more informed discussions on the role of comparative information. It will also allow members to make an informed cross-check on the overarching CBA and customer valuation programme, especially in areas where Anglian is proposing levels of service towards the top or bottom end of the industry. Such cases may warrant investigation by the company and the CEF to demonstrate the economic efficiency of the proposals and check the reasonableness of societal valuation assumptions.

However, there is a risk that regulators consider this approach to accounting for comparative information as inadequate, given the potential for the CEF to be influenced by the views of the company. An alternative approach, therefore could be to adopt the same approach with customers as part of the process of acceptability testing. For instance, a part of this, you might consider holding deliberative events at which you present your business plan to customers, then ask their views on whether it is acceptable. Then, present the same group of customers with comparative information on the levels of service you provide relative to other companies and test how their responses change.

3.3.6. Accounting for differences between customers

Ofwat's statements regarding a "one-size-fits-all" programme of valuation and engagement research should probably also be interpreted as an expectation that companies consider both the average valuation of changes in service attributes across all customers, as well as the impact of particular sub-groups. This can be important, to the extent that particular measures to improve service affect customers in different areas or demographic groups differently.

Most water industry valuation research using SP has produced results that allow segmentation of values according to different characteristics of the population. For instance, it is straightforward to control for basic demographic characteristics of survey respondents when estimating the "logit" models used to derive WTP from SP survey results. Mixed logit techniques also provide statistical distributions around estimated WTP. Essentially, for a customer with given characteristics (eg. income, age), it is possible to derive distributions around where their WTP could reasonably be expected to lie.

These distributions of societal values by demographic characteristics could be useful in conducting CBA analysis of schemes targeted at specific customer groups, such as customers in urban/rural areas, or areas where incomes are relatively high/low. It could also be useful in estimating how societal valuations should be expected to change as the population demographics in Anglian's region evolves. For instance, if older people have a relatively low value for certain attributes, and Anglian expects an aging population, you would have a basis for indexing the societal value to changes the average age of the population.

Supplementing the existing to track valuation results according to basic demographic characteristics, we understand that Anglian is also conducting a market research study to improve its understanding of the heterogeneity of its customer base, in order to be able to define customer segments in a more meaningful and deep manner than mere demographics. This may include segments relating to the attitude of the customer towards the environment or towards water efficiency, the customer's perception of the affordability of the water bill (which may not only relate to their income level, but also to the way they manage their

finances), etc. Then, it may be interesting to understand how customer valuation results differ depending on these segments.

To gather the data required to support segmenting valuations by customer “type”, we would suggest developing a small number of simple questions that could be inserted at the end of a valuation questionnaire to identify which category customers fall into.

3.3.7. Introducing further innovation in valuation methods

Separate from the specific regulatory challenges set out above, Ofwat has also encouraged companies to test innovative valuation techniques. In her speech at the 2015 Beesley lecture, Ofwat’s CEO Cathryn Ross stated that she *“would love to see evidence based on companies having tried things in this control period – experimented, if you like, – and having learned as a result. Maybe from success, maybe from failure. But having learned”*.

This suggests that there may be some merit in investing time and resources in innovative methods, despite the risk of failure intrinsic with any innovative technique. Innovation may not be a sufficient condition for ensuring a robust valuation strategy. However, it may be a necessary condition for maintaining Anglian’s leading position, even if it is only by learning from experience and laying the grounds for improvement in future price reviews.

The key challenge in this field is to ensure that innovation efforts are not conducted in vain, and are applied only where they can be most relevant and aligned with Anglian’s strategic priorities. As described in this report, we see a range of areas where Anglian’s customer valuation programme could innovate compared to the PR14 programme. We also consider that Anglian’s valuation programme considered a wider set of valuation methods than many other companies at PR14, so Anglian has less need for improvement when compared to other companies.

3.4. Conclusion

This chapter reviews the range of considerations that will be relevant to the design of the PR19 societal valuation programme set out in Chapter 6 below. It also considers a range of regulatory challenges which are also relevant to how the valuation strategy will need to be structured.

We have considered the reasons why a certain attribute of service may represent a priority for Anglian. For instance, an attribute of service may be a priority if improvements to (or maintenance of) current levels of service are driving a significant volume of investment or operating expenditure, or if the attribute has been identified as a customer or stakeholder priority. A notable example of an attribute meeting these criteria is the value of drought resilience required for the WRMP.

In such circumstances, a robust basis of valuation evidence will be required to support the WRMP and the wider PR19 business plan. A similarly robust basis of evidence would also be required if changes in the valuation assumption could materially change CBA outcomes. In this context, a “robust” basis of evidence means one which is likely to meet stakeholder expectations at PR19. While there are no guarantees as to what forms of valuation evidence

will help meeting these challenges, recent recommendations from Ofwat provide some indications of what may be needed:

- While valuation research needs to be proportionate to customers' opinions and the importance of valuation assumptions in the business planning process, companies should draw on a wider range of valuation methods than SP;
- Companies should seek to triangulate valuation assumptions from a wider range of evidence, including data from ongoing customer contacts;
- Companies should make greater use of comparative information on their relative performance as part of their engagement and/or societal valuation process. As explained above, there are a range of ways this could be achieved including the possibilities of showing comparative information on survey instruments, or making greater use of comparative through engagement with the CEF or as part of acceptability testing; and
- Companies need to avoid treating customers as homogeneous when conducting valuation and engagement research, recognising the differences between customer segments when conducting research and applying its findings.

4. Review of Potential Valuation Methods

4.1. Identifying Alternative Valuation Methods

As we discuss in the previous chapters, for some attributes of service it may be appropriate to deploy a wider range of valuation methods to obtain societal valuations than at PR14. In part, this is driven by the regulatory recommendation to consider a wider range of valuation methods than just the SP methods used by most companies at PR14, and to “triangulate” valuations from a wider range of evidence.

Against this background, this chapter summarises a detailed review presented in Appendix B of the range of valuation methods that Anglian *could* deploy in performing the valuation research needed to inform the WRMP and wider PR19 business planning programme. We consider how these methods can be applied to each attribute area, the strengths and weaknesses of valuation methods with regards to individual attributes, while also considering where data or methods may be particularly useful as triangulation or validation tools.

For the purpose of this review, we group attributes and valuation research methods into the following six categories:

- Interruptions and disruptions to supply;
- Resilience and security of supply;
- Drinking water quality including aesthetics;
- Water resource options;
- Environmental services; and
- Flooding and nuisance impacts.

In researching appropriate valuation methods, our approach broadly followed a three part process for each attribute grouping:

- First we reviewed the methods used by Anglian at PR14 to obtain the valuations for specific attributes. For those attributes valued using SP, we reviewed the definitions and units used, the information presented to the respondent, and the context in which the valuation was obtained, eg. noting the other attributes that were valued alongside it in the same choice experiment.
- We then considered wider industry practice at PR14, in particular guidance produced before and after the price control, and evidence on the practices employed by other companies. In doing so, we also considered previous water industry work on the options for innovative valuation techniques, such as the 2011 report by Cascade for Ofwat which considered the scope for the use of RP in future price controls.
- Finally, we considered wider options for estimating customer and societal valuations of the specific attributes presented drawing on external evidence. Where applicable, we considered existing studies and assessed the extent to which findings, practices or methodologies would be appropriate in Anglian’s case. We undertook a wide ranging literature review, considering the academic literature on valuation techniques, including WTP, valuation techniques used in international water sectors, and the use of societal

valuation in other sectors in the UK and internationally; such as other regulated monopoly industries; environmental, nuisance and disruption externalities from various sectors; and WTP for attributes of market goods and services.

4.2. Valuation Options for Each Group of Service Attributes

This section summarises the range of valuation methods which *may* be appropriate for each attribute group, as described in more detail in Appendix B. The grouping of attributes for the purposes of this analysis reflects the opportunities and challenges in the application of valuation methods that the attributes within each group have in common. We provide the strategic assessment of the valuation methods that *should* be used for each attribute at the individual level in Chapter 6.

4.2.1. Interruptions and disruptions to supply

This group of attributes covers disruptions to supply such as short-term interruptions to water supply and incidents of low water pressure affecting properties. Table 4.1 summarises our assessment of the range of methods that could be applied to evaluate this type of attributes.

Overall, a range of valuation methods are available to examine the avoidance of short interruptions with some options for conducting RP methods if these attributes are sufficiently important to the business planning process. However, SP methods are likely to retain the greatest importance in valuing these attributes, as customers should be able to relate relatively well to these attributes, and the ability to target valuation research on precisely defined incidents of service failure (eg. interruptions of particular durations).

Table 4.1
Range of Possible Methods that Could Be Used to Evaluate Disruptions to Supply

Method	Possible Applications	Comments
Stated Preference	<ul style="list-style-type: none"> SP is an established means of valuing avoided interruptions and reducing the likelihood of occasional problems with low pressure 	<ul style="list-style-type: none"> These service failures are relatively simple attributes for customers to understand If valuations are required for interruptions of a specific duration or duration range, SP can generally obtain WTP for a precisely defined attribute more easily than RP or other techniques
	<ul style="list-style-type: none"> Persistent low water pressure can be more challenging. It can be valued altruistically, whereby customers are informed that disruption occurs at “other people’s properties” An alternative approach would be a targeted survey directed to those affected, or to carry out two surveys, one obtaining an ‘altruistic’ valuation and one for those directly affected 	<ul style="list-style-type: none"> Cognitive testing may be required to ensure that respondents understand the term “persistent” in the same way as Anglian does, and to test for the effects of using an “altruistic” definition of the problem, since a failure to do so will bias estimates

Method	Possible Applications	Comments
Use of Ongoing Information	<ul style="list-style-type: none"> Analysis of customer statements in Social Media/ direct contacts to Anglian Water about the reason why the disruption was a disturbance for them, which measures they had to take to mitigate the problem, in which time of the year (or the day) a disruption is more controversial Including short surveys on costs of damages/ mitigation measures in Anglian's current proactive contacts to affected customers 	<ul style="list-style-type: none"> It may be possible to directly estimate the cost of damages incurred due to supply interruptions. However, such estimates are likely to underestimate total valuations, since customers are also willing to pay to avoid the disutility of disruption
Revealed Preference	<ul style="list-style-type: none"> Avertive behaviour models could be used to value avoided interruptions, using private expenditure on water pipe repairs (on pipes that fall within customers' responsibility) as an instrument for WTP to avoid the disruption of supply interruptions 	<ul style="list-style-type: none"> A particular difficulty from this method arises in translating this information into a WTP for an interruption of a specific duration. This may be solved by comparing prices of and demand for similar repair services which offer different response times, however, the extent to which response time affects the customer's decision on which service to use would need to be determined
	<ul style="list-style-type: none"> Avertive behaviour methods may be able to derive valuation information from data on the purchase of water pumps to evaluate low water pressure attributes 	<ul style="list-style-type: none"> The relationship may be complicated by the need to make assumptions about the lifespan of any appliances, which can be a challenge when applying RP methods to derive valuation information for any attribute from the purchase of durable goods
	<ul style="list-style-type: none"> Hedonic pricing methods could be used to value persistent low water pressure, since low water pressure is an attribute which tends to affect particular properties 	<ul style="list-style-type: none"> However, this application is limited in the extent to which house buyers are aware of low water pressure when choosing to buy a property, or aware of the costs it will impose on them.
Benefits Transfer	<ul style="list-style-type: none"> There is a relatively long track record of SP valuations for shorter interruptions from previous price reviews 	<ul style="list-style-type: none"> This evidence can provides a source of BT valuation evidence for triangulation in the upcoming price review

4.2.2. Resilience and security of supply

Resilience and security of supply relate to the likelihood of customers experiencing long-term supply disruption or restrictions on water use.

At PR14, Anglian used SP to estimate WTP to reduce the probability of a hosepipe ban, while a second stage survey considered more severe (and less likely) water use restrictions.

Overall, a wide range of methods could be deployed to value resilience attributes, and in light of their strategic importance (see Chapter 3), it is likely that a range of them will need to be

deployed as part of the PR19 research programme. In particular, there is potential to improve on the valuation for non-domestics by deploying a mix of SP and analysis of macroeconomic and insurance data to support a “triangulated” valuation. Additionally, a number of other existing studies may provide opportunities for BT estimates of resilience attributes, such as those surveyed in the recent Water UK study.

Table 4.2 summarises our assessment of the range of methods that could be applied to evaluate this type of attributes.

Table 4.2
Range of Possible Methods that Could Be Used to Evaluate Resilience

Method	Possible Applications	Comments
Stated Preference	<ul style="list-style-type: none"> Customer understanding of lower probability events, such as use of standpipes and rota cuts can be relatively limited, which makes SP challenging 	<ul style="list-style-type: none"> Any SP research should be preceded by extensive cognitive testing to check customers’ understanding of the relative likelihood of low probability events, and to refine the way in which these attributes are represented in choice experiments
	<ul style="list-style-type: none"> Employing SP with very informed customers, such as holding focus groups to brief some customers in detail about the resilience challenge Anglian faces before asking them to complete SP exercises 	<ul style="list-style-type: none"> This may be necessary if cognitive testing shows it is difficult for customers to understand attributes in shorter quantitative surveys
Use of Ongoing Information	<ul style="list-style-type: none"> Using the value of claims under business interruptions insurance policies as a potential source of valuation information for non-domestic customers Surveying customers who have been affected by prolonged supply interruptions (either in Anglian’s region or elsewhere) to understand how they coped 	<ul style="list-style-type: none"> This information could provide information on the economic harm caused to non-domestic customers from severe water usage restrictions. Surveys to affected customers could include questions asking them to value reductions in the probability that it could happen again
Revealed Preference	<ul style="list-style-type: none"> It is possible to estimate the effect of prolonged supply interruptions on non-domestic customers using macroeconomic data to estimate lost economic output Research in this area was recently carried out by Water UK, and the data had sufficient geographic granularity to derive values for Anglian’s region 	<ul style="list-style-type: none"> For application in Anglian’s business plan, it may be appropriate to conduct interviews with non-domestic customers to account for the manner in which they would respond to service interruptions, eg. the extent to which production would be lost, reduced, or shifted from one site to another
	<ul style="list-style-type: none"> Avertive behaviour models could be applied to the purchase of water tanks, as stored water may be a substitute for piped water in the event of long term disruption or restrictions 	<ul style="list-style-type: none"> This may prove difficult for some customers, in cases where stored water is not a feasible or appropriate substitute. And for other customers, expenditure on their own resilience to interruptions may not respond to marginal changes in the probability of

Method	Possible Applications	Comments
		water restrictions
Benefits Transfer	<ul style="list-style-type: none"> A number of other existing studies may provide opportunities for BT estimates of resilience attributes, such as those surveyed in the recent Water UK study 	<ul style="list-style-type: none"> Each study may refer to a different severity scenario and a different area. Therefore, great care needs to be taken when applying the results to the particular needs of Anglian Water. In any case, taking these caveats in mind, these studies can be useful as secondary sources for validation purposes

4.2.3. Drinking water quality and aesthetics

This category of attributes covers those related to the quality of tap water, including temporary incidents affecting the safety of drinking water (“boil water” notices).

SP represents a relatively simple means of valuing water quality and aesthetics attributes. However, of all the attribute groups for which Anglian is likely to require valuations, RP methods are likely to be particularly applicable in this case, ie. applying “avertive” behaviour methods.

An avertive behaviour study was commissioned by a group of water companies at PR14, including Anglian, which used expenditure on bottled water and water filter devices to estimate WTP for improvements to water quality. The study found a statistically significant (negative) relationship between tap water taste, and expenditure on bottled water and water filters. However, as this kind of study uses survey based methods to estimate expenditure on tap water substitutes and perception of current level of tap water, some of the biases affecting SP studies may still arise.

Furthermore, the use of surveys to affected customers on costs of damages and mitigation measures may also provide additional information for the “triangulation” of results from different methods.

Table 4.3 summarises our assessment of the range of methods that could be applied to evaluate this type of attributes.

Table 4.3
Range of Possible Methods that Could Be Used to Evaluate Drinking Water Quality

Method	Possible Applications	Comments
Stated Preference	<ul style="list-style-type: none"> SP is relatively simple to apply to these attributes, since they typically relate to attributes of service to which customers can relate 	<ul style="list-style-type: none"> However, while 'boil water' notices relate to the safety of drinking water, taste/odour and discolouration issues do not, so it may be appropriate to check whether respondents separate these issues correctly, and if not, whether valuing these attributes in different choice experiments or even different surveys affects the valuations
Use of Ongoing Information	<ul style="list-style-type: none"> Including short surveys on costs of damages/ mitigation measures in Anglian's current proactive contacts to affected customers 	<ul style="list-style-type: none"> It may be possible to directly estimate the cost of damages incurred due to drinking water quality incidents. However, such estimates are likely to underestimate total valuations, since customers are also willing to pay to avoid the inconvenience of the incident
Revealed Preference	<ul style="list-style-type: none"> Drinking water quality appears to be a suitable attribute areas for "avertive" behaviour models, and this method has been widely employed in literature, although with a particular focus on health risks from tap water 	<ul style="list-style-type: none"> Bottled water and water filters are the two most appropriate instruments to test for a substitute relationship, however, complexity arises from the need to separate alternative demand factors which affect demand for bottled water, eg. convenience and portability
	<ul style="list-style-type: none"> A particularly useful "avertive" behaviour exercise may be to compare trends in the actual sales in bottled water over time from region to region, allowing for the estimation of changing satisfaction with tap water quality 	<ul style="list-style-type: none"> However, it may prove difficult to find good quality data available for use in this study
Benefits Transfer	<ul style="list-style-type: none"> SP values from other water companies at PR14 may be available for results validation 	<ul style="list-style-type: none"> However, at PR14, companies defined and presented these attributes differently, which could have led to wide variation in valuations
	<ul style="list-style-type: none"> The Drinking Water Inspectorate and/or governmental institutions may provide valuations for drinking water attributes 	<ul style="list-style-type: none"> Attributes related to the <i>health</i> risks from problems with drinking water should probably be valued through BT methods

4.2.4. Water resource options

Water resource options refer to the means by which companies maintain the balance between supply and demand. Unlike other attribute groups, water resource options do not represent "outputs". However, customer preference for certain options over others may represent an important consideration in estimating the social and environmental cost of individual schemes (eg. the construction of a new reservoir). As we discuss in Chapter 4, certain

demand management measures such as metering and leakage reduction can also generate strong opinions from customers and stakeholders.

We have identified a range of methods that could be used to value customers' preferences for alternative water resource options, and in particular, certain improvements to SP methods compared to those applied at PR14. Table 4.4 summarises our assessment.

Table 4.4
Range of Possible Methods that Could Be Used to Evaluate Water Resource Options

Method	Possible Applications	Comments
Stated Preference	<ul style="list-style-type: none"> Anglian used SP at PR14 to determine customers' relative preference for seven different water resource options 	<ul style="list-style-type: none"> We consider that SP instruments focused on water resource options need to control for the factors customers may associate (possibly incorrectly) with leakage reduction and other conservation measures, such as environmental improvements, better resilience/interruption probabilities, and lower bills
	<ul style="list-style-type: none"> There is potentially a wider role for deliberative research, spending time through focus groups educating customers on the trade-offs Anglian faces, then asking for their opinions on its water resource strategy 	<ul style="list-style-type: none"> This may be necessary if cognitive testing shows it is difficult for customers to understand the implications of each water resource option in shorter quantitative surveys
	<ul style="list-style-type: none"> SP methods could also be used to ask customers to make trade-offs between attributes of household appliances (including water efficiency) and the price of appliances 	<ul style="list-style-type: none"> In essence, this would involve using other factors besides the water bill as payment vehicle for estimating the value of water conservation measures
Use of Ongoing Information	<ul style="list-style-type: none"> There is limited scope for the use of day-to-day customer information to evaluate water resource options 	<ul style="list-style-type: none"> However, Anglian could consider the use of interactive tools based on innovative SP methods on an ongoing basis – eg. as an “add-on” on Anglian’s website, or using tablets in customer engagement events (see Section 5.5)
Revealed Preference	<ul style="list-style-type: none"> Using information on demand for and prices of water efficient appliances (ie. washing machines and dish washers) compared to less efficient appliances, or expenditure on water conservation equipment 	<ul style="list-style-type: none"> However, such a relationship may prove spurious or difficult to isolate statistically, if customers also consider other efficiency aspects of an appliance, or, in the case of metered customers, the private saving from reduced water bills
Benefits Transfer	<ul style="list-style-type: none"> Anglian could consider validating the results obtained by this wide range of methods with the results from PR14 	<ul style="list-style-type: none"> However, more weight should be given to the results from the improved instrument suggested above, which will reduce the probability of bias

4.2.5. Environmental services

This attribute group considers aspects of service related to the environmental impact of the water industry. Anglian valued river and coastal water quality alongside pollution incidents in the PR14 Main Stage survey, while a second stage survey focused in more depth on aspects of river quality.

In its most recent guidance on environmental valuation, the Environment Agency has encouraged companies to use an “ecosystem services” approach when evaluating the environmental costs of investment options at WRMP19. This approach provides a framework to evaluate the value of an ecosystem interpreted as an asset for the society, as part of the country’s “Natural Capital”.

The Natural Capital approach categorises the benefits of an ecosystem for society into four types of service; supporting, provisioning, regulating and cultural. Within each service type, different estimation methods (SP, hedonic pricing etc.) may still be applied. This method may be appropriate for estimating the different value of rivers of different quality, and thus estimating the societal benefit from an improvement in the quality of a river to a higher category.

Therefore, aside from traditional SP methods, a variety of alternative methods could also be used to support a “triangulated” valuation of environmental attributes. Table 4.5 summarises our assessment of the range of methods that could be applied to evaluate this type of attributes.

Table 4.5
Range of Possible Methods that Could Be Used to Evaluate Environmental Attributes

Method	Possible Applications	Comments
Stated Preference	<ul style="list-style-type: none"> SP is particularly attractive for valuing environmental attributes as it takes account of existence value in a way that market data or averted expenditure cannot 	<ul style="list-style-type: none"> The wide range of valuations between companies at PR14 suggests that valuations for environmental attributes were particularly sensitive to the survey question and/or the definitions presented to customers
	<ul style="list-style-type: none"> Focus groups may provide a forum in which to test whether informed customers exhibit a different WTP relative to other customers 	<ul style="list-style-type: none"> These events could include cognitive testing to test for sensitivity of responses to minor changes in the information presented or the units used, for example
	<ul style="list-style-type: none"> It may also be appropriate to value separately local sites and sites across Anglian’s region, thus separating altruistic and private use valuations 	<ul style="list-style-type: none"> The extent to which the distinction between altruistic valuations and private use valuations are dependent on distance would require testing
Use of Ongoing Information	<ul style="list-style-type: none"> The travel cost method, aimed at evaluating the recreational value of environmental assets, requires surveying the distance and time spent traveling by visitors (which can be done on an ongoing basis at 	<ul style="list-style-type: none"> However, using this method to value a marginal change in the quality of an environmental attribute would require comparisons between sites of different quality, and as such it may prove difficult to find a statistically significant

Method	Possible Applications	Comments
	each specific site), as well as aggregate number of visits to a site	relationship
Revealed Preference	<ul style="list-style-type: none"> Hedonic Pricing methods could be applied to environmental attributes, using econometric modelling of the relationship between property prices and quality of environmental assets in close proximity 	<ul style="list-style-type: none"> This method would require high quality, extensive data, and, particularly in the case of coastal water quality, it would be difficult to separate the effect of high quality bathing water and other demand factors, eg. the aesthetic value of a sea view
	<ul style="list-style-type: none"> It may be possible to conduct “indirect” hedonic pricing research by interviewing estate agents or surveyors about the effect of changes to the local environment on house prices 	<ul style="list-style-type: none"> This may result in a more feasible way of evaluating house price effects of environmental improvements, despite the subjectivity (and therefore possible noise) intrinsic to this type of data
Benefits Transfer	<ul style="list-style-type: none"> BT is also widely used practice in valuing environmental assets For instance, CO2 emissions impacts are simple to value using BT methods, based on government guidance 	<ul style="list-style-type: none"> However, in some cases, it is more difficult to use BT to value marginal changes in environmental quality A potentially useful existing study is NWEBS (2013) which values improvements in water quality in rivers using the same quality categories as Anglian used at PR14

4.2.6. Flooding and nuisance impacts

This category of attributes concerns primarily the service provided on the wastewater side of the business, specifically sewage flooding and nuisance from sewage plants and the sewerage network. The valuation of water mains flooding also uses similar methods used to value sewer flooding, so we cover them in this section too.

For flooding and sewage plant nuisance attributes, we consider that a mix of a range of methods could be applied at PR19 to derive a triangulated valuation for these attributes of service. Table 4.6 summarises our assessment of the range of methods that could be applied to evaluate this type of attributes.

Table 4.6
Range of Possible Methods that Could Be Used to Evaluate Wastewater Attributes

Method	Possible Applications	Comments
Stated Preference	<ul style="list-style-type: none"> Reflecting wider industry practice and guidance, Anglian estimated altruistic valuations for these attributes using SP at PR14 	<ul style="list-style-type: none"> However, valuations may be sensitive to the way the attributes are presented on survey instruments (eg. either as a discrete number of properties affected, or as a probability that the respondent's property is affected)
	<ul style="list-style-type: none"> A separate survey targeted to affected customers may be appropriate alongside an altruistic region-wide valuation 	<ul style="list-style-type: none"> Customer understanding of the attribute may be heavily influenced by past experience of the attribute, but many respondents are liable to have not experienced flooding or nuisance
Use of Ongoing Information	<ul style="list-style-type: none"> The cost of settling insurance claims following sewer flooding incidents may provide a useful source of triangulation 	<ul style="list-style-type: none"> It would be reasonable to assume that the true value lies somewhere between the altruistic valuation estimated with SP and the sum of this altruistic valuation and insurance payout
Revealed Preference	<ul style="list-style-type: none"> It may be possible to value sewer flooding using Avertive Behaviour methods, utilising private expenditure on flood resistance and resilience 	<ul style="list-style-type: none"> This method is likely to be of limited use, since sewer flooding represents only a small proportion of the flooding risks faced by properties, and is a more serious type of flooding incident
	<ul style="list-style-type: none"> Hedonic pricing is likely to be appropriate for valuing the private cost of nuisance, and the method has previously been applied to estimating house price effects of proximity to industrial sites 	<ul style="list-style-type: none"> It is, however, more difficult to estimate the effect of different levels of sewage plant nuisance on property prices, and finding such precise data may prove difficult
	<ul style="list-style-type: none"> "Indirect" Hedonic Pricing could be conducted, by interviewing estate agents and surveyors, and estimating how they consider sewage plant nuisance when valuing properties 	<ul style="list-style-type: none"> This method may even be appropriate if there is a house price effect on properties that have experienced sewer flooding (should there be a perception that such flooding is therefore likely to occur again)
Benefits Transfer	<ul style="list-style-type: none"> The FHRC's Multi-Coloured Manual 2013 may provide a source of BT through data on the cost of flood damage 	<ul style="list-style-type: none"> The manual considers residential and non-residential damage separately, and provides a number of datasets which may provide triangulation opportunities

4.3. Conclusions

This chapter, which summarises the more extensive review in Appendix B, sets out a wide range of valuation methods which Anglian *could* use to value changes in service at PR19, including a range of possible improvements to the valuation. Some involve relatively simple and applicable valuation methods that should produce highly applicable valuations. Some methods would produce valuations that are less closely applicable, or may not be successful due to uncertainties about data availability. However, the extent to which it is *worthwhile* to deploy this range of valuation methodologies requires an assessment (conducted in Chapter 3

above) regarding the relative importance of each attribute to Anglian. In Chapter 6 below, we match the range of research methods discussed in this chapter to the range of strategic priorities discussed in Chapter 3 to formulate a valuation strategy.

5. Potential Improvements to Traditional Stated Preference Methods

Before formulating the valuation strategy in Chapter 6 below, we also need to consider the need to improve on the SP methods applied by Anglian and other companies at PR14.

At PR14, large SP surveys formed the cornerstone of most companies' valuation programmes, and were used to value the majority of service attributes required to populate companies' investment and operational planning models. The SP methods companies used were, for the most part, conducted following the guidance on carrying out WTP surveys in the 2011 UKWIR guidance. While this study did not prescribe the significant reliance many companies placed on SP methods, it did set out recommendations on how SP can be conducted to maximise respondent comprehension and the reliability of valuation results.

Since PR14, there has been a significant amount of retrospective comment and analysis by the industry of how this approach to valuation research could be improved. This chapter discusses potential improvements to SP methods in light of the comments discussed in Section 3.3.

5.1. Problems Identified with PR14 Stated Preference Methods

In its recent Water 2020 consultation, Ofwat stated that it expects to “see companies developing a robust, balanced and proportionate evidence base and [it] accept[s] that a one-size-fits-all approach will not work for customer engagement”.

In part, this reference to avoiding a one-size-fits-all approach, could represent a reaction to the customer valuation research conducted at PR14, which made a very substantial use of SP techniques, and mostly executed in accordance with a “rule book” set out in UKWIR's 2011 guidance.⁶¹

Drawing from the experience from PR14, a number of studies have identified some limitations associated with these “traditional” SP methods, in the form they were used at PR14 by water companies in England and Wales.

One of the known limitations of SP is that results tend to vary depending on the respondent's recent experiences (eg. if the survey is undertaken immediately after a drought), as well as on the type of questions posed to customers and the background information provided.⁶²

In the context of the water sector in England and Wales, a recent comparative study by Accent has shown that, for most service measures, “the range of PR14 unit values across companies is large despite being based on superficially similar surveys”.⁶³ Table 5.1 shows the analysis undertaken by United Utilities in its submission to the Water2020 “market place for ideas”, which shows the high variation in WTP across companies at PR14 compared to

⁶¹ UKWIR (2011) “Carrying out Willingness to Pay Surveys”

⁶² HM Treasury / DWP (2011) “Valuation Techniques for Social Cost-Benefit Analysis: Stated Preference, Revealed Preference and Subjective Well-Being Approaches”, p.35

⁶³ Accent (2014) “Comparative Review of Willingness to Pay Results”, p.5

what would be expected as a result of differences in customer preferences across the country.⁶⁴

Table 5.1
Example of Inter-Company Variation in PR14 Societal Valuation Results

Service characteristic	High value	Low value	Median
1 property affected by 1 drinking water taste and smell incident	£28,537	£196	£2,008
1 property affected by an unexpected interruption (3 to 6 hours)	£1,670	£50	£206
1 property affected by 1 internal sewer flooding incident	£367,291	£22,530	£110,800

Source: United Utilities (2016)

A potential way to improve in the robustness of these methods is to ensure respondents understand correctly the exercise, the trade-offs they need to consider, the implications of failure for each attribute of service, and the units in which these are presented.

In particular, the 2014 study for UKWIR by Blue Marble Research found that one of the main problems with the PR14 valuation methods identified by customer engagement experts in the sector was the use of “scenarios which are too complex, not real-world and too abstract”.⁶⁵ For instance, Figure 5.1 to Figure 5.3 illustrate the complexity of the SP instruments used at PR14 based on those recommended in the UKWIR guidance. Some features of these sample choice cards that may have imposed a high cognitive burden on the respondent include:

- The relatively large number of levels of service and attributes that the respondent has to evaluate at the same time;
- For service attributes where the survey seeks altruistic valuations for impacts on service at “other peoples properties” could have been confusing, leading customers to question whether incidents could happen at their property. Some alternative presentation/description of the attributes could improve this;
- The large amount of text and information included in the definition of each attribute of service. Also, some of the relevant units do not appear with the choices; for example the number of pollution incidents is yearly but that is hard to tell without inspecting the text more closely; and
- Many of the levels of service are defined in terms of small changes to very low risks. This problem could be a particularly important limitation of the SP exercise illustrated in Figure 5.1. While it is relatively easy to understand the difference between 1-in-10 and 1-in-20 the difference between 5 in 1,000 and 1, in 1,000 seems somewhat meaningless – especially when it is in terms of years rather than households. At a minimum this

⁶⁴ United Utilities (2016) “Improving Customer Research and Engagement”, p.8

⁶⁵ UKWIR (2014) “Post-PR14 Customer Engagement, Communications and Education”

challenge associated with presenting probabilities on SP instruments suggests some testing of alternative units and presentations of service attributes is required before launching new SP valuation research at PR19.

In light of this complexity, in particular for low probability events like prolonged restrictions, it seems highly likely that many customers would have struggled with this form of instrument. In reality, some may well have focused in the one or two things they care about and ignored the others. This approach is not necessarily unrealistic, of course, as customers may only have strong preferences regarding a subset of the attributes, but it does illustrate that some simplification to the survey method could be considered.

Figure 5.1
Example of Traditional SP Choice card – Water Service

		OPTION A	OPTION B
1	AN UNEXPECTED INTERRUPTION to the water supply at your property lasting between 6-12 hours. The chance that this happens at your property in any one year	5 in 1,000	1 in 1,000
2	A BAN ON USING THE HOSE PIPE at your property that would typically last for 5 months beginning in May and ending in September. The chance that this happens at your property in any one year	1 in 10	1 in 20
3	You will be told that FOR UP TO 2 DAYS YOU WILL NEED TO BOIL TAP WATER from your property first before drinking, cooking or preparing food. It may affect your health if you do not boil the water before drinking.. The chance that this happens at your property in any one year	1 in 5	1 in 50
4	THE WATER AT YOUR PROPERTY HAS A TASTE AND ODOUR that is not ideal for a week at a time, but it is safe to drink. The chance that this happens at your property in any one year	10 in 1,000	This does not happen
5	THE WATER IS DISCOLOURED AT YOUR PROPERTY for a week at a time, but it is safe to drink. Running the tap for several minutes will not remove the discolouration. The chance that this happens at your property in any one year	15 in 1,000	This does not happen
6	THE CHANGE IN YOUR ANNUAL WATER AND SEWERAGE BILL to provide the service quality above. The new bill level will also apply in all later years.	Increase of £5 each year for 5 years, from £350 in 2015 to £375 by 2020	Increase of £10 each year for 5 years, from £350 in 2015 to £400 by 2020

Source: UKWIR (2011) – Appendix 10.

Figure 5.2
Example of Traditional SP Choice card – Environment

		OPTION A	OPTION B
1	<p>QUALITY OF RIVER WATER.</p> <p>Miles of river in each water quality category (out of a total 120 miles of river in your area) in any one year</p> <div style="border: 1px solid black; padding: 5px; width: fit-content;"> <ul style="list-style-type: none"> ■ High Quality ■ Medium Quality □ Low Quality </div>	<p>6 miles 5% 48 miles 40% 66 miles 55%</p>	<p>0 miles 0% 48 miles 40% 72 miles 60%</p>
2	<p>QUALITY OF COASTAL BATHING WATER.</p> <p>Number of beaches in each quality category (out of a total 45 beaches in your company's area) in any one year</p> <div style="border: 1px solid black; padding: 5px; width: fit-content;"> <ul style="list-style-type: none"> ■ High Quality ■ Sufficient or Good Quality </div>	<p>10 beaches 22% 35 beaches 78%</p>	<p>20 beaches 44% 25 beaches 56%</p>
3	<p>POLLUTION INCIDENTS on rivers and streams in your area, caused by your water and sewerage company. This can have an impact on local habitats such as killing fish. There might be fewer fish in the rivers for the rest of the year.</p> <p>Number of pollution incidents in your area in any one year</p>	10	5
4	<p>AN UNEXPECTED STOPPAGE of the water supply at your property lasting between 2-3 weeks.</p> <p>The chance that this happens at your property in any one year</p>	3 in 15,000	1 in 15,000
5	<p>THE CHANGE IN YOUR ANNUAL WATER AND SEWERAGE BILL to provide the service quality above.</p> <p>The new bill level will also apply in all later years.</p>	<p>Increase of £5 each year for 5 years, from £350 in 2015 to £375 by 2020</p>	<p>Increase of £10 each year for 5 years, from £350 in 2015 to £400 by 2020</p>

Source: UKWIR (2011) – Appendix 10.

Figure 5.3
Example of Traditional SP Choice card – Sewerage Service

		OPTION A	OPTION B
1	FLOODING FROM THE SEWER GETS INTO OTHER PEOPLE'S PROPERTIES. Number of other people's properties where there is a 1 in 10 chance of this happening in any one year	500	100
2	FLOODING FROM THE SEWER GETS INTO public places like parks, footpaths, and roads in your area. The chance that this happens in your area in any one year	3 in 1,000	1 in 1,000
3	ODOUR FROM SEWAGE TREATMENT WORKS REACHES OTHER PEOPLE'S PROPERTIES. This happens about 12 times a year for a day at time, at properties close to a sewage treatment works. Number of other people's properties this happens to	5,000	500
4	LOW WATER PRESSURE AFFECTS THE TAPS, SHOWERS AND BOILERS AT OTHER PEOPLE'S PROPERTIES. This happens persistently, for example at weekday breakfast times, at some properties at the top of tall buildings or on hills. Number of other people's properties this happens to in any one year	1,500	600
5	THE CHANGE IN YOUR ANNUAL WATER AND SEWERAGE BILL to provide the service quality above. The new bill level will also apply in all later years.	No change	Increasing by 2% a year, so increasing by 10% in total

Source: UKWIR (2011) – Appendix 10

UKWIR (2014) also identified two attributes of service that were generally most challenging to evaluate at PR14, and the problems associated with the methods some companies used:

- **Leakage:**⁶⁶ For customers, the study found that leaks were emblematic of waste and inefficiency. Leakage is one of the few areas where “uninformed” customers have a personal view on the performance of a water company – although often formed on hearsay rather than personal experience.

As well as having a low tolerance for leakage per se, customers also find descriptions of leakage volumes abstract and are unlikely to have knowledge about why or when leakage occurs. On the other hand, discussions about the amount of water lost through leakage as a percentage tended to exacerbate the perception that leakage is not being controlled by water companies. Introducing detail about leakage levels including losses from customer owned pipes was liable to create further confusion.

⁶⁶ UKWIR (2014), p. 70.

Other companies (like Anglian) opted to exclude leakage from the main WTP study and obtain valuations as a function of the benefits of avoiding water use restrictions, based on assumptions on the links between the two attributes. These assumptions were difficult to justify and potentially less robust than direct inclusion in the questionnaire.

- **Resilience to severe drought restrictions:**⁶⁷ The study found that engagement around resilience was challenging because: (i) respondents find it difficult to consider future time horizons; (ii) respondents tend to be misinformed about climate change and population growth prospects; (iii) few customers have direct experience of loss of supply or water restrictions; and (iv) bill impacts related to managing low risk and high impact scenarios are abstract, especially given many customers will never have experienced the types of water use restrictions that would be required in severe droughts (eg. stand pipes and rota cuts).

Therefore, the study recommended that the design of the survey instruments needs to pay special attention to the way resilience service levels are defined, and the degree to which consequences of such service levels are understood by respondents.

The study found that companies improved their descriptions of resilience planning over the course of PR14 engagement by using more “consumer-friendly” language and supporting descriptions with visual images. However, it concluded that there is still scope for making resilience more meaningful to customers, particularly by ensuring that customers appreciate the impacts of resilience planning and the trade-offs between the different water resource options. A way to achieve this can be the use of more interactive tools such as the “sliding scale” method described in Section 5.4.

5.2. Simplifying the Presentation of Service Attributes and Levels

5.2.1. Anglian Water’s SP studies from PR14 were simpler than the 2011 UKWIR guidance

At PR14, Anglian undertook one main SP survey (which evaluated a wide range of service attributes, in order to give *breadth* to the study), followed by three second stage SP surveys (respectively focused on water resources, flooding and the environment in order to give *depth* to the findings).

The main survey evaluated twelve service attributes in total, which were divided in four groups of three attributes each: water availability, water quality, wastewater and environment. Each choice card presented to the respondent evaluated only one group of three attributes at a time. Figure 5.4 shows an example of the choice cards used by Anglian to evaluate the first group of attributes, which related to water availability. The choice cards corresponding to the remaining attribute groups were presented in a similar layout.

⁶⁷ UKWIR (2014), p. 74.

Figure 5.4
Example of Choice card used by Anglian Water at PR14 – Main Survey

	<i>Option 1 Current situation</i>	<i>Option 2 Alternative A</i>	<i>Option 3 Alternative B</i>
Unexpected interruptions to supply <i>Number of households affected per year by a 6-12 hour loss of supply</i>	18,000 households per year	21,000 households per year <i>(worse than current situation)</i>	18,000 households per year <i>(no change from current situation)</i>
Persistent low water pressure <i>Number of households affected per year by persistent low water pressure</i>	600 households per year	0 households per year <i>(better than current situation)</i>	600 households per year <i>(no change from current situation)</i>
Hosepipe bans <i>Chance of a 6 month ban occurring in any given year</i>	10% <i>(1 in 10 years)</i>	25% <i>(1 in 4 years)</i>	5% <i>(1 in 20 years)</i>
Water bill <i>Change in your annual water bill</i>	No change	Increase by £20	Increase by £30
WHICH DO YOU PREFER?			

Source: Anglian

The layout and contents of the sample choice card shown in Figure 5.4 used by Anglian at PR14 is different from those suggested by UKWIR (2011), illustrated in Figure 5.1, in a number of ways:

- The respondent only needs to evaluate three attributes at a time. This has the advantage of significantly reducing the cognitive burden on the respondent, thereby potentially improving the robustness of the results. However, there is a chance that reducing the number of available options may induce the respondent to ignore any trade-offs with other service attributes, thereby potentially biasing the responses upwards. If using a similar approach for the PR19 valuation programme, we would suggest that Anglian tests the strength of each of these two opposing effects in order to find the optimal number of attributes to be presented in each choice cards.
- The description of the service attributes is significantly simpler, with less information. The respondent is assumed to remember the implications of each attribute of service from a show card that has been presented previously – see Figure 5.5.
- The show card uses relatively “customer-friendly” language, and improves customer understanding of the exercise by stating the causes of the problem, as well as the potential ways Anglian can reduce the chances of occurrence. However, the presentation of the information could still be improved by illustrating each service attribute description with more graphics. This could help the respondent remember the key issues related to each attribute when choosing between packages. Tying the service attribute to show card by using same or similar graphics would also probably help respondents.
- These choice cards also indicate which service levels are better or worse. If applying similar methods for the PR19 valuation programme, Anglian may benefit from testing to determine whether the results would differ dramatically with and without the “better” or “worse” designations. For instance, it is possible that respondents simply focus on the

“better” or “worse” and use these as decision making tools and ignore the specificity. These labels could help customers, but it could be determinative, in the sense that this approach could influence valuation results. An alternative that could be tested would be to use shading of the option that gets worse (or better) to indicate the direction of change, without using the words better/worse.

- The probability of rare events is expressed in terms of “number of households affected per year”, instead of “the probability that your household is affected in any one year”. This way of presenting levels of service is likely to be more meaningful to customers, since it is more factual and less abstract. However, it is phrased in a way that may be understood by customers as an “altruistic” type of valuation, since it does not directly state that one of the affected households could actually be *theirs*. This should at least be clarified in the questionnaire. Also, the lack of a denominator (ie. the total number of households in the Anglian area) might lead customers to overestimate the likelihood of their household being affected. A potential solution could be to add a note on the total number of households in the Anglian area, but as noted above, we recommend some testing of alternative ways of presenting risk measures to customers as part of developing new SP instruments for PR19.

Figure 5.5
Example of Show card used by Anglian Water at PR14 – Main Survey



Source: Anglian

5.3. Simplifying Trade-offs with a “Max-Diff” Approach

Another possible innovation that retains the SP approach is the use of the so-called “max diff” approach to valuation, which may represent a method of simplifying the choices faced by respondents as compared to the traditional choice card approach widely used at PR14. In contrast to the traditional SP choice card shown in figures above, the “max diff” approach involves presenting customers with a range of possible options (such as a series of changes in service and a change in the bill). They are then invited to select their “most favoured” and “least favoured” option from the list. From these choices, it is possible to derive valuations as follows:

- If customers are presented with a series of options (denoted A, B, C, D, and E), they will choose one option as their preferred option and another option as their least preferred. This is less complex than a traditional choice card, essentially because the choice card had fewer “moving parts” and the trade-offs customers are asked to make are fewer;
- Suppose a respondent selects option A as their most preferred option and option E as their least preferred option. From this choice, we know that the customer prefers A to all other options, and prefers all of B, C, and D to E. By asking customers to make these choices a number of times, we can derive information on customers’ ranking of attributes. And if one of the options (ie. from A to E) is a change in the bill, we can estimate customers’ “utility functions” in the same way as we do using normal SP methods that defines the relative importance customers’ ascribe to the water bills they face and the level of service attributes provided. From this estimated utility function, we can derive valuations in the usual way, ie. using econometric logit models.

The figure below illustrates the type of choice card that could be presented to respondents under this approach. However, it is important to note that the same improvements to the presentation of attributes and service levels as is possible using the conventional approach to SP (see Section 5.2 above) such as simplifying units or the presentation of probabilities could also be incorporated into this methodology. Also, to ensure that the modelling produces data that can be used to value improvements as well as deteriorations in service, respondents would need to be shown a range of separate choice cards listing service improvements and deteriorations in service.⁶⁸

⁶⁸ Mixing deteriorations and improvements on the same card would not produce meaningful data, as it would not be informative to learn that customers’ most preferred option is a service improvement / bill reduction, and their least preferred option is a deterioration / bill increase.

Figure 5.6
Illustration of a Choice Card Using the "Max Diff" Approach

Service Attribute	Current Experience	Option	Customer's Choice
The probability of experiencing a 3-6 hour interruption at your property	1-in-10 Probability of an Incident	Improving the Probability to 1-in-30	Best Option
The probability of experiencing a hosepipe ban in your area	1-in-15 Probability of an Incident	Improving the Probability to 1-in-20	
The probability of experiencing problems with water odour at your property	1-in-5 Probability of an Incident	Improving the Probability to 1-in-8	
Incidents of flooding from sewers in public areas	20 Incidents Per Year in your Area	Reducing the Number of Incidents from 20 to 15 Per Year	
Number of beaches classified as "high quality" environmental standards	35 out of 40 Beaches	Increasing the Number of High Quality Beaches from 35 to 38	Least Best Option
Your annual water and wastewater bill	£400 per year	Reduction in the Bill by £5 per year	

However, whether this approach represents a genuine improvement in terms of enhancing customers' ability to understand the attributes and service levels, and helping them to make more meaningful trade-offs between alternative options, is something that would ideally need to be tested through some prior qualitative work to ensure it produces robust results. In particular, if the main complexity arises from the individual attribute definitions and service levels then this approach would not materially address any problems with the complexity of the instrument.

5.4. Developing Adaptive Choice Methods

Another possible improvement to the SP methods used previously would be to develop surveys based on an approach known as Adaptive Choice-Based Conjoint Analysis (ACBC). ACBC is a relatively new approach for modelling customer preferences and valuations, which has some similarities to the traditional forms of conjoint analysis that Anglian has used in previous SP instruments. However, the ACBC approach differs, in that it generates a *personalised* multi-stage survey for each respondent, such that the conjoint analysis each respondent participates in is tailored to the responses and preferences of the individual. By adjusting instruments to individuals' preferences, the survey instrument each customer experiences could be simpler than the traditional approach.

Specifically, it may reduce the informational burden on participants and make the process more engaging (and therefore more enjoyable), while also reflecting more accurately the decision making process people undertake when choosing between options in real life scenario.⁶⁹

This approach, which we have seen applied to assess customer preferences regarding alternative pharmaceutical products, works as follows:

- Under the traditional SP approach, respondents participate in choice experiment and contingent valuation exercises, through which they choose between a series of options with information on the “level” of attributes for each option. The respondent then chooses the option they prefer, trading off differences in service levels and bill effects. Of course, because customers see a series of discrete choices, they may not be given the option to select a package that represents their preferred level of service across all attributes.
- By contrast, the ACBC approach is more interactive:
 - In the first stage, called “**Build Your Own**”, respondents choose their preferred level across all attributes individually, with no reference to options or bundles. As such, the respondent does not need to consider trade-offs between attributes when making these choices. However, variations on this stage include the inclusion of a “cost configurator”, in which the total cost of the package selected by the respondent changes as the respondents chooses the level of each attribute.
 - The results from the “Build Your Own” task are then used (by a computer program built into online/CAPI system) to generate a relevant set of packages to test in the second section, the **Screener Section**. This section begins with the respondent seeing a series of options/bundles and stating whether each option is “a possibility” or “unacceptable”, while any option marked as a possibility is retained for the subsequent Choice Tournament section.⁷⁰ The software then identifies any attribute levels which were never chosen and attribute levels which were always chosen: they are named “unacceptable” and “must have” respectively. The list of “unacceptable” attributes is then presented to the respondent, who must choose one option which is “totally unacceptable”, before an equivalent process follows for “must have” attributes.
 - The “**Choice Tournament**” follows, in a format similar to a choice experiment applied in traditional SP conjoint analysis. The difference, however, is that the options presented do not contain any attributes at levels deemed unacceptable by the individual respondent, and “must have” attribute levels are present across every option (in effect reducing the number of attributes that the respondent must consider).⁷¹ This removes the possibility that the respondent rejects options

⁶⁹ Cunningham, C. et. al. (2010), “*Adaptive Choice-Based Conjoint Analysis A New Patient-Centered Approach to the Assessment of Health Service Preferences*”, *The Patient: Patient-Centred Approach to the Assessment of Health Service Preferences*, 3(4), p. 260.

⁷⁰ Cunningham, C. et. al. (2010), “*Adaptive Choice-Based Conjoint Analysis A New Patient-Centered Approach to the Assessment of Health Service Preferences*”, p. 261.

⁷¹ Cunningham, C. et. al. (2010), “*Adaptive Choice-Based Conjoint Analysis A New Patient-Centered Approach to the Assessment of Health Service Preferences*”, p. 262.

containing bundles of attributes they prefer due to the presence of attribute levels deemed “unacceptable” or the absence of attribute levels deemed “must have”.

A 2010 review of studies employing ACBC found that respondents found them more engaging than conventional SP, despite requiring the respondent to devote more time.⁷² ACBC also produced more precise results than traditional SP methods, yielding smaller standard errors.⁷³ It would also represent a less substantive departure from the traditional SP approach than the slider method described below so the risks associated with its use may be less. The downside of this approach in the context of Anglian’s PR19 valuation programme is that it would require more development, potentially adding cost and time to the process of developing and implementing SP research.

5.5. Stated Preference Valuation Methods Using Sliders

5.5.1. More interactive valuation methodology using “sliding scales” allowing customers to choose packages of service

As well as these revisions to traditional SP tools, some companies (including Anglian) have experimented with interactive web-based tools that allow customers to select their desired levels of service. These tools provide a more graphical, user-friendly interface than a traditional choice card (see pictures below). They involve asking consumers to select their desired service level for a number of attributes using “sliders” on a computer or tablet screen. As they select higher/lower service levels, the bill rises/falls. We are aware of two specific examples of these tools used at PR14.

Anglian developed an “investment simulator tool”, where customers were asked to choose the different levels of investment in a set of attributes of service, contingent on the consequent change on the average annual bill and the overall carbon footprint.

⁷² Cunningham, C. et. al. (2010), “*Adaptive Choice-Based Conjoint Analysis A New Patient-Centered Approach to the Assessment of Health Service Preferences*”, p. 268-269.

⁷³ Cunningham, C. et. al. (2010), “*Adaptive Choice-Based Conjoint Analysis A New Patient-Centered Approach to the Assessment of Health Service Preferences*”, p. 268.

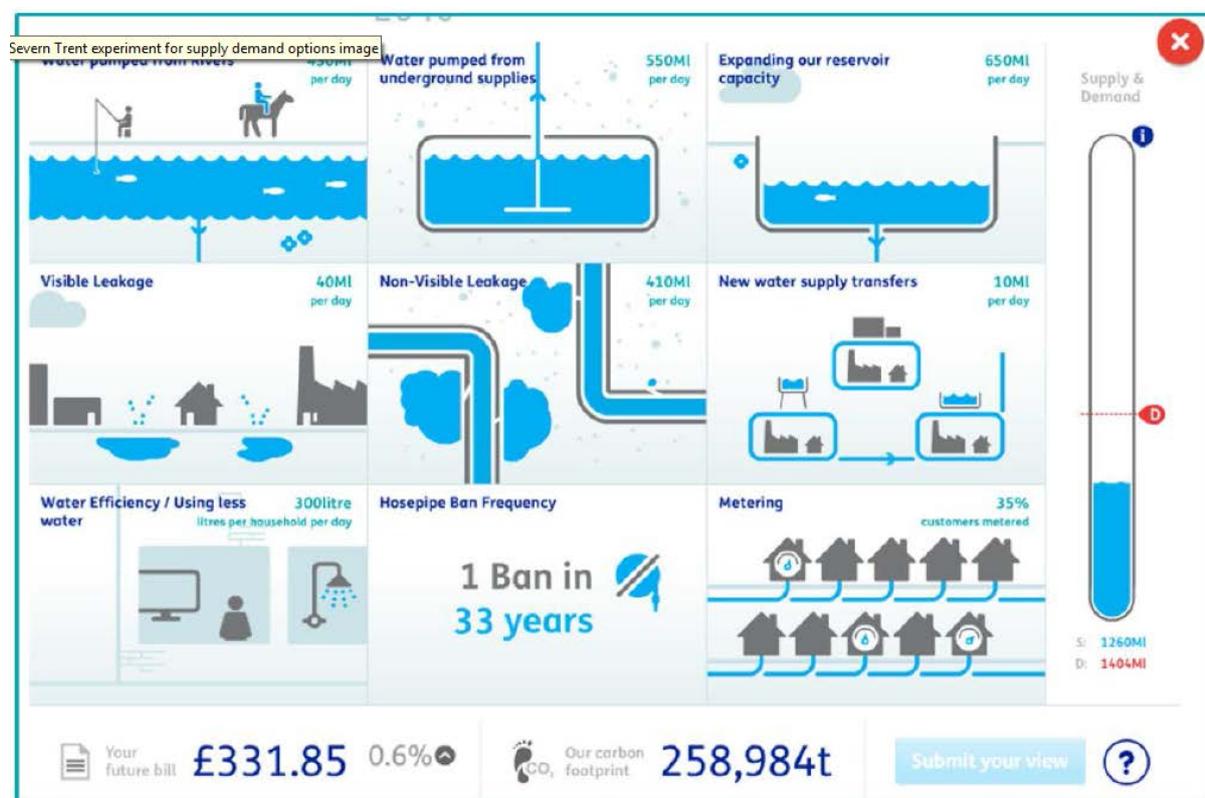
Figure 5.7
Anglian’s Choice Experiment Using Sliders at PR14



Source: Anglian Water

As illustrated in Figure 5.8, Severn Trent used a similar tool that allowed customers to choose between a range of different water resource options, making a trade-off between changes in the bill and CO₂ footprint of the business, and changes in levels of service. We understand that, as customers selected higher levels of service, bills tended to rise. Changes in some service attributes or changing the mix of water resource options changes the “carbon footprint”. Also, respondents needed to provide sufficient supply from alternative water resource options or demand reduction to ensure the supply-demand balance could be met.

Figure 5.8
Severn Trent Choice Experiment Using Sliders - Screenshot from UKWIR (2014)



Source: Severn Trent, reporting in UKWIR (2014)

5.5.2. Potential enhancements to customer engagement with the survey instrument compared to traditional SP methods

This approach is, in essence, a form of SP valuation experiment, since it uses a survey instrument that asks customers to make a trade-off between changes in service and the price they pay. However, in contrast to the traditional choice card approach, it has a number of potential advantages that could improve customers' engagement with the survey instrument:

- It has a more graphical interface, with animations and more interactive elements. This could improve customers' interest in the exercise, as well as their understanding and concentration, potentially making the resulting valuations more meaningful.
- Our experience from PR14 suggests some participants in SP exercises were reluctant to choose between alternatives that they deemed equally inconsistent with their preferences. For instance, some price-sensitive customers might be reluctant to choose between two alternatives that each involve improvements in service and an increase in the bill. This may cause them to become disengaged with the survey instrument. This approach described above could avoid this problem by allowing customers to select the level of service they want for all attributes.
- This approach could also reduce the complexity of the trade-offs customers are asked to make. For instance, on a traditional choice card (see Figure 5.1 above, for instance), customers are typically asked to choose between two packages with different service

levels and bill impact, with some services improving and others deteriorating. Choosing between alternative packages could place a substantial cognitive burden on consumers. This alternative approach may reduce cognitive burden, as respondents can select higher or lower levels of service for each attribute individually, allowing them to experiment to see the effects of higher or lower service on bills.

Of course, these enhancements to the valuation research programme are at this stage theoretical. We would recommend that some cognitive testing of this form of instrument should be conducted to test the extent to which it improves customers' engagement, understanding and concentration. In particular, there are a number of design choices that would be required in order to implement it, as we describe below. For instance, it would be informative to pilot this approach alongside a more traditional approach to get qualitative feedback to determine whether it helped customer understanding, whether customers made meaningful decisions, and whether respondents found evaluating the trade-offs a realistic exercise.

If these benefits can be verified through testing of this instrument, a potentially attractive element of this approach to valuation is that the valuation tool could be incorporated into Anglian's ongoing customer engagement efforts at relatively little ongoing cost. Anglian could simply put this tool on its website and periodically invite some/all customers to participate in it.

One potential downside of this approach is that it may embed the selection biases often associated with online surveys. Specifically, those less comfortable with using computer-based survey instruments could be deterred from participating in the survey. However, this downside could be addressed by supplementing this valuation tool with more traditional methods to access those customers less comfortable with such online valuation methods. It may also be the case that these instruments are challenging for the same customer groups as find traditional SP challenging, meaning there would be little disadvantage to this approach.

5.5.3. Obtaining valuations from customers' choices using the "slider" approach

As well as some cognitive testing, some development of this slider tool would also be required so that it produces data from which econometric analysis can be conducted to derive customer valuations.

Traditional SP exercises involve asking consumers to choose between two or more packages of service levels and bill levels (see Figure 5.1, for instance). By asking many respondents to make different trade-offs between bill and service levels, we can use statistical techniques (usually, logit modelling) to derive an implied demand, or WTP, for each service.

This slider tool works differently. Rather than asking customers to choose between two or more discrete packages, this approach asks customers to choose service levels for a range of attributes from a range options using a slider. As they choose better/worse service, the bill rises/falls. Hence, underlying the choice the customer sees is a vector of "prices" that define the change in the bill following a change in service.

By asking respondents to choose their desired levels of service using a number of different price vectors, we can use statistical techniques to derive an implied demand function for each service. Rather than the logit modelling required to derive valuations from discrete choice data, we envisage using linear regression to estimate demand curves from data on respondents' selected "demands" for each service, conditional on the prices they faced when making the trade-off. In essence, the "quantity" of service "a" customers demand (q_a) can be defined as a function of the price of this service attribute customers faced in the slider tool (p_a), as well as the prices of other attributes (denoted b, c and d), as follows:⁷⁴

$$q_a = \beta_0 + \beta_1 \cdot p_a + \beta_2 \cdot p_b + \beta_3 \cdot p_c + \beta_4 \cdot p_d$$

Rearranging this equation to state p_a as a function of q_a and the price of other attributes, gives the following, which is essentially a simple demand curve

$$p_a = A - B q_a$$

$$\text{where: } A = (\beta_0 + \beta_2 \cdot p_b + \beta_3 \cdot p_c + \beta_4 \cdot p_d) / \beta_1 \quad \text{and} \quad B = 1 / \beta_1$$

Then, the change in consumer surplus that comes from marginally increasing or decreasing service attribute q_a (ie. customers' marginal WTP for/accept changes in service) can be estimated by evaluating the integral of this formula over the range of service levels considered, here between X and Y:⁷⁵

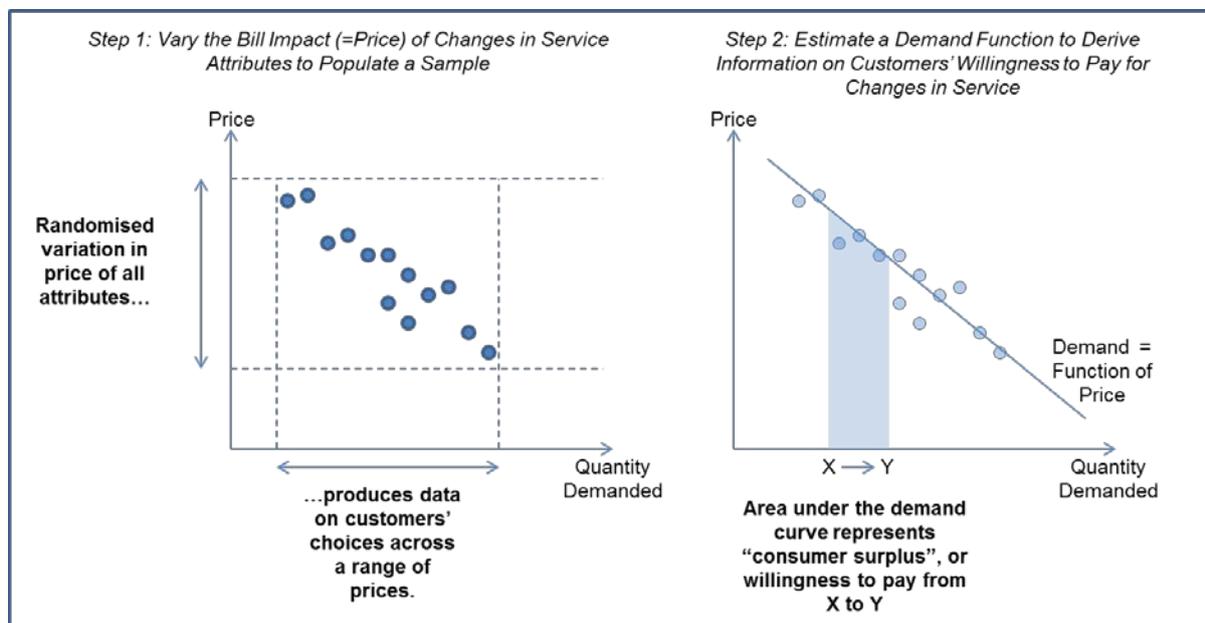
$$\int_X^Y [A - B \cdot q_a] dq_a$$

As Figure 5.9 illustrates in more graphical terms, the data required to estimate the econometric demand functions described in this section comes from randomly varying the prices (marginal change in bill following marginal change in service) customers face across the sample. (Hence, some assumptions will be required on a wide but plausible range of bill impacts that could arise from marginally changing service levels.) From this data, we estimate a demand function, and the area under the demand function represents the amount customers are willing to pay for an improvement in service, or the compensation they require for a deterioration in service.

⁷⁴ This example assumes a linear demand function, but this form of analysis could of course be expanded to consider other functional forms, and to incorporate attributes of the customer into the function, such that the resulting estimates of WTP for improvement would be a function of customer characteristics/demographic indicators (eg. age, income, statements declaring customers as being particularly concerned with particular topics such as the environment). You could also generalise this basic approach to derive valuations that account for any substitutability and complementarity between service attributes.

⁷⁵ Here, X and Y represent particular levels of the service attribute. For instance, they could represent changes in the probability of an interruption to service from 1-in-20 years to 1-in-30 years.

Figure 5.9
Illustration of How the Slider Tool Can Be Used to Derive Valuation Information



Potentially, this approach gives different, and better, information than SP discrete choice exercises. It allows us to estimate the entire demand curve for each attribute, by varying the price of marginal additions to the attribute (ie. by varying how much the cost changes when the respondent scrolls up a 1-unit higher level of the attribute.) For instance, one deficiency of discrete choice experiments (ie. traditional SP) is that it is not necessarily clear whether the resulting valuation represents a marginal or average valuation of service improvement, and in most applications it could be a mix of average and marginal, depending on how the levels are set. By contrast, this new “scrolling” exercise allows estimation of the whole demand curve (within the variation in prices used in the experiment), which allows us to calculate both marginal and average WTP at any point, thus providing more information to inform business/investment planning tools.

5.5.4. Managing the risks associated with this more innovative survey instrument

It is also important to bear in mind that we are only aware of a small number of previous exercises that have attempted to use this approach to engagement research in the water industry. It is important that Anglian bears this in mind when making valuation assumptions for business planning. In particular, there is a risk that respondents will not engage with the instruments as well as we believe they are likely to, or that the data does not allow us to derive valuations with an adequate degree of statistical precision. Also, because they are relatively innovative, we need to bear in mind that they do not have the same regulatory “buy-in” as established methodologies such as discrete choice based on the 2011 UKWIR guidance.

To mitigate these risks, we would not advocate relying on this approach as the sole valuation tool. Instead, we would suggest developing this tool as one calibration point for those

attributes of strategic importance (see Chapter 3), where triangulation of values across a range of valuation tools is required.

At the same time, it can be developed with a view to deploying it on a more continuous basis to create a time series of valuation information that can be used to track how customers' preferences change over time or in response to specific events, such as flooding incidents, economic up/downswings, hosepipe bans and other widespread restrictions on water use, and so on. While this approach may not be able to completely replace the use of traditional SP studies based on fully representative samples of the population, it provides a practical and relatively low-cost means of building a valuation time series that customers may (subject to testing) find engaging and informative.

5.5.5. Practicalities of developing a valuation tool using the “slider” approach

A number of detailed design choices would need to be made as part of developing and implementing this slider valuation tool:

- The graphics and animations would need to be designed in order to convey a realistic and meaningful sense of the changes in service that customers are being asked to make. Some cognitive testing would be needed to ensure that the images do not cause any “framing” bias to the respondent.
- The interface would also need to make clear the amount by which service and bill changes as the respondent moves the slider up or down. This could be achieved by placing the maximum and minimum bill and service changes at the top and bottom of each slider, for instance. If this information is not presented, customers could of course experiment to see what bill and service changes occur as the slider moves up or down, but this could impose a cognitive burden on customers, effectively requiring them to perform some mental arithmetic to make trade-offs between bills and service levels.
- This slider tool would need to be accompanied by the same sorts of introductory explanations that precede standard choice experiments, such as defining attributes, reminding customers that changes in service affect the bill and noting that bills may rise and fall for other reasons. Other introductory text may also be needed to ensure customers understand how to interact with the tool to make choices based on the “prices” associated with marginal changes in the service.

In practical terms, this valuation approach would require the design of a bespoke ‘app’ to reflect the investment categories of interest to Anglian, and its branding. We anticipate that the development of this tool will need to be a discrete project with a timeline of 8-10 weeks. As part of this work, Anglian would need to work with a team involving a web designer / programmer and a market research agency that can perform the required cognitive testing. Anglian (or the market researcher) would also need to work with an Econometrician to analyse the resulting data.

5.6. Presenting Information on Companies’ Relative Performance

As discussed further in Section 3.3.5, Ofwat has highlighted its intention to promote and enable an increased use of comparative information on company performance in the customer

challenge process at PR19.⁷⁶ The CMA Bristol Water determination also questioned whether customers who were asked about their WTP for service improvement would have answered differently had they known about Bristol Water's position relative to the industry.

One solution to this challenge would be to present customers with some information on how the level of service Anglian provides varies from that provided by other companies before asking them to complete a valuation questionnaire. However, in our view some considerable caution is required in the use of comparative information in customer engagement research. In particular, it is important to remember that it is not necessarily economically efficient for companies to provide the same level of service, as companies' respective customers will have different WTP for service changes, and they will also have different costs of service driven by regional factors such as topography, water resource endowment, and so on.

A possible counter to this argument, however, arises out of the behavioural economics literature. Conventional economic models typically assume customers' wellbeing ("utility") is defined by their own consumption of goods and services (including public goods they also enjoy such as environmental factors). Behavioural economics calls this basic assumption into question in a number of ways, including by observing that peoples' wellbeing (demonstrated through experiments, *inter alia*) is linked to their level of income or consumption of goods/services *relative to others*. In this case, there might be an argument for considering relative performance in valuation research, though we will need to make a careful review of the literature on this subject before drawing any firm conclusions on this point. In particular, while behavioural economics identifies problems with the conventional "neoclassical" economic model, its insights on improvements to policymaking in light of these problems are less clear cut and the subject of much academic debate.

Further, informing customers of the level of service provided by their water company and how this compares to the levels of service provided by others, could both add complexity to already challenging research instruments, and be extremely leading. One particular risk is that, presenting this information within the context of the survey would unduly emphasise the import of the comparison (and might suggest to respondents that the real goal of the exercise to evaluate the service level of their company relative to the services of others).

Some cognitive testing could be built into the research programme to test these effects, and if they are material, it may be better to address the challenge of using more comparative information at the CEF level. At the CEF, it will be possible to explain to members the reasons for differences in service across companies, and to engage in more informed discussions on the role of comparative information.

However, there is a risk that regulators consider this approach to accounting for comparative information as inadequate, given the potential for the CEF to be influenced by the views of the company. An alternative approach, therefore could be to adopt the same approach with customers as part of the process of acceptability testing. For instance, a part of this, you might consider holding deliberative events at which you present your business plan to customers, then ask their views on whether it is acceptable. Then, present the same group of

⁷⁶ Ofwat (May 2016) "Ofwat's customer engagement policy statement and expectations for PR19", p.10

customers with comparative information on the levels of service you provide relative to other companies and test how their responses change.

5.7. Making Greater Use of Online Survey Methods

5.7.1. Anglian's use of alternative survey methodologies

As part of developing valuation programmes for PR19, Anglian and other companies are considering whether their SP research should make greater use of online survey methods. In making the choice between survey methods, some care is needed, as there is a body of evidence which suggests the mode of the interview (face-to-face, online etc.) affects the estimates of WTP produced.

At PR14 Anglian used two survey modes, CATI (Computer Aided Telephone Interviews) and Online:⁷⁷

- CATI participants were recruited by a previous telephone call, in which a time for the CATI was agreed, and were sent show cards in advance. In the Main Stage study, 1,000 online participants and 1,000 CATI respondents was chosen as the target sample sizes for the residential survey, with 500 CATI respondents for the non-domestic survey.
- The CATI surveys included a proportion (10 per cent) of water only or wastewater only customers, meaning choice cards for these customers were restricted only to the services which they receive, while the online survey included only customers who receive both water and wastewater.
- Both online and CATI surveys used random sampling for recruitment of respondents. There were a number of differences in the demographic characteristics, both between surveys types and compared to the region as a whole. For instance, both surveys underrepresented younger age groups, but more so for the CATI than for the online survey. The online survey over-represented females at a ratio of 65:35 (compared to the population ratio of 51:49).
- The surveys proceeded in a standard order, beginning with screening and quota questions, followed by introductory questions on perception of current service levels, questions on service priorities (including the choice experiments to elicit WTP), follow up questions on motivation for these responses, and finally socio-economic and demographic questions.

The results showed a range of differences between the online and the CATI methods:

- The response to some follow up questions differed between the two survey samples. Respondents in the online survey were more sceptical about whether improvements presented in the choice experiments would actually be delivered, with significantly more replying “quite unlikely” or “very unlikely”, and significantly fewer replying “quite likely” or “very likely”.⁷⁸

⁷⁷ Eftec and ICS consulting (2012), “Anglian Water, PR14 Willingness to Pay Survey: Final Report”, p. 26 and Table 3.4.

⁷⁸ Eftec and ICS consulting (2012), Table 4.24.

- Respondents online appeared to find the survey more interesting than those who took part in the CATI (53.4 per cent compared to 33.4 per cent), and nearly twice as many found the CATI survey “difficult to understand” (11.1 per cent compared to 6.2 per cent).⁷⁹
- The WTP estimates from the CATI and the online surveys differed materially. The observations from the online survey were weighted to control for sampling differences, in age, gender and income, but “the results for weighted and unweighted models were found to be very similar”, and the WTP estimates of the weighted sample was not presented.⁸⁰
- The average WTP across all attributes emerging from the CATI sample was between 100% and 50% higher (depending on the modelling technique used) than the WTP results emerging from the online sample.⁸¹ Hence, there appears to be some systematic evidence that customers declared higher valuations using the CATI method.

5.7.2. There is limited industry guidance on appropriate valuation methodologies

There is limited industry-wide guidance on the choice between alternative survey methods, but recent publications do provide some insight into the trade-offs between these methods:

- The 2014 report by Blue Marble for UKWIR did not compare survey methods empirically, but notes the difference in valuations for attributes between companies, and suggests that differences in survey techniques could be contributing to these differences.⁸²
- The Blue Marble study also notes that some CCGs reported that acceptability scores gathered via online surveys differed substantially from those gathered using a CAPI method (Computer Aided Personal Interviewing).⁸³ Anglian’s own experience of systematic differences between online and face-to-face methods suggests this result also applies to WTP research.
- The Blue Marble study also notes that online surveys are less likely to deliver a representative sample, particularly as participation is self-selecting.⁸⁴ However, there are also potential participation advantages to online methods, as some customers might be less predisposed to participating in face-to-face than online research. Online may also be superior in reaching some categories of customers, such as those who are busy and less likely to be at home, customers who live in apartment buildings behind entry phone systems where researchers, and so on.

⁷⁹ Eftec and ICS consulting (2012), Table 4.25.

⁸⁰ Eftec and ICS consulting (2012), p.47.

⁸¹ Eftec and ICS consulting (2012), Table 4.31.

⁸² UKWIR (2014), “*Post PR14 Customer Engagement, Communications and Education*”, produced by Blue Marble, pp. 37-38.

⁸³ UKWIR (2014), “*Post PR14 Customer Engagement, Communications and Education*”, produced by Blue Marble, pp. 37-38.

⁸⁴ UKWIR (2014), “*Post PR14 Customer Engagement, Communications and Education*”, produced by Blue Marble, pp. 37-38.

- Blue Marble notes that the anonymity of online surveys is beneficial in that it can allow the addressing of sensitive topics, but it may also affect truthfulness (in that the ‘need to please’ an interviewer is missing), and encourage stronger negative responses.
- An HM Treasury guidance document on valuation research⁸⁵ is not prescriptive about which survey mode is appropriate for an SP study. It considers a number of survey-related biases relating to online techniques:
 - Interviewer bias can arise from face-to-face and telephone surveys, but this effect can be mitigated by well-trained interviewers;
 - Non-response bias can arise whenever individuals’ propensity to take part is determined by the extent to which they have strong opinions on the subject. Postal and online surveys are most at risk of this problem, while face-to-face interviews with participation incentives are least likely to carry this bias; and
 - Fatigue and frustration may arise in long survey formats, reducing the effort participants make to provide accurate answers. This problem is not specific to any survey methodology, but is easier to identify, and therefore potentially control for, with face-to-face interviews.

5.7.3. Recommendations

Overall, there are advantages and disadvantages associated with both online and face-to-face research methods. However, some of the downsides associated with online methods are probably reducing, as people become more and more active online and comfortable with computerised interfaces. Also, the choice of the most appropriate methodology probably depends on survey design. For instance, if Anglian adopts the “slider” approach then online is likely to be the best approach as most people would feel more comfortable on their own device.

On the other hand, surveys which require lots of reading (detailed cards, descriptions) are likely less reliable online. In a face-to-face survey the interviewer can hand a respondent a card and read or walk them through substantial portions of it, whereas in an online context respondents are likely to speed through reading text. You could consider creating a delay in the survey (so that a page will not progress until five or ten seconds has passed) which can encourage respondents to read, but this approach can also cause drop offs.

In this particular case, given the likely complexity of service attributes/levels, there would at least need to be some extensive testing of online instruments, possibly combining online research with face-to-face research to ensure some “hard to reach” groups are included. For instance, Anglian might consider testing more complicated online surveys using live chat/cognitive interview. You could also conduct some surveys with respondents completing the survey at home online, but with an interviewer present on the phone or view an online conferencing system like Skype.

⁸⁵ Fujiwara, D. and Campbell, R. for HM Treasury / DWP (2011), “*Valuation Techniques for Social Cost-Benefit Analysis: Stated Preference, Revealed Preference and Subjective Well-Being Approaches*”

5.8. Conclusions

As discussed in this Chapter, companies' PR14 SP research mostly applied the methods set out in the 2011 UKWIR guidance. Aside from the regulatory pressure to consider a wider range of valuation methods besides SP, experience from PR14 suggests there is scope to simplify the PR14 research methods in order to improve respondents' comprehension and thus the reliability of valuation results. This chapter has set out a range of options for improving on the "traditional" SP approach, including:

- Simplifying the presentation of service levels and attributes, although we note that the methods used by Anglian at PR14 were significantly simpler than those used by the wider industry. However, a particular issue with the SP instruments used by most companies (including Anglian) relates to the presentation of probabilities on SP instruments. At a minimum we recommend testing of alternative units and presentations of service attributes before launching new SP valuation research at PR19;
- One option for simplifying the traditional SP approach would be to use a "max-diff" approach, though we recommend this should be subject to cognitive testing to demonstrate whether it results in a material improvement to respondents' experience. It may be that simplifying the presentation of attributes and service levels is a more important step towards improving the instrument than simplifying the nature of the trade-off they face using the max-diff approach;
- Another option would be to both simplify the list of attributes customers face and make the survey more interactive using the "adaptive choice" method, which we have seen used in some pharmaceutical research applications. However, further work would be needed to develop and test this approach;
- The "slider" method also has promise as more interactive/engaging research tool, and could be run alongside a more traditional SP valuation survey. It could also be used after the PR19 process as a way of gathering data on customer preferences in a more continuous way than is possible at present; and
- Another possible improvement to SP instruments could come from inclusion of more comparative information on firms' relative performance, which is a suggestion emerging from (inter alia) the CMA Bristol Water process. However, we have concerns about the effect of including information on relative performance in SP instruments. At a minimum, this approach would require very extensive testing to assess how respondents react to this information.

This chapter also considers alternative survey methodologies (face-to-face vs. online, etc). It discusses the advantages and disadvantages of increasing the emphasis on online methods, but concludes that (at least) some element of face-to-face should be retained in order to reach less accessible groups. However, the survey methodology also depends on the type of survey instrument: for instance, more interactive instruments like the "slider" approach may be better-suited to online methods. Also, given the Anglian PR14 research suggests online research produces materially lower valuations, online research could also be seen as a lower risk method, if Anglian wishes to avoid overstating the economically efficient level of service provision to avoid large reductions in expenditure allowances through the price review.

6. Developing a PR19 Valuation Strategy

In this chapter, we develop our recommended societal valuation strategy for Anglian Water at PR14, drawing on the assessment of each service attribute's relative importance in Chapter 3, our appraisal of potential valuation methods for each type of attribute described in Chapter 4, and our suggestions for improving SP methods described in Chapter 5.

6.1. Defining a Strategic Framework

6.1.1. Process for selecting required valuation methods

Based on the findings from previous sections, we have defined a Societal Valuation Framework (SVF), which maps each of the attributes that require a valuation for the development of the WRMP and the wider Business Plan at PR19 to a set of recommended valuation studies. Our recommendations are based on the following considerations:

- *Assessment of Strategic Importance.* Based on the findings from Section 3.1, illustrated in Figure 3.3, we have assessed the importance (“high”, “medium” or “low”) of each attribute of service around four dimensions:
 - 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.
- *Candidate Valuation Methods.* Based on the findings from Chapters 4 and 5, we assess each of the identified methods available for each attribute, and we determine their appropriateness based on the strategic importance of the attribute (which determines proportionality) and the feasibility of the method. These methods include:
 - SP, based on suggested improvements and innovative techniques;
 - the use of ongoing customer information to obtain valuations and insights on their preferences, including the use of social media analysis and analysis of insurance payouts;
 - RP, such as the “travel costs” method and “avertive” behaviour or hedonic pricing techniques; and,
 - BT from past valuations and other available sources.

Based on this assessment, we draw our recommendations on the specific valuation programmes (and corresponding deadlines) in which each of the attributes may be included, and how to derive the valuation assumptions for that attribute, eg. whether triangulation is needed, and if so, how this should be undertaken.

We have also taken into account any specific requirements related to the valuation of the attribute, such as the internal deadline when the valuations are needed, or any specific aspects

of the attribute that require special attention (such as duration of the incident, or the type of customer/ property affected).

Note, this framework sets out the valuation evidence we have recommended Anglian obtains, as organised by the valuations required by the business. As part of each of the valuation studies, it will be important to consider the appropriate units in which to present service attributes to customers, and how complex attributes should be explained. We discuss this challenge further in Section 5.2 with reference to potential improvements to SP techniques.

6.1.2. The example of resilience

Figure 6.1 shows how we have applied this framework to assess, and develop our recommendations on, the societal valuation strategy for drought resilience. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of drought resilience in the WRMP and business planning process. As the figure shows, we identify this area as an important strategic priority against all the criteria identified in Chapter 3, so we show red lights against each of them in the figure.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value drought resilience. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

In this case, the relative importance of the drought resilience attribute means that we recommend deploying a relatively large number of valuation techniques through a series of studies. Then, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to identify as robustly as possible a lower bound valuation for resilience. This reflects the assumption, which will need to be tested as the business planning process progresses, that the economic value of drought resilience is high relative to the costs of the schemes Anglian is considering.

Also, given the short timeframe over which the drought resilience attributes need to be valued, we have suggested that it may be necessary to draw primarily on existing evidence to value drought resilience in preparing the draft WRMP (such as from the recent Water UK study on drought resilience), then provide new evidence to test/support this assumption later in the programme.

6.1.3. The example of persistent low pressure

Figure 6.1 shows how we have applied this framework to recommend a valuation strategy for a relatively important attribute. By contrast, Figure 6.2 shows how we have applied it to a relatively low priority attribute: persistent low pressure. While this attribute has been identified at PR14 as a stakeholder priority, which would normally justify acquiring a relatively sound/broad basis of valuation evidence, in this case we understand that the company is now part way through an investment programme to address the problem. Moreover, the costs per household to improve service are materially less than the likely value that would emerge from a valuation programme.

Therefore, we have recommended that BT evidence (ie. by inflating PR14 values) should form the basis for the PR19 valuation. We present the application of this same framework to the remaining service attributes in Appendix D.

Figure 6.1 Societal Valuation Framework Applied to Drought Resilience

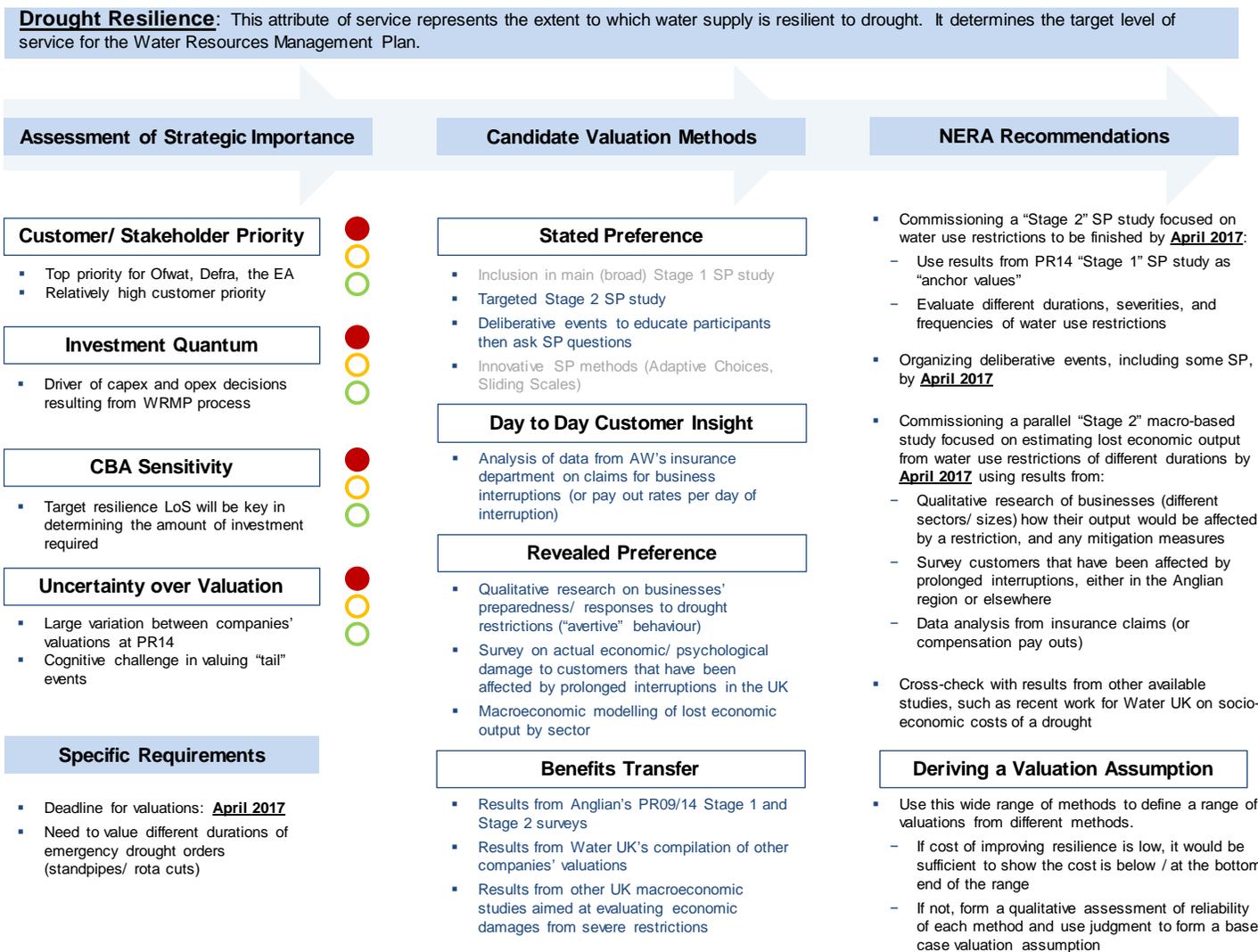
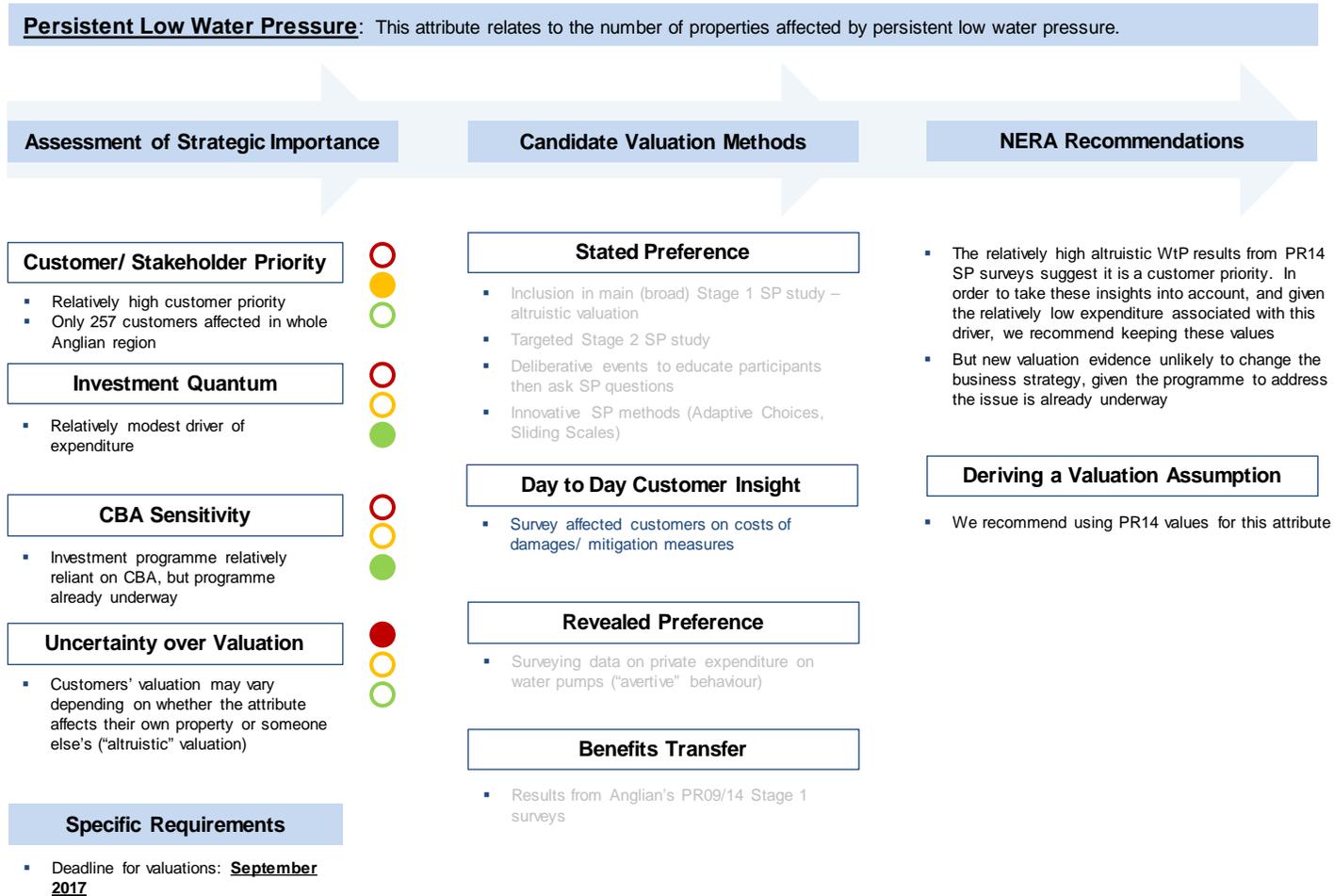


Figure 6.2 Societal Valuation Framework Applied to Persistent Low Pressure



6.2. Mapping Anglian's Attributes of Service to Recommended Valuation Research Studies

Drawing on our recommended valuation strategy for each attribute described above and shown in more detail in Appendix D, we have identified a defined set of valuation studies (and associated deadlines) that we recommend Anglian undertakes in the lead up to PR19.

Table 6.1 and Table 6.2 show the attributes of service to be covered by each recommended study, as well as the deadline for which valuations are needed in each case.

Table 6.1
Mapping of Attributes of Service to Recommended Studies (Part 1)

Research Package:	Main "Stage 1" Stated Preference	"Stage 2" SP on Resilience	"Stage 2" SP on Options	"Stage 2" on Output Loss	Broad "Sliding Scales" SP	"Sliding Scales" on Options	Deliberative Workshops	Complaints/ Social Media Analysis
Brief Description:	Improved broad SP	Improved SP focused on restrictions/interruptions	Improved SP method controlling for other factors	Macro study (based on findings from other studies)	Laying grounds for ongoing research	Laying grounds for ongoing research	Educating respondents, then ask SP	Analysis of customer data "warehouse"
Deadline:	Aug 2017	Apr 2017	Jun 2017	Apr 2017	Aug 2017	Jun 2017	Aug 2017 (*)	Aug 2017
Attributes Covered:								
Drought Resilience		✓		✓			(*) Apr 2017	
Resilience to Others	✓	✓		✓			✓	
Supply Interruptions	(x2)	✓		✓	✓			✓
Demand Mgmt. Strat.			✓			✓	(*) Jun 2017	
WR Options								
Wastewater Solutions			✓				✓	
WRC Growth								
River Water Quality	✓				✓		✓	
SSSI Habitats and Recreation Sites								
Sewer Flooding	(x2)				✓			
Water Flooding	✓							
Customer Contacts							✓	✓
Water Quality Notices	✓				✓		✓	
Discolouration; Taste&Odour	✓				✓		✓	
Water Hardness								
Carbon							✓	
Odour and Flies	✓							
Coastal Waters	✓							
Low Pressure								
Traffic Disruption	?							✓
Others								

Source: NERA

Table 6.2
Mapping of Attributes of Service to Recommended Studies (Part 2)

Research Package:	Survey to Customers Affected	Data Analysis of Insurance Compensation	“Indirect” Hedonic Pricing	“Travel Costs” RP Research	Assessment of Externalities	Ecosystem Services Assessment	BT from PR14/PR09 and Others
Brief Description:	On costs of damage/mitigation measures	Collect data and analyse if feasible	Interviewing estate agents on house price effects	Lay grounds for ongoing surveys to visitors	Then decide whether further research is needed	Qualitative, then monetise where possible & proportionate	Adjustment/adaptation/translation
Deadline:	Aug 2017 (*)	Aug 2017 (*)	Aug 2017	Aug 2017	Feb 2017	Feb 2017	Aug 2017
Attributes Covered:							
Drought Resilience	(*) Feb 2017	(*) Feb 2017					✓
Resilience to Others	(*) Feb 2017	(*) Feb 2017					✓
Supply Interruptions	(*) Feb 2017	(*) Feb 2017					✓
Demand Mgmt. Strat.							✓
WR Options					✓	✓	✓
Wastewater Solutions					✓		✓
WRC Growth					✓		✓
River Water Quality			✓	✓		✓	✓
SSSI Habitats and Recreation Sites			✓	✓			✓
Sewer Flooding	✓	✓	✓				✓
Water Flooding	✓	✓	✓				✓
Customer Contacts				(opp. cost of time)			✓
Water Quality Notices	✓						✓
Discolouration; Taste&Odour	✓						✓
Water Hardness							✓
Carbon							✓
Odour and Flies	✓		✓				✓
Coastal Waters				✓		?	✓
Low Pressure	✓						✓
Traffic Disruption	✓			(opp. cost of time)			✓
Others							✓

Source: NERA

Below we group these studies into five different work packages. We describe in more detail each of the studies in the sections below.

6.2.1. Work Package 1 – Main Study

This work package includes the main research programmes that will cover a broad range of attributes, combining a wide range of methods, such as stated preference, revealed preference and benefits transfer. The studies included in this work package are:

- *Main “Stage 1” SP Study.* We recommend that Anglian conducts a broad SP study, covering a range of the most important attributes from across the business. By incorporating a broad range of attributes of service, it will be possible to “tease out” an understanding of how customers consider the trade-offs between each of them and the effect on bill levels. We recommend following a similar methodology to Anglian’s main “Stage 1” SP study at PR14, but incorporating the suggested improvements in the presentation of attributes and service levels described in Section 5.1 and 5.2.
- *Developing a “Sliding Scale” SP Tool.* As a means of triangulating valuation evidence from a range of sources, we recommend valuing a selection of attributes using a new

interactive tool based on the Anglian “decider slider” from PR14. This will allow Anglian to contrast the valuations emerging from the relatively traditional SP survey and this new valuation method. As this development stage, we recommend that this tool is used to examine the value of those attributes of service it is relatively straightforward to explain to customers.

Once this tool has been developed and thoroughly tested, the incremental cost of each new respondent is minimal. Therefore, this tool could be used more frequently than once in each price review, thereby building up a continuously growing database of time series results that could be used in future price reviews. This would also allow Anglian to test how customer preferences change over time and in response to events.

- *Data Analysis of Insurance Compensation.* For a number of attributes, it may be possible to derive valuation information from insurance market data. For instance, it may be possible to obtain data on the levels of business interruptions insurance companies take out to value supply interruptions. It may also be possible to obtain valuation information from data on insurance claims and actual pay outs after past incidents that cause damage to property.
- *“Indirect” Hedonic Pricing Study.* This RP study would be based on interviews with estate agents aimed at providing insights (and quantifying if possible) on the observed house price effects of certain aspects of service, such as the effects of sewage treatment plant odour. This represents an attempt to address the challenges typically experienced when conducting hedonic pricing studies with house price data, as it would be difficult to tease out water and wastewater service impacts from other drivers of price differences.
- *“Travel Costs” Research Study.* This RP study would be based on interviews to visitors of environmental sites, who will be asked for details on the time and money spent to arrive to the site. This information, along with data on total number of visits to the site, will be used to estimate the recreational value of the place. We recommend undertaking these surveys on an ongoing basis where possible, eg. by placing tablets in the cafés of Anglian’s water parks.
- *BT.* For all attributes of service, we recommend triangulating/cross-checking the results obtained from the methods described above with the results from sources readily available. These sources may include the valuations used by Anglian and/or other companies at PR14, as well as the results from other published studies, eg. government guidance, academic papers, or industry-led studies such as the recent Water UK study which evaluated the societal costs of a drought for a range of stakeholders. Rather than a specific study, this may need to be an ongoing programme of work conducted by Anglian in parallel with the broader valuation programme, that cross checks new valuation evidence with that emerging from the range of studies listed above.

However, we also recommend that valuations from previous pieces of research are inflated for changes in market data. Most often, it will be sufficient to update previous estimates based on changes in general inflation (eg. CPI/RPI), but in some cases there may be other market indices or new government guidance from which it is possible to update previous estimates. For instance, amongst other things, we recommend that Anglian obtains latest government guidance on the social cost of carbon and other environmental externalities, and new market evidence on the price of shellfish.

6.2.2. Work Package 2 – Wellbeing and Day-to-day

Rather than standalone research programmes, this work package includes those workstreams that will be conducted on an ongoing basis, aimed at collecting, analysing and obtaining insights for societal valuation from a range of sources of continuous information on customers' satisfaction with Anglian's services. The package includes the following workstreams:

- *Complaints and Social Media Analysis.* The societal valuation programme ideally needs to be closely linked to Anglian's wider programme of engaging with its customers. In particular, as new means of engaging with customers emerge (eg. social media) it may be possible to take more from it in order to support Anglian's valuation work. For instance, it may be possible to use this data to better identify customer priorities, to improve the calibration and design of SP exercises, or to inform avertive behaviour and other RP valuation techniques.

We therefore recommend that Anglian's research programme includes a programme of work to analyse information that Anglian is currently gathering in the "Customer Views Data Warehouse", which incorporates all the information from day to day customer information (eg. Twitter posts, customer contacts, internet forums) in one single platform. For some attributes, this platform contains information on self-reported damage costs and mitigation measures from affected customers, which can be used for a bottom-up valuation of the consequences of an incident. Valuations emerging from this approach are likely to represent understatements of the value that customers place on avoiding service problems, as they ignore factors such as inconvenience effects, but they may be helpful in identifying a bottom end of the valuation range as part of work on triangulation.

- *Surveys to Customers Affected by Service Failures.* Similar to the complaints and social media analysis, this research programme at identifying the self-reported damage costs customers associate with water service failure, and identifying the mitigating measures they take, which can be used for a bottom-up valuation of the consequences of an incident. However, the method of obtaining this information will be slightly different, since it will be based on proactive contacts to customers that have been affected in the past (in Anglian's region and potentially in other regions). We also recommend establishing this practice as a common procedure, to be undertaken in an ongoing basis every time there is an incident in Anglian's region. However, valuation evidence emerging from this type of research would need to be interpreted with care, as customers who have experienced problems may be inclined to overstate the consequences of service failure, for example if they believe they think they can influence the water company in taking measures to improve their own (potentially relatively poor) level of current service.

6.2.3. Work Package 3 – Water Resources Management Plan

This work package includes those studies that will be aimed specifically at obtaining the societal valuations needed for the development of Anglian's WRMP. The package includes:

- *"Stage 2" SP Study Focused on Resilience.* We recommend that Anglian conducts an SP study targeted at evaluating different durations, severities, and frequencies of water use restrictions and supply interruptions. It will be aimed at estimating the "curve" that defines the relationship between duration and customer's willingness to pay, potentially

depending on the type and the cause of the incident. It should also allow Anglian to understand the different effects on customers from expected as opposed to unexpected prolonged water use restrictions, which will allow valuation of measures aimed at improving resilience to catastrophic events as well as resilience to drought.

- *“Stage 2” SP on Investment Options.* As well as the levels of service provided to customers, there is some evidence that customers have preferences (that can be valued) regarding the means by which Anglian delivers those service outputs. In particular, customers may have preferences for alternative water resource options, or for alternative wastewater capacity solutions. This SP study will be targeted at evaluating customer preferences between these options “for their own sake”. As discussed in Section B.4 in Appendix B, this research will need to control for changes in those service attributes that customers may associate with each option so that Anglian can identify the value placed on these alternatives “for their own sake”, not a value reflecting customers’ (possibly incorrect) assumptions about the effects of alternative options. An example is shown in Figure B.4 that seeks to value alternative water resource options.
- *“Sliding Scale” SP Tool Focused on WRMP Options.* The “sliding scales” tool, developed as part of Work Package 1, could be extended to value customers’ preferences for alternative water resource supply/demand options, by inviting customers to choose how to balance supply and demand interactively (and also controlling for the attributes of service that customers could associate with these options).
- *“Stage 2” Study on the Value of Output Lost by Non-Domestic Customers Due to Restrictions or Supply Interruptions.* This study will be aimed at estimating the loss of economic output caused by water restrictions and supply interruptions of different durations and severities. It will draw on Gross Value Added (GVA) data by economic sector at the regional level, and apply a set of assumed percentage losses for each scenario considered. To increase the robustness of this method compared to previous applications (such as in a recent study for Water UK on resilience), it may be beneficial to survey business customers across a range of sectors to better account for the proportion of economic output that would be lost when restrictions occur. It may also be possible to broaden this study to gather BT evidence from previous studies, or to survey customers (either inside or outside the Anglian region) that have been affected by service failures in the past. We also recommend investigating whether valuation evidence can be drawn from the business interruption insurance market.
- *“Deliberative Workshops”.* Some attributes (particularly resilience and alternative water resource management options) are challenging to estimate through SP. We therefore recommend holding a number of deliberative events aimed at educating a small number of customers on the detailed implications and trade-offs around some specific attributes of service, after which respondents will be asked to express their preferences for different levels of service by participating in an SP exercise.

6.2.4. Work Package 4 – Environment

The valuation programme described in this chapter has, to a large extent, envisaged the need to value a range of environmental attributes of service.

However, in addition to the programme of research we have set out, and as described in Section 3.2.5, Anglian will need to conduct a detailed assessment of each water resource

option in order to identify the specific social and environmental impacts associated with each option. Once this work to identify environmental impacts has concluded, there will be a need to check that the valuations delivered through this programme of work will be sufficient to value the specific impacts identified.

This research to identify environmental impacts will also be necessary to implement the “Ecosystem Services” approach, which provides a framework to evaluate the value of an ecosystem interpreted as an asset for the society, as part of the country’s “Natural Capital”. The framework categorises the benefits of an ecosystem for society into four types of service: supporting, provisioning, regulating and cultural (see Section B.5.3.6). We recommend using this framework to identify the environmental impacts associated with relevant investment programmes, then quantify and monetise only where feasible and proportionate using the outputs from the research programme set out above, BT (or new valuation research if the available sources are not sufficiently robust).

6.3. Interactions with Other Programmes of Research

6.3.1. Interactions with the CBA modelling

As described in Chapter 3, a key criterion for targeting the valuation research to ensure the effort and cost expended is justified by the benefits it delivers, relates to its relative importance to the CBA programme. In particular, we have worked with Anglian in-house experts to form a view on those valuations and service attributes for which the strongest evidence base is needed to support the PR19 business plan, either due to the quantum of expenditure or the sensitivity of CBA outcomes to changes in the societal valuation.

While this analysis provides a good starting point for targeting the valuation programme effectively, and also meeting the regulatory requirement that the engagement and valuation programme be proportionate, it was based on a mix of expert judgment and sensitivity analysis from the PR14 CBA modelling. We therefore recommend that, to the extent possible, Anglian keeps under review (ie. throughout the PR19 business planning process):

- The impact of marginal changes to the valuation results that emerge from the PR19 valuation programme on the outcomes of CBA models; and
- The areas where it proposes (as a result of the CBA analysis and any other changes in circumstances, such as new regulatory requirements) to spend relatively large amounts of capital or operational expenditure to improve or maintain service quality.

For this reason, it will also be important to ensure that Anglian leaves open the possibility to adjust the valuation programme to target new areas where we have not (at the time of writing) envisaged that valuation evidence will have a significant role to play in formulating the valuation programme.

6.3.2. Interactions with the wider PR19 customer engagement programme

As well as ensuring alignment (through some degree of continued iteration) between the CBA and valuation programmes, it will be similarly important to ensure alignment with the wider customer engagement programme. Within the context of preparing the business plan, we see the role of the qualitative engagement programme as identifying the needs and

priorities of customers, which Anglian then aspires to address as closely as possible where there is an economic case for doing so. Hence, the prioritisation of attributes in Chapter 3 also considers whether each attribute represents a customer/stakeholder priority, but based on the findings from qualitative research from PR14. We recommend that Anglian keeps under review the range of attributes customers prioritise, as findings from the PR19 engagement research emerge, and ensures that the valuation programme continues to target a proportionate amount of effort on these areas.

6.4. Meeting Emerging Regulatory Challenges

6.4.1. Triangulating valuations from a range of sources

As explained in Section 3.3, Ofwat has encouraged companies to derive the societal valuation assumptions used in their business plan from a range as wide as possible of different methods and sources, in order to increase the robustness of the results. Ofwat refers to this concept as a “triangulation” process.

For each attribute covered in Appendix D, we have suggested the most appropriate means to undertake this “triangulation” process. For instance, in the case of drought resilience, where the cost of the schemes that Anglian is considering is likely to be lower than the societal valuation, we have recommended drawing on the outputs from a series of studies to identify as robustly as possible a lower bound valuation.

For other attributes where this assumption is less clear, we have recommended drawing on a qualitative assessment of the reliability of the outputs from each source of evidence. This will enable Anglian to identify a “central estimate” using relative weights for each valuation assumption, as well as a set of valuation ranges around this estimate, with increasing different degrees of confidence, to inform sensitivity analysis.

In general, there is limited scope for planning a precise triangulation process for each attribute. The exact procedure will depend on the outcomes from each study, and will require expert assessment of the results and their interaction with the CBA process.

Therefore, the key of the success of the process will be to ensure communication and iteration between the relevant internal teams all throughout the process. This will need to be supported by a pragmatic use of valuation ranges to assess the strength of evidence underpinning particular investment and/or operational programmes, and to incorporate the resulting level of uncertainty over the economic case for including them in the PR19 business plan.

6.4.2. Ensuring Anglian’s engagement and valuation programme continues to innovate

Ofwat has also encouraged companies to take risks and test innovative valuation techniques. However, it has also emphasized the need for proportionality of the programme. While developing our recommendations for Anglian’s societal valuation strategy, we have kept these recommendations in mind, by suggesting the incorporation of further innovative techniques in the programme where most relevant and aligned with Anglian’s strategic priorities.

For most of the attributes covered in Appendix D for which our strategic assessment has highlighted a high (or medium-to-high) stakeholder and/or business priority, we have recommended the use of a wide range of alternative methods to the more traditional SP techniques, such as data analysis of insurance claims and actual compensations, the “travel costs” method, and costs of damages estimation based on surveys to affected customers and market data.

We have also suggested new methods to evaluate some attributes such as “indirect” hedonic pricing, which consists of estimating house price effects of service failure drawing on interviews to estate agents, as opposed to market data. Furthermore, we have proposed the use of an innovative technique to estimate the value of lost economic output from supply interruptions and water use restrictions of different durations, drawing on macroeconomic data and thorough qualitative research on the effects of water shortage for each industry type.

Finally, we have also recommended a number of improvements to the traditional SP techniques, along with the use of a more innovative interactive SP instrument based on the use of “sliding scales” as opposed to “choicecards”. With this method, the consumer will be able to tailor its preferred level of service for each attribute simultaneously, based on the consequent increases/decreases in price. Subject to rigorous cognitive testing, this method is likely to improve the experience of the respondent, thereby mitigating any risks of bias or misunderstanding of the exercise.

6.4.3. Establishing the basis for more ongoing valuation research in the future

Ofwat has recommended companies to explore a wider use of operational data from day-to-day customer interaction. It has also encouraged companies to pursue valuation research on an ongoing basis over the course of price reviews, as opposed to considering it as a “one-off” project for each business plan.

Following these recommendations, we have considered the scope for use of ongoing research for each of the attributes covered in Appendix D. For some attributes, we have recommended the use of Anglian’s customer views data warehouse to extract information on self-reported costs of damages or impact mitigation measures taken by customers. This data warehouse, which forms part of Anglian’s wider engagement programme, will compile ongoing information from different customer contact points (eg. Twitter, internet, customer calls, etc.).

We have also recommended the incorporation of short targeted surveys in Anglian’s already existing protocol of proactively contacting affected customers after some types of incidents. These questions will be designed to extract information about factors that influence customer valuation (eg. duration, time of the day, frequency, etc.) and the sensitivity of valuations around them, as well as about self-reported costs of damages or impact mitigation measures taken by customers.

Furthermore, we have recommended undertaking some of the innovative valuation programmes on an ongoing basis over the course of PR19 and subsequent reviews, with the aim of laying the grounds for the development of a continuous time series database of customer valuations over time. Programmes for which we have suggested this practice

include the “sliding scales” SP instrument, the collection and analysis of insurance data, or the surveys to visitors underlying the “travel” costs method.

6.5. Timetable for Delivering Valuation Research

The deadlines for each of these studies may vary depending on the attributes of service that they cover. While most of the valuations used for the development of the Business Plan will be needed by September 2017, the valuations on resilience and water resource options will be needed by April 2017 and June 2017 respectively, as described in more detail in Section 3.2.6. To align with these internal requirements, Figure 6.3 illustrates our proposed schedule for the valuation research programme recommended above.

Figure 6.3
Indicative Gantt Chart for the Recommended Valuation Research Studies for PR19

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Work Package 1 - Main Study								
Main "Stage 1" Stated Preference								Δ
Developing Broad "Sliding Scales" Innovative Stated Preference					Δ			
Data Analysis of Insurance Compensation								Δ
"Indirect" Hedonic Pricing								Δ
"Travel Costs" RP Research								Δ
BT from PR14/PR09 (incl. other companies) and Updating Market Evidence								
Work Package 2 - Wellbeing & Day-to-day								
Social Media / Complaints Analysis								
Surveys to Customers Affected								
Work Package 3 - WRMP								
"Stage 2" SP Study on Resilience/ Supply Interruptions					Δ			
"Stage 2" Macro-Based Study on Resilience					Δ			
Deliberative Workshops					Δ			
"Stage 2" SP on Water Resource Options							Δ	
"Sliding Scales" on Water Resource Options							Δ	
Work Package 4 - Environment								
Assessment of Externalities of Options/WRC System Failure		Δ						
"Review Point" of SVF Strategy			Δ					
Further Primary Research (if Necessary)						Δ		Δ
Ecosystem Services Assessment (Qualitative)		Δ						
"Review Point" of SVF Strategy			Δ					
Monetisation of Attributes (if Possible and Proportionate)						Δ		Δ
Work Package 5 - Direct Procurement								
Further Primary Research (if Necessary)								
Synthesis Report								
Interactions with Other Workstreams								
Review Emerging Findings from Qualitative Research on Priorities		Δ						
"Review Point" of SVF Strategy			Δ					
Continuously Review Interactions Between CBA and Valuation Workstreams								

Source: NERA

Finally, Table 6.3 below sets out the rationale for the timing and sequencing of the valuation projects in each of the work packages, as presented in Figure 6.3 above.

Table 6.3
Rationale for the Sequencing and Timing of the Recommended Valuation Studies

Work Package	Comments on Recommended Timing
WP1 – Main Study	<ul style="list-style-type: none"> ▪ The internal deadline for the valuations required for the business plan is September 2017 (except from those also needed for the WRMP, which we address in Work Package 3). In order to allow some time for “triangulation” of the results with other sources, we recommend finishing the Main Stage SP by August 2017 – preferably with emerging results ready by July 2017. ▪ The Main Stage SP study will cover a broad range of attributes. We recommend Anglian to incorporate in this study the improvements and prior cognitive testing described in more detail in Chapter 5. Therefore, we recommend allowing a period of 6 months to ensure a rigorous development of the project. ▪ Parallel to the Main Stage SP study, the programme will include a more innovative interactive SP instrument based on “sliding scales” (see Section 5.4). Since the tool will be in its early development phase, and delivered on an ongoing basis, its findings will be most useful in future price reviews. However, we recommend finishing the development phase by May 2017, in order to be able to incorporate some initial research findings in the “triangulation” process for PR19. ▪ Along with the findings from SP research, we recommend triangulating the results with findings from alternative methods such as RP and BT, where appropriate. In order to benefit from synergies, for each research programme we recommend covering all attributes included in the study at the same time. Values will be needed by August 2017, to allow some time for “triangulation” of results.
WP2 – Wellbeing and Day-to-day	<ul style="list-style-type: none"> ▪ Our proposed valuation programme will also include ongoing collection and analysis of data from Anglian’s day-to-day interaction with customers, such as customer contacts, social media posts, and proactive contacts with customers affected by service failure. ▪ Emerging findings from the duration of the programme will be included in the “triangulation” process for the relevant attributes.
WP3 – WRMP	<ul style="list-style-type: none"> ▪ The WRMP timetables require a resilience attribute to be prepared early in 2017. While it will not be possible to have a valuation from the Main Stage SP research by then, we have recommended embarking on an early and substantive research effort focused on resilience. ▪ This programme includes a “Stage 2” SP study focused on resilience and interruptions attributes, in parallel with deliberative workshops focused on resilience and alternative demand-side/water resource options, and a study using macroeconomic and insurance data to examine the economic consequences of prolonged restrictions for

	<p>non-domestics.</p> <ul style="list-style-type: none"> ▪ The aim is for these studies to be completed by the end of April 2017, though we also recommend drawing information on the value of resilience from the subsequent “Main Stage” SP report. Hence, the value of resilience may need to be cross-checked against this later study. It will also be possible to use BT evidence from the recent study for national study on resilience for Water UK and from Anglian’s PR14 research. ▪ We further recommend undertaking an additional “Stage 2” SP study targeted to water resource options (as well as wastewater solutions), using the improved methodology described in Section 4.2.4. Given the importance of water resource options, we recommend developing also a parallel “sliding scales” tool targeted to this attribute. In order to be able to meet the WRMP timelines, the emerging findings from both studies need to be available by June 2017.
WP 4 – Environment	<ul style="list-style-type: none"> ▪ As part of the valuation programme, Anglian will need to undertake a rigorous qualitative assessment in order to thoroughly identify the externalities associated with certain complex attributes. These externalities will mostly relate to environmental impacts, but may as well include other impacts such as noise or traffic disruption. ▪ These workstreams may identify the needs for further primary research currently not included in the programme. In order to allow sufficient time to undertake this additional research, we recommend undertaking a review of the societal valuation framework based on the new findings by March 2017.
Interactions with Other Workstreams	<ul style="list-style-type: none"> ▪ Anglian will obtain emerging findings from the wider customer engagement process, which will update its understanding of customer priorities. In order to allow sufficient time to incorporate these findings into the design and implementation of the other work packages, we recommend undertaking a review of the societal valuation framework based on the new findings by March 2017. ▪ With regards to the interactions with the CBA process, we recommend ongoing iterations between the relevant internal teams all throughout the programme in order to ensure that the two processes align correctly.

Source: NERA

7. Conclusions

This report, intended to support Anglian's programme of work to deliver the societal valuations required for the PR19 business planning process, reviews the range of customer valuation techniques that could be deployed to deliver the required valuations, and develop a strategy for the appropriate application of those methods to deliver the required societal valuations.

To meet these objectives, we have drawn on a range of evidence, including a review of the PR14 valuation programme undertaken by both Anglian and the wider industry. We have also conducted a review of literature to identify appropriate valuation methods, held detailed discussions with Anglian in-house experts to identify evidence on strategic priorities for the upcoming price review, and assessed a range of statements from regulators on upcoming priorities.

7.1. Review of the PR14 Valuation Programme

Our review of the PR14 engagement research suggests that Anglian's customer valuation and engagement programme was largely successful. Ofwat's risk based review also recognised the strength of the engagement programme, suggesting it was deemed to be more extensive and/or higher quality than 'the average company' at PR14.

Similarly, it is important to note that some of the problems identified with the wider industry's valuation programme do not necessarily apply to Anglian to the same extent as other companies. Notably, its SP instruments were less complex than some and this complexity is the root of much of the criticism levelled at the industry's PR14 SP research.

However, as Anglian has recognised in its internal reviews, there is still an opportunity for improvements to be made for the PR19 valuation programme. These include the need to build stronger links with ongoing customer engagement, the value of using a wider range of methods to evaluate each attribute through a process of "triangulation", and the need for greater coherence with the WRMP process. This is in line with the emerging regulatory challenges for PR19, and various retrospective reviews of the wider industry's PR14 valuation research.

7.2. Review of Strategic Priorities

Following this review of the PR14 valuation programme, we have also reviewed the range of strategic priorities that will be relevant to the design of the PR19 societal valuation programme. As part of this work, we have considered the reasons why a certain attribute of service may represent a strategic priority for Anglian. For instance, a particularly robust basis of valuation evidence will be required to support the WRMP and the wider PR19 business plan where:

- Improvements to (or maintenance of) current levels of service are driving a significant volume of investment or operating expenditure;
- It has been identified as a customer or stakeholder priority. A notable example of an attribute meeting these criteria is the value of resilience required for the WRMP; or

- Changes in the valuation assumption of an attribute materially change CBA outcomes.

In this context, a “robust” basis of evidence means one which is likely to meet stakeholder expectations at PR19. While there are no guarantees as to what forms of valuation evidence will help meeting these challenges, recent recommendations from Ofwat provide some indications of what may be needed:

- While valuation research needs to be proportionate to customers’ opinions and the importance of valuation assumptions in the business planning process, companies should draw on a wider range of valuation methods than SP;
- Companies should seek to triangulate valuation assumptions from a wider range of evidence, including data from ongoing customer contacts;
- Companies should make greater use of comparative information on their relative performance as part of their engagement and/or societal valuation process; and
- Companies need to avoid treating customers as homogeneous when conducting valuation and engagement research, recognising the differences between customer groups when conducting research and applying its findings.

7.3. Identifying Potential Valuation Methods

We have also conducted an extensive review of the valuation methods which Anglian *could* use to value changes in service at PR19, including a range of possible improvements to the valuation. Some involve relatively simple and valuation methods that should produce highly applicable valuations. Some methods would produce valuations that are less closely applicable, or may not be successful due to uncertainties about data availability or the efficacy of the method. However, the extent to which it is *worthwhile* to deploy this range of valuation methodologies requires an assessment regarding the relative importance of each attribute to Anglian. This assessment has informed the development of the valuation strategy summarised below.

7.4. Improvements to SP Methods

Aside from the need to consider a wider range of valuation methods besides SP, experience from PR14 suggests there is scope to simplify the PR14 research methods in order to improve respondents’ comprehension and thus the reliability of valuation results. Ofwat has also encouraged companies to innovate in their engagement and valuation programmes. As part of this work we have considered a range of options for improving on the “traditional” SP approach, including the following:

- Simplifying the presentation of service levels and attributes;
- Applying a “max-diff” approach, though we recommend this should be subject to cognitive testing to demonstrate whether it results in a material improvement to respondents’ experience;
- Simplifying the list of attributes customers face and making the survey more interactive using the “adaptive choice” method, which we have seen used in some pharmaceutical research applications. However, further work would be needed to develop and test this approach;

- Developing the “slider” method as a more interactive/engaging research tool that could be run alongside a more traditional SP valuation survey. It could also be used after the PR19 process as a way of gathering data on customer preferences in a more continuous way than is possible at present; and
- Including more comparative information on firms’ relative performance. However, we have concerns about the effect of including information on relative performance in SP instruments. At a minimum, this approach would require very extensive testing to assess how respondents react to this information.

We have also considered the choice between alternative survey methodologies (face-to-face vs. online, etc). We conclude that (at least) some element of face-to-face should be retained in order to reach less accessible groups. However, the survey methodology also depends on the type of survey instrument: for instance, more interactive instruments like the “slider” approach may be better-suited to online methods. Also, given the Anglian PR14 research suggests online research produces materially lower valuations, online research could also be seen as a lower risk method, if Anglian wishes to avoid overstating the economically efficient level of service provision to avoid large reductions in expenditure allowances through the price review.

7.5. Recommended Valuation Strategy for PR19

Based on the findings from our assessment of the relative importance of each of Anglian’s attributes of service for the PR19 business planning process, and our evaluation of the identified candidate valuation methods, we have developed a recommended Societal Valuation Framework for PR19. This framework maps each of the attributes that require a valuation for the development of the WRMP and the wider Business Plan at PR19 to a set of recommended valuation programmes and associated deadlines.

Table 6.1 and Table 6.2 show the attributes of service to be covered by each recommended study, as well as the deadline for which valuations are needed in each case.

Table 7.1
Mapping of Attributes of Service to Recommended Studies (Part 1)

Research Package:	Main “Stage 1” Stated Preference	“Stage 2” SP on Resilience	“Stage 2” SP on Options	“Stage 2” on Output Loss	Broad “Sliding Scales” SP	“Sliding Scales” on Options	Deliberative Workshops	Complaints/ Social Media Analysis
Brief Description:	Improved broad SP	Improved SP focused on restrictions/ interruptions	Improved SP method controlling for other factors	Macro study (based on findings from other studies)	Laying grounds for ongoing research	Laying grounds for ongoing research	Educating respondents, then ask SP	Analysis of customer data “warehouse”
Deadline:	Aug 2017	Apr 2017	Jun 2017	Apr 2017	Aug 2017	Jun 2017	Aug 2017 (*)	Aug 2017
Attributes Covered:								
Drought Resilience		✓		✓			(*) Apr 2017	
Resilience to Others	✓	✓		✓			✓	
Supply Interruptions	(x2)	✓		✓	✓			✓
Demand Mgmt. Strat.			✓			✓	(*) Jun 2017	
WR Options								
Wastewater Solutions			✓				✓	
WRC Growth								
River Water Quality	✓				✓		✓	
SSSI Habitats and Recreation Sites								
Sewer Flooding	(x2)				✓			
Water Flooding	✓							
Customer Contacts							✓	✓
Water Quality Notices	✓				✓		✓	
Discolouration; Taste&Odour	✓				✓		✓	
Water Hardness								
Carbon							✓	
Odour and Flies	✓							
Coastal Waters	✓							
Low Pressure								
Traffic Disruption	?							✓
Others								

Source: NERA

Table 7.2
Mapping of Attributes of Service to Recommended Studies (Part 2)

Research Package:	Survey to Customers Affected	Data Analysis of Insurance Compensation	"Indirect" Hedonic Pricing	"Travel Costs" RP Research	Assessment of Externalities	Ecosystem Services Assessment	BT from PR14/PR09 and Others
Brief Description:	On costs of damage/mitigation measures	Collect data and analyse if feasible	Interviewing estate agents on house price effects	Lay grounds for ongoing surveys to visitors	Then decide whether further research is needed	Qualitative, then monetise where possible & proportionate	Adjustment/adaptation/translation
Deadline:	Aug 2017 (*)	Aug 2017 (*)	Aug 2017	Aug 2017	Feb 2017	Feb 2017	Aug 2017
Attributes Covered:							
Drought Resilience	(*) Feb 2017	(*) Feb 2017					✓
Resilience to Others	(*) Feb 2017	(*) Feb 2017					✓
Supply Interruptions	(*) Feb 2017	(*) Feb 2017					✓
Demand Mgmt. Strat.							✓
WR Options					✓	✓	✓
Wastewater Solutions					✓		✓
WRC Growth					✓		✓
River Water Quality			✓	✓		✓	✓
SSSI Habitats and Recreation Sites			✓	✓			✓
Sewer Flooding	✓	✓	✓				✓
Water Flooding	✓	✓	✓				✓
Customer Contacts				(opp. cost of time)			✓
Water Quality Notices	✓						✓
Discolouration; Taste&Odour	✓						✓
Water Hardness							✓
Carbon							✓
Odour and Flies	✓		✓				✓
Coastal Waters				✓		?	✓
Low Pressure	✓						✓
Traffic Disruption	✓			(opp. cost of time)			✓
Others							✓

Source: NERA

Appendix A. Anglian's PR14 Valuation Programme

A.1. Main Stage Survey

Twelve attributes were valued, using SP methods, in Anglian's Main Stage survey. Six attributes related to tap water services, three attributes related to wastewater services, and three attributes related to environmental aspects of the services for which Anglian are responsible.⁸⁶ Choice experiments were used, while Contingent Valuation exercises were included, and used to scale the valuations estimated by the choice experiments appropriately to account for package effects.

Anglian chose to separate the twelve attributes into four 'blocks' of three attributes each, with attributes in the same block related to one another.⁸⁷ The four choice experiment blocks are presented in Table A.1. The identical structure of the four choice experiments allowed the same design of choice experiment to be applied to all four blocks.⁸⁸

Table A.1
Choice Experiment Blocks and Attributes Valued in the Main Stage Survey

Water Services 1 (WS1)	Water Services 2 (WS1)	Wastewater Services (WW)	Environmental Services (ES)
Unexpected 6-12 hour interruptions	Taste and odour of tap water	Sewer flooding inside properties	Pollution incidents
Persistent low water pressure	Discoloured tap water	Sewer flooding in external areas	Coastal water quality
Hosepipe bans	'Boil water' notices	Nuisance from sewage treatment	River water quality

Source: Eftec and ICS Consulting⁸⁹

Two survey methods were used for the Main Stage survey, CATI (Computer Aided Telephone Interviews) and Online. CATI participants were recruited by a previous telephone call, in which a time for the CATI was agreed, while online respondents were recruited by internet panels.⁹⁰ A large target sample size of 2500 respondents was chosen, of which 500 were non-domestic customers interviewed by CATI, 1000 were domestic customers interviewed by CATI, and 1000 were domestic customers interviewed online. In order to represent the views of water only and wastewater only customers from the domestic and non-domestic sectors, 10 per cent of the CATI respondents were recruited from Hartlepool

⁸⁶ Eftec and ICS Consulting (2012), "Anglian Water PR14 Willingness to Pay Survey: Final Report", Table ES.1.

⁸⁷ For example, the first 'Water Services' block related to interruption to supply, while the second related to the quality of tap water.

⁸⁸ Eftec and ICS Consulting (2012), p. 22.

⁸⁹ Eftec and ICS Consulting (2012), p. 21.

⁹⁰ Eftec and ICS Consulting (2012), p. 26.

Water's service area, and 10 per cent were recruited from Cambridge Water's service area.⁹¹ All online respondents, however, were recruited from Anglian combined water and wastewater customers.⁹²

The Main Stage questionnaire was accompanied by a number of show cards which were presented to the respondent to provide additional information. CATI respondents were sent the show cards in advance, while online respondents saw the show cards on screen.⁹³ The domestic questionnaire contained preliminary questions followed by four main sections:⁹⁴

- **Preliminary questions:** Questions regarding recruitment, screening and quota (i.e. confirming whether the customer received only one of water or wastewater services, or both);
- **Section A: Introductory questions,** related to the customer's perceptions of current service levels;
- **Section B: Service priorities,** where the choice experiment blocks and contingent valuation package questions were asked;
- **Section C: Follow-up questions** were asked on the customer's motivations for their responses to choice questions; and
- **Section D: Socio-economic characteristic and demographics.**

Both CATI and online surveys employed the same questionnaire, and presented precisely the same supporting information, ensuring consistency between the two modes. The non-domestic questionnaire followed a closely similar format, although Section D was not required. The CATI interviewer also completed two questions assessing the extent of the customer's understanding and the consideration they gave when taking part in the choice experiments.

For eight of the twelve attributes, the survey estimated customers' WTP for improvements in terms of the number of properties affected per year (ie. an "improvement" in the attribute is a *decrease* in the number of properties affected) or willingness to accept deterioration in an attribute, while other approaches were used for the remaining four attributes. For hosepipe bans, the survey estimated WTP for a reduction in the chance (probability) of the event happening in any year; for pollution incidents, the unit was the absolute number per year; and, in the case of coastal and river water quality, the survey estimated WTP for an increase in the number of beaches/ivers achieving a specified quality benchmark.⁹⁵

⁹¹ Eftec and ICS Consulting (2012), Table 3.4.

⁹² In fact, 916 online surveys were completed, while the full target samples were recruited in both CATI surveys.
Source: Eftec and ICS Consulting (2012), p. 26.

⁹³ Eftec and ICS Consulting (2012), p. 26.

⁹⁴ Eftec and ICS Consulting (2012), p. 25.

⁹⁵ Eftec and ICS Consulting (2012), p. 20.

For each attribute, 5 levels of services were specified, level 0 representing the 'status quo', "Level 1" and "Level 2", representing improvements and "Level -1" and "Level -2" representing declines. This allowed for "gains loss asymmetry" and any non-linear effects to be tested for.⁹⁶ Level 2 represented the highest service level that could be obtained within the current, feasibility constraints.⁹⁷

In Section B, "Service Priorities", respondents were randomly assigned two blocks, a combination of either WS1 or WS2, and either WW or ES, and the order in which the two blocks were discussed was also randomised.⁹⁸

The section followed a five part process:

1. Respondents were faced with the **first Contingent Valuation exercise** on the first block, in which they chose between two options, the status quo (with no change in the bill), and an option where all attributes improved to the maximum "Level 2", with a corresponding increase in the bill amount.⁹⁹ This Contingent Valuation exercise was used to test for the extent of substitutability between attributes in the block, and determine appropriate scaling factors.
2. Respondents then completed **eight Choice Experiments**, in which the first option represented the status quo (with no change in the bill), while the other two options changed (improved or deteriorated) at least one attribute.¹⁰⁰ In the second and third options, the water bill increased or decreased by £10 or £20 for household customers, and 3 per cent or 6 per cent for business customers (reflecting, in part, that non-household customers' bills and consumption of water vary by a far greater extent than households).¹⁰¹
3. A **second Contingent Valuation exercise** for the second block followed, following the same process as in part 1.
4. A series of **eight Choice Experiments** for the second block, following the same form as part 2.
5. Finally, respondents completed a "**sub-package**" **Contingent Valuation exercise**, in which they were presented with all six attributes (from both blocks), and were asked to choose between the 'no change' option for all attributes and the maximum improvement "Level 2" option for all attributes (with an associated increase in water bill).¹⁰² This test

⁹⁶ Eftec and ICS Consulting (2012), p. 18.

⁹⁷ Eftec and ICS Consulting (2012), p. 19.

⁹⁸ Except the subsample of Water only and wastewater only customers, who were inevitably restricted in the combinations they could be presented.

⁹⁹ Eftec and ICS Consulting (2012), p. 23.

¹⁰⁰ Eftec and ICS Consulting (2012), p. 23.

¹⁰¹ Eftec and ICS Consulting (2012), Table 3.2.

¹⁰² Eftec and ICS Consulting (2012), p. 23.

is used to help determine the “benefits value ceiling”, which proxies for the maximum WTP for all improvements.¹⁰³

Econometric models were applied to the findings of the choice experiments, in order to convert this information into usable estimates of WTP. For each ‘block’, the most appropriate model was selected, based on the one which provided the best fit to the data.¹⁰⁴

In order to generate estimates of total and average WTP, the results of the online and CATI surveys for residential customers were pooled. This was possible as the questions asked in both questionnaires were identical. There were, however, substantial differences in the aggregate results from the two survey modes. The average WTP across all attributes emerging from the CATI sample was between 54% and 109% higher than the online sample, depending on the econometric model applied.¹⁰⁵ This suggests that customers declared higher valuations using the CATI method, due to inconsistencies in the samples of respondents in the respective surveys, or due to biases which arise from the different questionnaire modes (the so called “interviewer effect” present in CATI but not online surveys). This topic is discussed in detail in section 5.7.

Domestic and non-domestic benefit estimates were aggregated in order to estimate total and average marginal WTP. Domestic WTP was estimated over the total number of residential properties served by Anglian’s water services and wastewater services, while non-domestic customers were aggregated by the total number of non-domestic properties and based on the average non-domestic bill level. (This final adjustment was not required for residential customers, since bill changes were presented using absolute, fixed amounts rather than percentage increases or decreases.¹⁰⁶)

The Contingent Valuation exercises found significant package effects, when large improvements across multiple attributes were presented. The magnitude of package effects was found to be higher for business customers than residential customers, and, as such, it was decided to apply scaling factors of 0.35 for households and 0.19 for non-domestic customers.¹⁰⁷ Anglian chose to report the scaled values as their primary input into CBA. The Main Stage report notes, however, that the scaled benefits are conservative estimates, and, particularly for projects where large, multi-dimensional improvements (across attributes) are not likely, unscaled estimates should be “applied as a further sensitivity scenario where appropriate”.¹⁰⁸

For domestic customers, five of the twelve attributes valued in the Main Stage survey exhibited gains-loss asymmetry, that is, the WTP for an improvement to the attribute was different to the willingness to accept a deterioration in the attribute, while gains loss

¹⁰³ Eftec and ICS Consulting (2012), p. 12.

¹⁰⁴ Eftec and ICS Consulting (2012), p. 36.

¹⁰⁵ Eftec and ICS consulting (2012), Table 4.31.

¹⁰⁶ Eftec and ICS Consulting (2012), p. 66.

¹⁰⁷ Eftec and ICS Consulting (2012), p. 69.

¹⁰⁸ Eftec and ICS Consulting (2012), p. 70.

asymmetry was also exhibited for two attributes. For all attributes where asymmetry occurred, willing to accept exceeded WTP.

In the case of non-linear effects, diminishing marginal effects were found for some attributes, with WTP for a movement to “Level 1” higher than a movement to “Level 2”.¹⁰⁹ However, these differences were considered to be relatively marginal, and a linear approximation was applied across all attributes.¹¹⁰

A.2. Second Stage Surveys

A.2.1. Flooding study

A second stage WTP study on flooding was carried out in 2013. The study obtained additional WTP estimates for changes in WTP with respect to:¹¹¹

- The source of flooding (water mains or sewage);
- The type of property affected (nine areas were considered including homes, public buildings, agricultural land etc.);¹¹²
- The location of the flooding (internal or external);
- The severity of flood (three categories; low, medium and high);
- The frequency of the flood (six frequencies were considered, ranging from once a year to once every hundred years).

The flooding survey also estimated relative weights for three flooding solutions: sewer construction, Sustainable Urban Drainage Solutions, and “Customer Solutions” (i.e. providing support for customers removing hard surfaced outdoor areas).

A.2.2. Environment study

The environment study involved research into two attributes related to river water quality. It estimated customers' WTP for improvements in river quality in relation to four specific attributes:

- Fish and other animal life;
- Plant life
- Water level and flow
- Litter

¹⁰⁹ Eftec and ICS Consulting (2012), Table 6.1 and Table 6.2.

¹¹⁰ Eftec and ICS Consulting (2012), p. 63.

¹¹¹ Eftec and ICS Consulting (2013e), “*PR14 Customer Research: Completion Report*”, p. 9.

¹¹² Eftec and ICS Consulting (2013b), “*Anglian Water PR14 Second Stage Flooding Survey: Final Report*”, p. 13.

The study also built on the Main Stage survey by valuing improvements across different rankings (Low to Good, Low to Medium and Medium to Good).¹¹³ It also estimated customer's WTP for a reduction in the number of pollution incidents of various severities (Minor, Moderate or Major) affecting rivers of various quality, and testing for difference in valuation for local incidents (within 15 miles from the respondent) and incidents further afield.¹¹⁴

This study allowed attributes of river quality to be represented by an index, which was then applied to Cascade Consulting's 'Ready Reckoner' tool for estimating impact on the Water Framework Directive water quality assessments.¹¹⁵

A.2.3. Water resources study

The water resources study focussed on two aspects in relation to water restrictions and water resource management:

- Estimating WTP for more severe water use restrictions, namely Non-Essential Use Bans and Rota Cuts/Standby, which were compared in valuation to Hosepipe Bans. Restriction durations were also varied across three levels.¹¹⁶ Choice experiments, involving trade-offs between the frequency and duration of the three different water use restrictions were carried out. The more extreme restrictions were presented with lower probabilities, for example, rota cuts might occur as infrequently as once in 400 years.¹¹⁷
- Estimating relative preferences towards different Water Resource Options. The water resources study considered sever water resource options:¹¹⁸
 - Extracting more water from rivers and groundwater;
 - Taking water from the sea and treating (desalination);
 - Construction of a new reservoir;
 - An increase in the existing levels of leakage detection and repair;
 - An increase in the number of domestic customers who are metered;
 - Allowing the reuse of treated wastewater; and
 - An increase in water transfers from other regions.

¹¹³ Eftec and ICS Consulting (2013d), "Anglian Water Environment Study: River Quality and Pollution", p. 51.

¹¹⁴ Eftec and ICS Consulting (2013d), p. 25.

¹¹⁵ Eftec and ICS Consulting (2013d), p. 13.

¹¹⁶ Eftec and ICS consulting (2013a), "Anglian Water PR14 Second Stage Water Resources: Final Report", p. iv.

¹¹⁷ Eftec and ICS consulting (2013a), Table ES.2.

¹¹⁸ Eftec and ICS Consulting (2013d), p. 10.

Appendix B. Identifying Appropriate Valuation Methods

This appendix presents in detail the information summarised in Section 4.2. As set out in more detail in Chapter 4, a wide range of societal valuations are required by Anglian in the context of conducting the CBA modelling underpinning the WRMP and the wider PR19 business plan. For the following groupings of service attributes, this appendix sets out the range of valuation methods that Anglian *could* deploy in order to obtain the valuations it requires, either in the form of specific valuations or to obtain a range from which it can triangulate the valuations used for business planning:

- Interruptions and disruptions to supply;
- Resilience and security of supply;
- Drinking water quality and aesthetics;
- Water resource options;
- Environmental impacts; and
- Flooding and nuisance impacts.

B.1. Interruptions and Disruptions to Supply

This grouping of attributes covers short-term interruptions to water supply and incidents of low water pressure in properties, for reasons such as localised failures in the network infrastructure. We discuss longer term interruptions related to the concept of “security of supply” separately, in Section B.2.

B.1.1. Anglian Water’s approach at PR14

At PR14, Anglian used SP methods to value two main service measures related to disruptions to supply. The Main Stage survey was used to estimate the value both residential and non-residential customers place on changes in the number of properties affected by unexpected 6-12 hour interruptions per year, and changes in the number of properties affected by persistent low water pressure per year:¹¹⁹

- Respondents were presented with a show card explaining what the attributes mean, before participating in a choice experiment that sought to value these two attributes alongside hosepipe bans.¹²⁰
- Participants were informed that the current level of unexpected interruptions was 12,000 per year, and that 500 properties were affected by persistent low water pressure each year.
- In the choice experiments, both the bill and the number of properties affected by either attribute varied. The instrument also included a contingent valuation exercise to test for any additive relationships between the three service attributes in the exercise and those in other choice experiments, and assist in determining an appropriate scaling factor for the

¹¹⁹ Eftec and ICS consulting (2012), “*Anglian Water PR14 Willingness to Pay Survey: Final Report*”, Table 3.3.

¹²⁰ Eftec and ICS consulting (2012), “*Anglian Water PR14 Willingness to Pay Survey: Final Report*”, p. 21.

valuations of individual attributes. This is due to “package effects”, whereby the summing of WTP estimates for individual attributes can over-estimate the value of improvements, due to the substitution between attributes which were not tested, or tested in different choice experiments.

In practice, where Anglian took valuation results from this Main Stage survey, we understand that it followed the recommendation of its consultants to use the lower “scaled” WTP estimates rather than the unscaled estimates.¹²¹

A second stage study from the previous price review, PR09, was used as a source of BT to estimate the relative value customers placed on interruptions of duration other than 6-12 hours. The PR09 study valued ‘unwarned’ stoppages of 3-6 hours, 6-24 hours, and 3 week duration.¹²² The ratio between the values of avoiding these interruptions of different durations were used to scale the value of avoiding unplanned 6-12 hour interruptions that was estimated in the Main Stage research.

B.1.2. Industry practice and guidance

The 2011 UKWIR guidance on carrying out WTP surveys provided specific guidance on how to estimate customer WTP in relation to interruptions to supply. The report recommended that interruptions were classified according to their duration; less than 3 hours, between 3 and 6 hours and between 6 and 12 hours.¹²³ In particular, UKWIR noted the term “unexpected” was preferable to “unplanned” or “unwarned”.¹²⁴

In practice, at PR14 most companies used SP surveys as the predominant means for estimating WTP for a reduction in interruptions, although the definitions used, the durations tested, and the valuations found thereafter varied materially between water companies.¹²⁵ Generally, customers were willing to pay more for reducing longer term duration interruptions, although this was not found when comparing results between companies. For example, four companies reported higher residential valuations of 3-6 hour interruptions than another company’s valuation for a 1-4 week interruption.¹²⁶

For persistent low pressure, the UKWIR guidance recommended an ‘altruistic’ approach, with the question or experiment making clear that the respondent is considering reductions in low pressure at other people’s properties, as consumers may be willing to pay for improvements which will not benefit themselves.¹²⁷ In asking this question, some companies

¹²¹ Eftec and ICS consulting (2012), p. 70.

¹²² Anglian Water (2012), “Societal Valuation Framework”, p. 16.

¹²³ UKWIR (2011), “*Carrying Out Willingness to Pay Surveys*”, produced by NERA and Accent for UKWIR, p. 28.

¹²⁴ UKWIR (2011), “*Carrying Out Willingness to Pay Surveys*”, p. 28.

¹²⁵ Accent (2014), “*Comparative Review of Willingness to Pay Results*”, p. 12.

¹²⁶ Accent (2014), p.13.

¹²⁷ UKWIR (2011), p. 26.

used chance of being affected as the unit of measurement, rather than the number of properties affected.¹²⁸

B.1.3. Wider options and recommendations

In this section, we assess the specific SP instruments used by Anglian to evaluate short-term interruptions and low water pressure at PR14. We also evaluate the merit of alternative methods, such as RP or estimating the cost of damage. We discuss further scope for innovation and improvement of SP techniques in more detail in Chapter 5.

B.1.3.1. SP valuation research for short-term interruption attributes

As noted above, SP has been the predominant method for valuing attributes related to interruptions. SP is a relatively simple and practical method for determining valuations for specific levels of interruption, such as the 6-12 hour unexpected interruption tested in Anglian's Main Stage survey. Also, short term interruptions are a relatively simple attribute for customers to understand and relate to, as many will have experienced such interruptions, and the challenges associated with extremely low probability events do not apply. Hence, for short-term interruption attributes it is unlikely that respondent confusion materially biases results.

As noted above, at PR14 Anglian used results from the PR09 second stage study to estimate how the value of interruptions of different durations varies. In principle this remains a sound approach for PR19, unless there is reason to believe that *relative* valuations of different lengths of interruption have changed in the period since the original study, or if current investment plans are particularly sensitive to estimates for this type of attribute thus requiring a more up-to-date, robust evidence base.

To address this, and in particular whether there is a need to update the PR09 second stage study on interruptions, one option may be appropriate to include two short-term interruption attributes in the Main Stage research (eg. up to 3 hours and 6-12 hours). This will allow Anglian to assess whether the ratio between the value of interruptions of different duration has changed materially.

B.1.3.2. SP valuation research for persistent low pressure

Applying SP methods to persistent low pressure is likely to be more challenging. For instance, some customers, particularly those who have never experienced low water pressure, may have misconceptions on how low pressure inconveniences customers, particularly since only 500 properties were affected by persistent low pressure across the Anglian region in 2013.¹²⁹ As such, we recommend the definition of this attribute needs to be tested in focus groups using cognitive questions to check customer understanding of the attribute.

¹²⁸ Accent (2014), p. 34-35.

¹²⁹ Eftec and ICS Consulting (2012), Table 3.2.

Anglian appears to have used an altruistic approach to value low pressure at PR14, since it asked customers to value changes in the number of properties affected by low water pressure, as opposed to asking their valuation for reducing the chance of their own property being affected by low water pressure. This may be a relatively conservative approach, since it may exclude some element of customers' private valuation, reflecting the possibility that their property could be one of those affected by the problem, particularly because the survey did not specifically note that the problem occurs at "other people's properties".

In light of this, there may be some merit in using SP to value separately changes in the number of other peoples' properties affected by persistent low water pressure, and changes in the probability that it will happen to the respondent. This would allow for triangulation of the two effects. However, it is likely that some cognitive testing will be required to ensure that respondents understand the term "persistent" in the same way, since a failure to do so may bias WTP estimates. Some cognitive testing may also be required (see Section 5) to ensure low probability events are presented to customers in a way they are most likely to understand.

B.1.3.3. Cost of damage and losses

Customers incur costs due to interruptions in supply, and for non-domestic customers in particular, it may be viable to estimate the costs incurred and income foregone due to interruptions:

- Domestic customers may incur costs to purchase bottled water, or to pay to use washing facilities outside of their home (eg. shower facilities at leisure centres or launderettes).
- Non-domestic customers may incur costs due to be damage to machinery and appliances should water supply suddenly fail, and income is lost if production must stop or if custom must be turned away.

However, water companies have tended not to estimate directly the costs incurred due to interruptions or to value of lost output by firms as a result of water supply disruption. Estimating the costs of interruptions from the bottom-up would be time consuming and costly. Extensive surveys would be required, yet the resulting valuation estimates would still tend to omit factors which would (in theory) be factored into customers' responses to SP surveys, such as the disutility of the inconvenience, and the cost of diverting management resources to dealing with the interruption. There is also difficulty in that when valuing lost output from non-domestics, there is a need to determine the extent of "catch up" production, given that some of the lost production or sales would occur in the period following an interruption to supply.

In practice, this approach is likely to be more practical for valuing resilience and security of supply attributes of service, as discussed in Section B.2.3.2 below.

B.1.3.4. Avertive Behaviour Models

Avertive behaviour studies are a RP method that could be used to find a market good (or combination thereof) that customers may consider a substitute to the non-market good we wish to evaluate (in this case, the avoidance of disruptions to supply), in order to obtain a valuation using market data for those good.

There is some scope for the use of avertive behaviour models in evaluating the WTP to avoid supply interruptions and persistent low water pressure incidents:

- Avertive behaviour models could be applied to derive valuation information from customers' expenditure on water storage tanks, which would provide an alternative water supply in the event of interruptions; however the purchase of tanks would also often reflect customers' desires to be resilient to long-term failures of supply, which is represented by a different attribute service measure. The benefits and disadvantages of this particular avertive behaviour instrument are discussed in detail in Section B.3.3.2 below.
- Another possible approach is cited in the 2011 report that Ofwat commissioned from Cascade Consulting and Eftec, which explored potential applications of RP techniques at future price reviews. This report suggested that expenditure on private water connection repairs (ie. repairs to the parts of the connection to water supply that fall within the customer's responsibility) could be employed as an avertive behaviour instrument to evaluate the value customers place in avoiding interruptions to supply.¹³⁰

A key limitation of using this approach, however, is that the proportion of water pipes that fall within private property is very small, and therefore the cost of the private repairs are likely to be much lower than the capital maintenance costs per household incurred by Anglian to reduce the likelihood of water supply interruptions. Therefore, this estimate is likely to be highly conservative and not be sufficient to fully evaluate the benefits of avoiding supply interruptions.

Furthermore, it is difficult to translate the expenditure on repairing water pipes at one's own property into a useful indicator for the purposes of CBA modelling, such as the marginal WTP for reducing the *duration* of short term, unexpected interruptions to supply.

- A potentially more useful relationship could be found by comparing demand (and prices) for similar water connection repair services which offer different response times. Some customers chose to pay extra for an immediate or near immediate repair to their water supply failure, for example, an 'emergency plumber' who responds within two hours of a call-out, as opposed to a non-urgent service which might only be able to respond within 24 hours of a call. In applying a RP technique, it would be assumed that the price premium that the customer pays for a faster repair exceeds or equals their valuation for bringing their supply of water back sooner (thus representing the lower bound of their WTP).

It may, however, prove unreasonable to assume that reducing the duration of an interruption is the key reason for which different repair services are chosen over one another. Factors such as customer trust for different providers, expectations about the quality of the repair, awareness of the cost difference, and general preferences may also influence the customers' choice. Therefore, it would be necessary to conduct a detailed survey to customers who recently had to contract a private repair to solve a supply disruption, in order to understand which factors influenced their decisions and why (and whether) they decided to pay a premium for any aspect of the service.

¹³⁰ Cascade (2011), "*The Use of Revealed Customer Behaviour in Future Price Limits*", p. 25.

- A similar instrument to connection repair expenditure is the purchase of insurance for water supply connection repairs.¹³¹ To determine the RP relationship, the number of houses insured (and the premium paid for this insurance) would need to be collected. Market data on insurance expenditure may be relatively easy to obtain, since a small number of firms provide such a service compared to the many that provide repair services. In addition, some of this data may be readily available to Anglian through its partnership with Aviva, offering HomeServe insurance cover.¹³²

Again, however, it would be difficult to convert this expenditure into an estimate of WTP for a reduction in the duration of supply interruptions. Furthermore, many relevant insurance products will also cover a number of other aspects of plumbing which do not relate to damage to the water supply pipe and other interruptions in supply. This means that customer's motivation to purchase these insurance products would be also be affected by their valuation of unrelated attributes, and the effect of water interruption on the premium would be hard to identify.

Therefore, some surveying to a sample of insurance customers would also be necessary in order to understand the motivations behind their decisions and control for factors that do not relate to interruptions to supply. Sampling would be easier in this case, since large insurers are more likely to possess a compiled database of customer details.

- The private purchase of water pumps is another possible avertive behaviour instrument for measuring the impact of low water pressure on homes and businesses.¹³³ Expenditure on pumps may be obtained from market sales data, or from surveys of households. However, the relationship is complicated by the need to make assumptions about the lifespan of the appliance and the customer's expectation of the lifespan of the appliance, and, when converting into a WTP over the course of the price review, a discount factor relevant to this attribute may need to be applied too. Such considerations are not required for avertive expenditure on non-durable products such as bottled water.

B.1.3.5. Hedonic Pricing

Hedonic pricing is a RP technique that could be applied to the low water pressure attribute, since low water pressure is generally associated with specific properties, such as flats and tall buildings. The hedonic pricing method would compare the house prices of properties affected by persistent low water pressure and the value of other properties, while controlling for other factors which are liable to influence property prices.

In general, the reliability of a hedonic pricing approach is determined by information asymmetries, in the extent to which customers have full information about the value of the product, and whether the price of the product in question reflects all information available to the customer. It is not clear to what extent customers are aware of low water pressure when choosing to purchase or rent a property, or whether, for those who are aware that a property has low water pressure, they are aware of the inconvenience that the low water pressure will

¹³¹ Cascade (2011), p. 26.

¹³² Anglian Water Direct website, link: <https://partner.homeserve.com/anglianwater>

¹³³ Cascade (2011), p. 24.

cause them ‘a priori’. Thus, the extent to which property prices are affected by this variable might be limited.

B.1.4. Conclusion

SP has been the primary means for estimating customers’ valuation of attributes related to interruptions and low water pressure across the industry and alternative options appear unlikely to be suitable substitutes for SP survey instruments. However, there may be scope to use these alternative methods for the purposes of ‘triangulation’, particularly for attributes which Anglian could decide are particularly important for its business plan.

Using averted behaviour information to estimate the costs imposed on customers by a supply interruption is one option, although these “bottom up” valuation approaches are unlikely to account for all costs incurred, and as such are likely to be a lower bound compared to values emerging from SP methods.

Finally, there may be significant scope for BT for previous Anglian SP estimates, either as an alternative to carrying out a new study or for use as a triangulation exercise for new surveys. In particular, there is no obvious reason to think that valuation results estimated through PR14 SP surveys could not provide highly relevant valuation information, albeit with relatively simple updates to control for inflation and changes in income levels, etc.

B.2. Resilience and Security of Supply

Resilience and Security of Supply service attributes represent the likelihood of customers experiencing longer-term service unavailability, for instance influenced by the robustness of critical water or wastewater facilities to severe/unusual events such as flooding, or the extent to which water supply is resilient to drought and other rare events which may restrict water supply for relatively long periods of time. Resilience can also involve water companies’ response to emergency disruption, eg. ensuring that emergency supplies of bottled water are distributed efficiently. These attributes of service are distinct from the shorter-term service interruptions caused by temporary incidents such as a burst pipe or the contamination of a water treatment plant, as discussed in Section B.1.

B.2.1. Anglian Water’s approach at PR14

Through its Main Stage research instrument, Anglian used SP methods to estimate domestic and non-domestic customers’ WTP for reductions in the probability of hosepipe bans, or willingness to accept increases in their likelihood:

- Specifically, resilience was included as part of a choice experiment alongside short term supply interruptions and low water pressure,¹³⁴ and respondents saw a show card to remind them of the nature of restrictions imposed on them during a hosepipe ban.
- Participants were informed that a hosepipe ban of 6 months duration occurs with a 10 per cent probability at present, and were given at least one of the following options: to reduce

¹³⁴ Eftec and ICS consulting (2012), “*Anglian Water PR14 Willingness to Pay Survey: Final Report*”, Table 3.3.

this probability to 5 per cent or 3 per cent, or increase it to 15 per cent or 25 per cent.¹³⁵ Probabilities were presented as a percentage, with the equivalent “Y in X years” statement shown in brackets directly below (e.g. 10 per cent, equivalent to 1 in 10 years).¹³⁶

- The data obtained from this instrument allowed estimation of the marginal WTP for or accept 1 per cent changes in the chance of a hosepipe ban.¹³⁷

The second stage Water Resources Survey asked customers a variety of questions relating to other types of water use restriction, namely non-essential use bans and rota/supply cuts.¹³⁸ These choice experiments involved trade-offs between the frequency and duration of the three different water use restrictions. More extreme restrictions were presented with lower probabilities. For example, rota cuts might occur as improbably as once in 400 years; in this exercise, all probabilities were presented in the “1 in X years” format.¹³⁹

B.2.2. Industry practice and guidance

Looking across the industry at the ways in which resilience and security of supply attributes were valued, Anglian’s approach seems to have been similar to that followed by many other companies. Specifically, SP was used as the predominant method for valuing resilience to drought across companies at PR14, particularly with regards to hosepipe bans and non-essential use restrictions.

However, the definitions and durations of restrictions were not standardized. Some companies failed to specify the duration of a hosepipe ban, or did not refer specifically to a “hosepipe ban” in reference to water-use restrictions.¹⁴⁰ The recommended explanation in the 2011 UKWIR guidance is “a ban on using the hose pipe at your property that would typically last for 5 months beginning in May and ending in September”, which appears similar to the definition used by Anglian.¹⁴¹

The UKWIR guidance also advised on the representation of low probability events in surveys, given widespread concern regarding customers understanding of rare, hypothetical events. It recommended that probabilities lower than 1 in 100 are presented over a common denominator (e.g. 1 in 400 and 2 in 400, rather than 1 in 400 and 1 in 200), although stated that cognitive testing should still be used to ensure that most respondents understand the relative differences in any probabilities presented.¹⁴²

¹³⁵ Eftec and ICS consulting (2012), Table 3.2.

¹³⁶ Eftec and ICS consulting (2012), Table 3.2.

¹³⁷ Eftec and ICS consulting (2012), p. xii.

¹³⁸ Eftec and ICS consulting (2013a), “*Anglian Water PR14 Second Stage Water Resources: Final Report*”, p. iv.

¹³⁹ Eftec and ICS consulting (2013a), Table ES.2.

¹⁴⁰ Accent (2014), “*Comparative Review of Willingness to Pay Results*”, pp. 32-33.

¹⁴¹ UKWIR (2011), “*Carrying Out Willingness to Pay Surveys*”, p. 31.

¹⁴² UKWIR (2011), p. 22.

In reviewing the processes used at PR14, the 2014 UKWIR report by Blue Marble Research recommended that resilience attributes should be made “more meaningful” to customers.¹⁴³ It notes the importance in making sure customers understand resilience to mean the same as the water company understands it, because low-risk and high-impact scenarios (such as rota cuts) appear abstract to survey participants.¹⁴⁴

The Blue Marble review also recommended that other aspects of resilience and security of supply, such as measures to make critical infrastructure more resilient to flooding, or to reduce reliance on single supply sources, require clear, customer-friendly language. It recommended the use by some companies of maps, animations and diagrams to help explain these concepts.¹⁴⁵

Some companies have used more deliberative research methods to value attributes of service that are more challenging to communicate to consumers in a simple, quantitative survey. For instance, Northumbrian Water held deliberative events at which it used the example of the Tewkesbury flooding in 2007, showing participants the scale and nature of disruption that flooding caused to water services.¹⁴⁶ The event was then related to the local region: “We have not had an incident on this scale in living memory in the North East”.¹⁴⁷ Then, participants were told the current risk of such events in Northumbrian’s region and asked to complete a simple choice experiment to state their WTP for improvements to infrastructure which could reduce this risk. Those customers willing to pay more were presented with two options relating to whether large numbers of customers should be protected from the event at any cost or whether a smaller number of customers should be protected at a specific cost.¹⁴⁸

B.2.3. Wider options and recommendations

As we discuss in Chapter 3, valuing changes in resilience will be a key input into the Anglian WRMP, and improving resilience to drought is likely to be a strategic priority for the business in preparing the PR19 business plan. Reflecting the importance of this topic, there may be a case for considering a wider range of research methods to support a “triangulated” valuation of resilience to drought than at PR14. We set out below some options for broadening the range of research methods used to value changes in resilience.

B.2.3.1. SP valuation research

As noted above, SP methods have been used extensively in the past to value changes in resilience attributes for both domestic and non-domestic customers. The methods for doing so are therefore relatively well-established. However, the main challenge in applying SP methods to resilience attributes is ensuring customers understand the nature of these

¹⁴³ UKWIR (2014), “*Post PR14 Customer Engagement, Communications and Education*”, p. 74.

¹⁴⁴ UKWIR (2014), p. 74.

¹⁴⁵ UKWIR (2014), p. 75.

¹⁴⁶ UKWIR (2014), p. 76.

¹⁴⁷ UKWIR (2014), p. 76.

¹⁴⁸ UKWIR (2014), p.76.

relatively low probability events that most will never have experienced. There may be insights that can be drawn from ongoing qualitative work on customers' views on improvements to longer-term resilience about how to make to customers understand the consequences of drought. We would also recommend that some testing of how customers cope with different presentations of low probability events should be conducted at the early stage of any PR19 SP research.

For instance, Anglian's 2014 second stage Water Resources Survey considered some events with particularly low probabilities. The display of such attributes differed from that in UKWIR's 2011 guidance (see Section B.2.2). This instrument showed probabilities ranging from '1 in 2' to '1 in 400' in the same exercise by varying the denominator in the stated probabilities. By contrast, the UKWIR guidance recommends presenting probabilities consistently across this exercise by varying the numerator (5 in 100 vs 10 in 100, etc) is likely to assist in customer understanding. This difference in approach does not necessarily highlight an error in the approach prescribed by either study, but it does illustrate the need to test which approach is likely to be best-understood by customers. (It is not clear whether the pilot or cognitive testing made sure of respondents understanding of these probabilities in the Anglian PR14 second stage study.¹⁴⁹)

Non-essential use bans and rota cuts involve increased levels of water extraction, and this was made clear in the definitions presented to respondents.¹⁵⁰ As such, there was some potential for customer response to overlap with their environmental preferences.

Also, compared to other attributes in the PR14 Main Stage survey, hosepipe bans exhibited an above average disparity between the household CATI and online results, with a 62% higher valuation from CATI participants.¹⁵¹ There are a range of possible explanations for this difference, and why the difference is especially large in the case of hosepipe bans. One possible explanation for the higher valuation of telephone participants may indicate that probabilities were understood differently by participants who participated on the telephone compared to those participating online, as described in Section 5.7.

As the example of the more deliberative research conducted by Northumbrian Water illustrates, another option is to incorporate some SP research into deliberative events focused on resilience. For instance, providing customers with a detailed briefing on the nature of the resilience challenge Anglian is facing, then asking them to complete a SP survey could provide a useful calibration point, as this event would also provide the opportunity to provide more detailed explanations of probability than is possible in a quantitative survey instrument completed through an online or short telephone/face-to-face interview.

The challenges associated with valuing more severe restrictions (prolonged rota cuts) are likely to be materially more acute than for valuing hosepipe bans, which many customers will have experienced before and are associated with much higher probabilities. Hence, to the extent that Anglian uses a range of different research methods to obtain valuations for the

¹⁴⁹ Eftec and ICS (2013a), p. 10.

¹⁵⁰ Eftec and ICS consulting (2013a), p. 9-10.

¹⁵¹ Eftec and ICS consulting (2012), Table 4.31.

more challenging attributes related to severe restrictions, it may be helpful to value hosepipe bans across the same range of research methods. This approach provides a point of reference across the various research instruments, as it may be possible to value hosepipe bans more reliably than for other attributes, and test how the relative value of hosepipe bans and more severe restrictions changes across research methods. This approach may also help customer understanding.

B.2.3.2. Market data on the value of lost economic output

Another means of valuing the consequences of prolonged interruptions to non-domestic customers is to draw on macroeconomic data to estimate the amount of economic output that would be lost following severe water use restrictions. This provides a cross-check on any SP research conducted to estimate the value non-domestic customers ascribe to reducing the probability of drought restrictions.

Recent research commissioned by Water UK (and undertaken by a consortium of which NERA was part) provides an example of how this can be done, and applied to value the economic consequences of drought.¹⁵² The study used the UK regional Gross Value Added (GVA) dataset from ONS, which provides historical output data by industry and region.¹⁵³

The regional breakdown was at the NUTS2 level, which includes 40 UK regions. As an example of the granularity that this data provides, within the two NUTS1 level regions that are served at least in part by Anglian (i.e. East Midlands and East of England), there are six NUTS2 sub-regions.¹⁵⁴ Data at a more regionally granular level (NUTS3) is available, but the sectorial breakdown is less detailed (NUTS3 level regional data is divided into 11 sectors, as opposed to the 33 sectors included in the NUTS2 level data). In any case, the study can be undertaken using both datasets, depending on the focus of the study (ie. sectorial or regional).

The next step was to estimate the average percentage of output that may be lost in a day of a water use restriction for each sector. This percentage varied depending on the severity of the restriction (hosepipe bans, non-essential use bans, or standpipes/rota cuts). We also provided assumptions on the percentages of output lost for those business users that abstract their water privately (ie. non-public water supply –non-PWS– users), whose licenses would be likely to be restricted by the Environment Agency in the event of water shortage in the PWS.

Since the scope of the Water UK study did not include any primary field research to obtain societal valuations, the assumptions on percentage losses (as well as on PWS/non-PWS use

¹⁵² Water UK (2016) “Water resources long term planning framework (2015-2065)”, Appendices F.3 and F.5.

¹⁵³ Office for National Statistics, Statistical bulletin: Regional Gross Value Added (Income Approach): December 2015.

¹⁵⁴ The NUTS2 sub-regions within the regions of East Midlands and East of England are: (i) Derbyshire and Nottinghamshire; (ii) Leicestershire, Rutland and Northamptonshire; (iii) Lincolnshire; (iv) East Anglia; (v) Bedfordshire and Hertfordshire; and (vi) Essex.

split by sector) drew mainly on the assumptions used by other studies that used a similar approach.¹⁵⁵

A potential way to improve the robustness of these assumptions would be to conduct Anglian's own field research by interviewing its large business users to assess their vulnerability to water use restrictions. This would involve an understanding of eg. how water fits in their production processes, any back-up supplies available, the maximum duration of a restriction they could bare without compromising their output, or any value lost from any deterioration of the quality of their product caused by the restriction (eg. in the case of agriculture, plants and flowers wholesalers and retailers, and other producers of perishable goods). Any evidence of value lost in past events (even if it is from regions other than Anglian's) would also be useful to support the assumptions. We discuss the scope of further research in more detail in Section B.2.3.3.

One of the advantages of this method is that it takes into account all sectors of the economy, weighted by the amount of economic output in the region. Therefore, it surpasses any issues with representativeness of the sample associated with WTP studies.

Furthermore, if the assumptions on GVA percentage losses are well grounded and supported by empirical evidence, the results are objective and robust, with less scope for bias. However, we note that the subjectivity from managerial responses to SP surveys may be beneficial in some cases, since it may capture more intangible costs from a water use restriction on businesses, eg. any reputational consequences for the manager, or lost clients due to a delay in the delivery of the output (most relevant in the case of exports).

B.2.3.3. New research to understand responses to drought restrictions

A key limitation of estimating the consequences of drought from lost economic output is that this approach requires an assumption on the proportion of economic output that would be lost if water supply were interrupted. The Water UK work described in Section B.2.3.2 made a reasonable, though somewhat crude, assumption that one 365th of output would be lost for each day of water use restriction due to severe drought. The accuracy of this assumption could be improved through research aimed at identifying how customers would respond to drought restrictions and to what extent their economic output would be affected in the short- and longer-term, and how this varies according to the timing and duration of drought restrictions.

- For instance, some non-domestic customers may lose very little economic output if they can respond to usage restrictions by delaying production and using up stock inventory, or if they can simply ask staff to work from home.
- By contrast, some seasonal industries could see markedly higher reductions in output if restrictions occur in summer months. Some industries could even be forced to relocate permanently, which would also have much more long-lasting consequences for the region.

¹⁵⁵ NERA (2006) "The cost of water Use Restrictions - A report for Thames Water"; Vivid Economics for Defra (2013) "Economic Impacts of Drought in England"; AECOM for EA and Defra (2015) "Strategic Water Infrastructure and Resilience"

Anglian could conduct research in this area, either by including some limited open-ended questions in quantitative survey instruments, or by conducting in-depth interviews with businesses and other non-domestic customers in the region.

As well as research into non-domestic consumers' response to drought, another source of evidence could be to interview customers who have experienced long restrictions to their water supply for reasons besides drought to understand how they responded. For instance, Anglian may know of specific customers which would fall into this category that we could include in the sample. But it may also be possible to conduct interviews amongst non-household customers outside the region who have experienced long term interruption to supply (eg. Severn Trent region or Northern Ireland). This would provide key insights into the actual impact and experiences of supply interruptions (rather than customers' expectations and speculation) which although not experienced by Anglian customers can be applied to the region.

From the resulting insights on the practical consequences of drought and customers' mitigation and response strategies, we envisage it will be possible to improve the robustness of valuations of avoided drought restrictions (available in previous work and in our recent study for Water UK) that rely on valuing lost economic output. This research will also inform the design of any quantitative (eg. SP) survey instrument, from which we can obtain alternative estimates of the economic consequences of drought based on survey evidence.

It may be appropriate to combine qualitative research on business' responses to water restrictions with the value of claims made by non-domestic customers under business interruptions insurance policies. Insurance claims would account for the direct costs incurred, while qualitative research could be used to assess the indirect costs which firms face, and the combined data may provide an appropriate estimate for total WTP to avoid such disruption.

B.2.3.4. Avertive Behaviour Models

A range of RP methods have been used in previous studies to value resilience and security of supply attributes. In particular, avertive behaviour models have been suggested as a means of estimating non-domestic customers' WTP to avoid severe restrictions, by discovering expenditure by firms on storage of water.¹⁵⁶ Such expenditure would be particularly relevant to industrial or agricultural customers that are particularly reliant on water as an input in production. However, storage of a sufficient volume of water is not feasible or suitable for many customers, and in any case, expenditure on storage can also be intended to abate short term interruptions to supply so it would be challenging to disentangle separate valuations of relatively short and long interruptions.

Expenditure on rainwater tanks presents a similar avertive behaviour opportunity for valuing security of supply. While stored tap water can relate to avoiding disruption due to short term interruptions, rainwater tanks are likely to be more use rainwater tanks provide a partial substitute to tap water, particularly in the event of water restrictions, and as such are particularly useful in valuing hosepipe bans, since a rainwater butt in domestic properties'

¹⁵⁶ Cascade (2011), "The Use of Revealed Customer Behaviour in Future Price Limits", p. 24.

gardens can provide an alternative to otherwise transporting water, while “Plumbed in” rainwater tanks (e.g. for toilet flushing) can substitute more broadly for tap water. However, there are alternative factors which may conflate motivation to use rainwater tanks beyond resilience to supply disruption or restrictions, for example, metered customers may do so to reduce expenditure, while other customers may do so due to their general preference to conserve water, and other perceived environmental benefits. A similar approach could be to study expenditure by non-domestic customers on their resilience to water supply disruption. For example, some firms may undertake expenditure to ensure that production can continue at a different site in the event of the loss of water supply or long-term water use restrictions. However, in all probability such expenditure to create the option to continue operation in the face of supply restrictions would be intended to mitigate a variety of risks, including interruptions to other utility services, so it may not be correct to attribute all of this value to the avoidance of water usage restrictions.

In light of these challenges, if Anglian decides to conduct averted behaviour valuation studies, the results would need to be interpreted with care. Specifically, suppose we had data that showed the total amount of expenditure some non-domestic customers spend on providing their own resilience to drought restrictions. Consider the example of a hospital that incurs cost to have on-site back-up water supplies (such as water storage tanks or large stocks of bottled water) to mitigate the effects of water use restrictions. Given the hospital has to be resilient to water restrictions at any cost, the value it would place on marginal reductions in the likelihood of water restrictions would be extremely small, and would not be easily identifiable from the amount of money it chooses currently to spend on back-up water supplies.

Within this context, it could be useful to conduct targeted surveys to hospitals and other highly-dependent large users to assess their behaviour in terms of risk aversion when making expenditure decisions for back-up supplies. This would imply, for example, asking the managers responsible for these decisions how their expenditure would change for different discrete changes in risk of restriction. However, there may be similar problems to those experienced in SP surveys with the respondents’ understanding of risk, described above. The costs that the hospital incurs to manage and refill its back-up supplies during a restriction event may provide a better, albeit conservative, guide as to their WTP to avoid interruption.

More useful RP information to value avoided water use restrictions would therefore come from understanding how customers would respond in the form of marginally higher or lower expenditure on mitigation strategies if resilience provided by the water company were marginally reduced or increased, and from the cost of using mitigation measures that are put in place. For instance, even if companies can move staff to other sites if they need to, it may be costly to do so in practice. This sort of data may be more challenging to obtain in the context of restrictions to water supply put in place due to severe drought, since most companies have never experienced a restriction of that type.

B.2.3.5. Hedonic Pricing

As well as averted behaviour models, hedonic pricing methods could also provide RP valuations of improved resilience if a link could be established between the value of properties in areas with higher and lower security of supply. However, it would be challenging to distinguish the effect of differing levels of security of water of supply on

property prices, and in any event the validity of this method is limited by buyers and sellers of property having little or no information on the likelihood of experiencing a drought. As a result, we do not recommend this approach for valuing resilience attributes.

It is also possible that some hedonic pricing methods could be deployed, using data from the business interruption insurance market data. In essence, this approach would involve extracting information on the demand for protection from prolonged water supply interruptions. However, as in the case of shorter interruptions (see Section B.1.3 above), it may be challenging to disentangle the value placed on avoiding interruptions in water supply from business interruptions experienced for other reasons.

B.2.3.6. BT

Given the importance of resilience for the industry and for the nation, there have recently been a number of studies aimed at evaluating the value of resilience in the UK that may be useful as a precedent, and potentially as a calibration point.

“Triangulation” of SP studies from different sources

A range of previous work by Anglian and other water companies may also provide some alternative sources of the value of avoided restrictions.

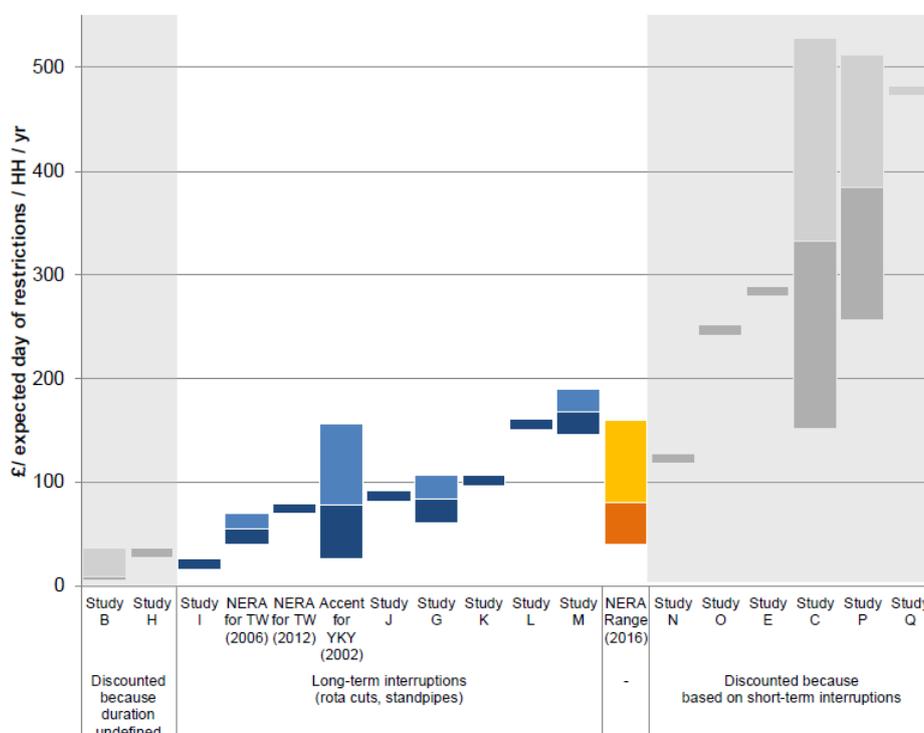
For example, the recent Water UK study compiled a range of SP evidence from public sources, as well as from studies received from water companies under confidentiality agreements (and therefore treated anonymously).¹⁵⁷

The main challenge in compiling evidence from different sources is to set all the evidence in comparable terms. For example, each study may be associated with a different question to the respondent: different durations of the restriction, different changes in levels of service, different definition of the levels of service (eg. “your property is at risk”, as opposed to “your property is affected”, or “number of properties affected in your region”).

In order to address this challenge, in the Water UK study we converted the results from each SP study into a common unit of measure: GBP per expected day of restriction per year. Figure B.1 illustrates the results of this compilation for the most severe level of restriction, i.e. involving full long-term service interruptions (lasting more than 14 days), with potential use of standpipes and rota cuts. The orange bar corresponds to the final valuation range that was incorporated in the National Water Resource Plan.

¹⁵⁷ Water UK (2016) “Water resources long term planning framework (2015-2065)”, Appendix F.2

Figure B.1
Compilation of Evidence on Household WTP to Avoid an Expected Day of Standpipes/Rota Cuts



Source: Water UK (2016)

However, there are a number of limitations in this method. First, it assumes that the relationship between duration of the restriction and WTP is linear. As we discuss in Section 3.1, this is not necessarily the case. In the case of Anglian, this limitation could be addressed by undertaking primary SP research for different possible durations (eg. a day, a week, two weeks, a month), and then using the smaller amount of available studies that have historically evaluated each particular duration, for validation purposes only.

Another problem with transferring evidence from studies undertaken by other companies is that the results may not be directly transferrable to the Anglian region. First, some assumptions should be made in terms of the income elasticity of the demand for avoiding water use restrictions, in order to be able to take into account any differences in regional income. Then, even between regions with similar income levels, local preferences and attitudes towards water restrictions may differ. Finally, differences in the baseline level of service may also affect the marginal WTP for a change in service levels. Some cognitive testing, potentially at the cross-regional level involving cooperation with other water companies, may be required to test the extent of these differences and potentially to estimate any conversion ratios to account for these factors.

The use of previous work conducted by Anglian would not be affected by these limitations, while providing a highly relevant point of reference. For example, the results of the PR09 and PR14 SP studies could be updated for factors such as changes in real incomes and inflation, and be used in the “triangulation” process.

However, even such research would need to be interpreted with care, in light of the broader industry and economic context at the time it was conducted. For example, Anglian's PR14 survey was carried out soon after the 2012 drought and hosepipe ban, so attributes such as usage restrictions were likely to be more "fresh in the memory" of the respondents than it may be for customers participating in the surveys for PR19. Likewise, respondents to the PR09 research could also have been influenced (depending on the timing of the research) by the recession that began around that time.

Ideally, constructing a time series of valuation research and taking an average of a long history of the resulting valuations would be a robust way to address these challenges, but the number of data points is relatively small at present. To address this issue in the longer-term, a possible element of the PR19 valuation strategy we have recommended (see Section 5.5) is to develop an ongoing tool for customer engagement that allows derivation of valuation information.

Recent studies that have evaluated the economic impact of a drought

During our work for Water UK, we identified three relatively recent studies that evaluated the economic impact of droughts in the UK using macroeconomic models similar those described in Section B.2.3.2. However, each of them referred to a different severity scenario and a different area. Therefore, the studies are difficult to compare among themselves, as well as to apply to the particular needs of Anglian. In any case, taking these caveats in mind when interpreting the results, these studies could be useful as secondary sources for validation purposes:

- Vivid et al. (2013) provides a model that estimates the economic impact of the drought that took place in England in 2011/12, affecting mostly the South East and Anglian regions. The model estimates that about £165 million in revenue and £96 million in profit were forgone by some firms and sites in the second quarter of 2012, when some water companies introduced hosepipe bans, and the EA encouraged agricultural irrigators to voluntarily cut their use.
- NERA (2006) estimates the loss of GVA by industry sector in London arising from business interruptions directly caused by the water use restrictions that would occur given 1975/76 rainfall patterns (the last time when standpipes and rota cuts were implemented in England), with the dry-year demand levels and available resources at the time of the study. The model estimates a total loss in London GVA of £4,929 million if no further action were to be taken.
- AECOM (2016) estimates the economic costs of a range of hypothetical drought scenarios, which differ in duration (1 or 3 years), severity (1 in 100 or 1 in 500 years) and decade of occurrence (2010s or 2050s). The estimated economic impact ranges from £261m in a one-year severe drought in the 2010s to £43,488m in a three-year extreme drought in the 2050s.

B.2.4. Conclusion

SP has a long track record of use in valuing resilience and security of supply attributes in the water industry, and the various alternatives have significant limitations that make them unsuitable for providing the primary basis for valuing these attributes in the context of the

WRMP and the PR19 business plan. In particular, the types of RP methods discussed above are very unlikely to provide enough systematic valuation information to inform business planning assumptions for Anglian.

Despite the challenges of using RP methods for this category of attribute, there may be significant value in Anglian drawing on BT information from previous studies it and other parties have conducted, updating and adjusting them for current conditions in the Anglian region where possible. Valuing avoided restrictions of non-domestic customers' supplies using macroeconomic data, following the approach in the recent Water UK study could also provide useful valuation information. However, as described above, this work could be improved by surveying customers' responses to interruptions to improve the pivotal assumption on the proportion of economic output lost due to prolonged supply restrictions. There are also a number of previous studies on the value of avoided interruptions that could be used as a calibration point.

B.3. Drinking Water Quality and Aesthetics

This category of attributes relates to the quality of tap water, including incidents which can make tap water unsuitable for drinking (and preparing food).

B.3.1. Anglian Water's approach at PR14

Tap water quality and aesthetics were valued at PR14 in Anglian's Main Stage survey. SP methods were used to determine customers' WTP for improvements to three attributes in relation to the quality of tap water:¹⁵⁸

- Number of properties affected each year by an unpleasant taste and/or odour of tap water;
- Number of properties affected each year by discoloured tap water; and
- Number of properties affected each year by 'boil water' notices.

These three attributes were tested in a single choice experiment. Participants were first presented with a show card which explained key information about the three attributes, and the "current level" of each attribute (in terms of the number of properties affected per year) was made clear in the choice experiments. The choice experiments were followed by a contingent valuation exercise which was used to determine the appropriate scaling factor to account for "package effects".

Notably, in the "highest" potential improvement presented to customers, the "level 2" improvement, the number of "boil water" notices would fall to zero per year, compared to the current level of 1,500; this is in contrast to the other attributes above, where only a proportion of the properties currently affected would be able to be protected.¹⁵⁹ In the qualitative section

¹⁵⁸ Eftec and ICS consulting (2012), Table 3.3.

¹⁵⁹ Eftec and ICS Consulting (2012), Table 3.2.

of the Main Stage survey, participants were asked about their attitude towards the hardness of tap water, with only 42% “happy with the current level” of this attribute; however, WTP for changes in the hardness of water were not obtained from this survey.¹⁶⁰

In relation to water hardness, we understand that Anglian undertook work very early in the PR14 business planning process to demonstrate that treating for water hardness is not cost beneficial.

B.3.2. Industry practice and guidance

Companies generally used SP for attributes related to water quality. The 2011 UKWIR guidance recommended that persistent taste and odour issues be tested as a single attribute, with a clear explanation that issues around the taste and odour of water are not related to the safety of drinking water.¹⁶¹

The UKWIR guidance also recommended that companies ask customers about their WTP to reduce the chance of persistent discolouration of water, and that a photograph should be shown to demonstrate the appearance of discoloured water.¹⁶² The duration should be stated and ‘persistence’ should be specified, as isolated or intermittent discolouration is less of a priority, and can often be caused by third parties, minimising the extent to which the water company can invest in order to abate the issue.¹⁶³

In practice, some companies measured discolouration and non-ideal taste or smell as a single attribute at PR14.¹⁶⁴ In addition, many companies did not define either attribute as “persistent”, and the duration of effects varied substantially from company to company.¹⁶⁵

The UKWIR guidance recommended that ‘boil water’ notices were tested alongside “non-emotive” visual stimuli, such as an image of the notices issues. It recommended that respondents were told they would need to boil tap water before drinking, cooking etc., “for up to 2 days”.¹⁶⁶

It seems many water companies chose not to ask customers for their valuation with regard to Boil Water notices at PR14. From a sample of three firms who did ask, their valuations varied by a factor of seven, suggesting there were significant variation in customer understanding and expectations of boil water notices, or that the wording of their respective survey questions biased results.¹⁶⁷

¹⁶⁰ Eftec and ICS Consulting (2012), Table 4.8.

¹⁶¹ UKWIR (2011), p. 34.

¹⁶² UKWIR (2011), p. 33.

¹⁶³ UKWIR (2011), p. 33.

¹⁶⁴ Accent (2014), p. 12.

¹⁶⁵ Accent (2014), pp. 28-28.

¹⁶⁶ UKWIR (2011), p. 35.

¹⁶⁷ Accent (2014), p. 16.

B.3.3. Wider options and recommendations

As previously explained, SP has been the predominant method for assessing customer valuation of water quality attributes in the industry. There is, however, an emerging evidence base that RP is an appropriate method for this category of attribute, and there is also existing research from which valuation of drinking water might be transferrable to Anglian's case.

B.3.3.1. SP valuation research

SP methods are relatively simple to apply to these service attributes, since they relate directly to the experience of customers. This means it is likely to be fairly reasonable to expect relatively uninformed customers to be able to trade-off the effect of these attributes increasing and decreasing and the consequent changes in their bill.

Again, we note the difficulty in presenting events of low probability to customers (see section B.1.3.1), such as is the case with the number of properties affected by taste and odour of tap water incidents and the number of properties affected by boil water notices. Anglian chose to present these figures as the nominal number of properties affected, rather than as the percentage of properties affected. Presentation in this form has two effects; firstly, it removes confusion arising amongst customers about the relative likelihood of events represented by small probabilities, and secondly, it encourages an "altruistic" valuation, since the unit indicates that the customers' bill will change in order to increase or decrease the number of properties affected across the Anglian region, rather than reducing the chance it will occur at that customer's property.¹⁶⁸

In its survey, Anglian did not explicitly state that discolouration and taste/odour issues were persistent. This is in contrast with the UKWIR guidance which recommended that respondents were asked about being "persistently" affected by these two attributes. This difference in approach may be deemed appropriate for Anglian's circumstances and investment considerations, but in any case, there may be merit in conducting cognitive testing to ensure understanding is homogeneous across respondents. For example, if some customers assume that the issue is currently persistently affecting 2,000 customers every year rather than affecting 2,000 customers on occasion each year, they there may be upwards bias in the average WTP estimate generated by both the choice experiments and the contingent valuation exercises.

The number of properties affected by 'boil water' notices is the only of these three attributes related to the safety of drinking water. As such, it is important that customers do not mistakenly assume that taste, odour or discolouration issues are associated with health risks, since it is important that their preference for reducing the health risks from water are accounted for by the 'boil water' question. Cognitive testing, as well as qualitative research or ongoing focus group research, would be helpful in testing the extent to which customers

¹⁶⁸ So long as participants are made aware earlier in the survey of the scale of Anglian Water's population, it is likely that they are aware that 2,000 homes is a small proportion of Anglian's customers (even if they have forgotten the exact number). In Anglian Water's PR14 Main Stage survey, this was achieved by informing the participant at the beginning of the "service priorities section" of the number of people served by Anglian Water, while a show card map of the water company's service area was also used.

associate discoloured or unusual smelling or tasting tap water with any health risk. If cognitive testing indicates that survey respondents in pilot surveys still confuse the source of health risks, it may be advisable to test ‘boil water’ notices in a different choice experiment or even a different survey.

For instance, rather than introduce water safety attributes into wider SP surveys, it may be preferable to value them through separate instruments, deliberative research, or even by asking customers who have experienced boil water notices (in Anglian’s region or elsewhere in the country) about their experiences and how much they would be willing to pay to avoid such incidents occurring in the future.

B.3.3.2. RP methods

Drinking water quality appears to be one of the most suitable attribute areas for avertive behaviour research, and there are a number of existing studies applying avertive behaviour for customer preferences in relation to water quality, although they generally focus on customer perception of health risks. Customers who dislike tap water can instead choose to consume bottled water, or purchase equipment to filter tap water prior to drinking. In the UK today, the risk of serious health problems from consumption of tap water is very low, and as such, customer substitution towards alternative water sources is likely to be primarily driven by preferences and perceptions about the taste and quality of tap water.

In their 2011 report on opportunities for RP methods for Ofwat, Cascade Consulting recommended that demand for bottled water and water filters may be appropriate instruments for avertive behaviour research into aesthetic features of tap water and water hardness, while the purchase of water softeners and lime scale cleaners are appropriate instruments for water hardness.¹⁶⁹ They suggested that household and business surveys could be used to determine consumption and expenditure on these items at a household level, while data from market sales and market research organisations would be suitable for ‘aggregate level’ data.

There are some challenges in the use of avertive expenditure for valuing water quality improvements. Particularly, demand for these products may be influenced by factors other than the RP relationship in which we are interested. This is particularly true for bottled water, where brand preference and loyalty may be a key factor in demand, as well as the convenience factor, in that bottled water is portable, and bottled water is often purchased for consumption when outside of the home.

A shared piece of research was commissioned by a number of water companies at PR14, including Anglian, on avertive behaviour using household expenditure on bottled water and water filters.¹⁷⁰ The report found that for an improvement in the taste of tap water (by one unit), households were, on average, willing to pay an additional £19 per year; for a single unit improvement in the smell of tap water, consumers were willing to pay £4 per year, and no

¹⁶⁹ Cascade (2011), pp. 22-23.

¹⁷⁰ Eftec and ICS Consulting (2013c), “*The Household Value for Tap Water – A Revealed Preference Study of Avertive Behaviours*”.

statistically significant WTP was found for improvements in the appearance of tap water.¹⁷¹ This research has recently been released in a working paper by the Centre for International Environmental Studies, and appears to be at the forefront of research into avertive behaviour in relation to demand for drinking water quality.¹⁷²

Despite being an innovative example of research to improve on previous SP estimates, this was a survey based avertive behaviour study. As such, the risk of biases present in SP research may have applied to this study too. For example, systematic inaccuracies in the self-reported expenditure on bottled water could bias results downwards. Biases related to “protest responses” may also still be present, as participants were required to assess the quality of tap water where they live.

Another potentially useful exercise could be to compare trends in the actual sales of bottled water over time from region to region, while controlling for other factors which might affect region specific demand for bottled water. This could allow for estimates of the changing satisfaction with tap water quality, or the extent to which consumers might be demanding a higher quality taste or perceived quality of their water. Compared to survey based RP research, there may be less potential for this data to contain biases; however, the feasibility and cost effectiveness of this exercise would depend on the ease in which this data could be obtained from market research firms and other sources.

B.3.3.3. BT

As with other attribute areas, there is scope for BT from previous studies to be applied to Anglian’s current societal valuation strategy, and some published literature on the value of drinking water quality may be transferrable to Anglian’s region. Previous SP surveys carried out by Anglian and other water companies may be relevant, although most of the academic literature applied to RP for drinking water focusses on considerations related to the health risks of tap water, which are not likely to be an area of particular focus for Anglian.

For attributes related to the health risks of drinking water, BT is likely to be highly appropriate, drawing on data and guidance from DWI and other government departments.

The 2013 Eftec RP study, which estimates WTP for an improvement in water quality specific to the Anglian region, could be used again at PR19, or its methodology could provide a basis for an updated RP exercise to allow for changes in taste or preference in the years since the first survey.

However, care must be taken with any BT exercise, since valuations given in previous surveys may have been specific to when they were carried out. Specific care must be taken when transferring RP estimates, since previous surveys were carried out in specific economic contexts, and demographic change may have taken place since the survey, meaning that consumption of the related good may have changed differently to WTP for attribute

¹⁷¹ Eftec and ICS Consulting (2013c), p. v.

¹⁷² Lanz, B., and Provins, A., (2016), “*Estimating the demand for tap water quality: Avertive expenditures on substitutes for hardness and aesthetic quality*”.

improvements. While SP research is only at risk of becoming out of date due to changing preferences for the attribute itself, RP research can be affected by changes in supply and demand caused by external factors over time.

B.3.4. Conclusion

Compared to the interruptions, security of supply and resilience attributes, there is significantly more scope to supplement SP research with RP research, if the importance of the attributes in question warrants the additional effort. The 2013 Eftec RP study provides a reasonable basis for which estimates WTP for an improvement in water quality specific to the Anglian region, could be used again at PR19. If Anglian wished to utilise this study again, the estimates generated could be indexed to appropriate measures of inflation or income growth to account for the time that has elapsed; or alternatively, the paper may provide a methodology with which an up-to-date study can be replicated. There may also be scope to conduct more RP work on water hardness, if this is of sufficient importance to Anglian's business plan.

B.4. Water Resource Options

This category of attribute relates to different options by which water companies maintain the supply demand balance. Unlike other attributes covered in this chapter, these represent the means by which water companies deliver service to customers; they are not “outputs” as such. However, they represent an important part of the CBA and WRMP process, and customer engagement suggests customers have strong preferences around the various alternatives open to companies, in particular with reference to leakage reduction and some other types of demand management option.

B.4.1. Anglian Water's approach at PR14

Anglian estimated customer's preferences for different water resource options in the second stage Survey on Water Resources. The survey considered attributes related to water use restrictions (see Section B.2.1) as well as water efficiency and capacity, including levels of leakage, preferences for meters, usage policies and acceptable sources. The survey also asked qualitative questions on attitudes towards the use and conservation of water.¹⁷³

Seven Water Resource Options were tested in a series of choice experiments, and from the experiments, relative rankings of preference were obtained. The seven water resource options were:¹⁷⁴

- Taking more from rivers and groundwater
- Taking water from the sea and treating (desalination)
- Constructing a new reservoir
- Increasing existing levels of leakage detection and repair

¹⁷³ Eftect and ICS Consulting (2013a), “*Anglian Water PR14 Second Stage Water Resources: Final Report*”, p. 1.

¹⁷⁴ Eftect and ICS Consulting (2013a), p. 10.

- Increasing the number of domestic customers who are metered
- Reusing Treated Wastewater
- Increasing water transfers from other regions

A graphic show card was used to briefly demonstrate the seven options, before a series of show cards were presented to explain in more detail the nature of each option. Respondents were also informed that all options were carbon neutral, and that any energy use would be from renewable sources, thus reducing the tendency for a customers' preference to be influenced by their broader environmental preferences.

For both residential and commercial customers, only leakage reduction produced a result that suggested customers' preferences favoured this option above others at the 95% significance level (i.e. for the six other options, the weighting from which Anglian's consultants derived valuations was not significantly different from the others water resource options).¹⁷⁵

B.4.2. Industry practice and guidance

Given that these alternative water resource options are not services or outputs that customers would normally be expected to value, the 2011 UKWIR guidance does not provide advice on the appropriate approach that should be followed when seeking to value changes in these alternative water resource options for "their own sake".

Nonetheless, at PR14 some firms directly asked households and businesses for their valuation of leakage reduction. Units used in choice experiments included the percentage of water lost, the number of litres lost a day per household, and the number of properties that could be supplied (by the lost water).¹⁷⁶

Many companies chose not to directly ask customers about leakage in their WTP surveys on the grounds that it was a prohibitively complex idea, or that leakage is a by-product of other issues (such as resilience, water efficiency and metering).¹⁷⁷ Instead, it was restricted to qualitative and more deliberative research.

In their 2014 report for UKWIR, Blue Marble noted that customers broadly identified leakage as a high priority, but that it was difficult to apply to research. It notes "'uninformed' customers have a personal view on the [leakage] performance of a water company, although often formed on hearsay rather than personal experience".¹⁷⁸ Customer understanding of the "economic level of leakage" is limited, with most customers disapproving of any amount of leakage.¹⁷⁹

¹⁷⁵ Efect and ICS Consulting (2013a), p. xii.

¹⁷⁶ Accent (2014), p. 36.

¹⁷⁷ UKWIR (2014), p. 70.

¹⁷⁸ UKWIR (2014), p. 70.

¹⁷⁹ UKWIR (2014), p. 70.

Blue Marble's report for UKWIR gave a series of specific guidance on leakage:¹⁸⁰

- Where companies wish to discuss detailed issues around leaking, in-depth research and consultation would be required, such as through lengthy workshops.
- The Economic Level of Leakage appears most suitable for discussion in stakeholder engagement rather than customer engagement, where the concept is difficult to make accessible to respondents.
- Companies should consider asking customers for the level of leakage they perceive to be acceptable, the so called "Emotional Level of Leakage". The water company would then need to ensure they adapt their approach to managing leakage and their communication of this issue in order to shape customer perceptions.

Despite the widespread caution about discussing the Economic Level of Leakage in customer engagement, Northumbrian Water carried out research using visual representations to direct understanding, and found that customers involved developed a "full understanding" of the matter.¹⁸¹ In focus groups, customers were shown a slide which demonstrated the current level of leakage, and how the current level of leakage was the efficient level, given the cost of finding and fixing more leaks is greater than the cost of producing the water that is lost. Respondents were then shown a series of water bottles with a proportion of water missing, each labelled to specify the level of leakage the bottle represents, and the cost of reducing leakage to that level. After checking the understanding, the interviewer then asked participants to write their preferred level of leakage. In Essex, 100 per cent of participants indicated the current level of leakage should be maintained, while in Newcastle, where the cost of reducing leakage was lower, approximately a third of participants favoured a decrease in leakage.

A particular example of innovative, interactive research methods used at PR14, was Severn Trent's use of an interactive tool to determine customer responses to issues around resilience and water resource options. The tool, used in their online survey, allowed customers to play off different combinations of supply and demand, changing supply sources, for example, by increasing extraction from rivers or expanding reservoir capacity, or decreasing demand via reducing leakage or increasing domestic metering.¹⁸² This method elicited clear preferences for preferred supply and demand management options, while making clear the cost implications of such changes, and the "carbon footprint" associated with these changes. This method resulted in an average WTP of an extra £30.05 to change water resource options, with a particular preference amongst respondents for increased domestic metering and reduced leakage.¹⁸³

¹⁸⁰ UKWIR (2014), p. 72.

¹⁸¹ UKWIR (2014), p. 73

¹⁸² UKWIR (2014), p. 78.

¹⁸³ UKWIR (2014), p. 78.

B.4.3. Wider options and recommendations

B.4.3.1. Improving on the SP methods used at PR14

Leakage and Water Resource Options are a particularly difficult area of attributes in which to apply SP research, given customer understanding is particularly weak. A particular challenge is that customers confuse certain water resource options with preferences for certain other service attributes or environmental options, and incorrectly assume that lower leakage leads to lower bills. This is an area where we consider that some improvements could be made compared to the methods used by Anglian at PR14 to value these attributes using SP (in addition to the general improvements to SP) presented in Chapter 5.

Figure B.2 shows an example of the choice cards Anglian used at PR14 to evaluate different water resource options, both on the supply- and the demand-side. In this case, the option being evaluated is leakage reduction, but the same presentation was used to evaluate a range of different options.

Figure B.2
Example of Choice card used by Anglian Water at PR14 – Water Resources

Option type	EXTEND THE PROGRAMME OF LEAKAGE REDUCTION - Using technology to avoid digging up roads
Impacts	Environmental Impact: None Disruption: None as technology used to avoid digging up roads
Water Saved	50 million litres per day (5% of daily usage in Anglian Water)
Reliability of Water Savings	Low - Considerable Uncertainty Around How Much Water is Saved
Change in annual bills	Increases by £15 per annum

Acceptable - yes or no

Source: Anglian

Anglian used a similar approach on the wastewater side, examining customers' preferences for alternative solutions to reducing the probability of sewer flooding incidents, using choice cards like that shown in Figure B.3.

Figure B.3
Example of Choice card used by Anglian Water at PR14 – Flooding Options

Option type	Construction of larger sewers to replace small sewers
Impact on the Landscape	HIGH: Depletion of raw materials Rainwater prevented from recharging the water table
Disruption from construction	HIGH: Significant noise and congestion during construction. Visually unattractive large scale construction No longer term impacts
Properties addressed	50 properties at risk of flooding once every 10 years
Impact on customer bills	Increases by £25 per annum

Acceptable - yes, no

Source: Anglian

An advantage of these types of choice card is that it helps respondents to understand the advantages and disadvantages of implementing each water resource option, by providing a breakdown of the implications in terms of three different dimensions: impacts (divided in turn into environmental impacts and traffic disruption), water saved in expectation, and uncertainty around these expected savings.

However, there are a number of disadvantages with it:

- The main disadvantage of this choice card is that it does not allow respondents to evaluate trade-offs between different options, ie. to compare the impacts and the costs associated with each option, and take decisions accordingly, within the same choice card. Adding a third column with a second resource option would potentially better capture customer preferences *between* resource options and providing more information on how much they trade-off cost against the choice of resource option. Another way of addressing this problem could be to represent changes in leakage and other water resource options as different rows on a choice card, allowing customers to make trade-offs between packages of resource options.
- Some respondents may also be associated certain changes in service with the savings in water that the instrument states come from leakage reduction. Hence, for example, they may believe that by saving water through leakage reduction there would be a reduction in probability of interruptions or restrictions. While this may be true, the resulting valuation may represent both the value customers associate with leakage reduction for its own sake, and the value they think leakage reduction brings in terms of a reduced likelihood of hosepipe bans and interruptions, for instance.

Figure B.4 provides an example of how these problems could be addressed,¹⁸⁴ by designing a choice experiment that asks customers to trade off changes in the bill and service attributes, against alternative water resource options that the company could choose. This approach can be used to understand whether customers care about service, bill effects, or genuinely favour some water resource options over others “for their own sake”.

Separate from this suggested improvement to the SP methods used to value alternative resource options, it is important that any such exercises inform participants about how leakage is minimised, located and repaired. Specifically, respondents must be aware of the current level of work carried out to detect leakages. For example, informing participants of the number of leaks found each year, or the volume/proportion of water that would be lost if these leaks had not been repaired, might inform customers valuation of incrementally increasing leakage repair expenditure. Some effort would also need to be made to explain in simple terms the idea that reductions in leakage do not necessarily reduce the bill.

“Protest votes”, where respondents choose not to answer truthfully in a SP exercise, are likely to be a particular issue for leakage since some customers who wish to see leakage reduced may be inclined to refuse to contribute to reducing something they feel the water company should have already minimised. The best method for reducing this tendency is to ensure respondents are as well informed about the topic as possible, in particular the economic level of leakage. However, industry experience suggests it is particularly difficult to explain this concept.

¹⁸⁴ Albeit within a choice experiment design that conforms in other ways to the methods recommended in UKWIR 2011 guidance on the presentation of attributes and service levels.

Figure B.4
Example of a Choice Card that Asks Customers to Trade-off Alternative Water Resource Options, While Controlling for Changes in Cost and Service

		PACKAGE A	PACKAGE B
1	WATER LEAKAGE The proportion of water that is treated and lost due to leakage	30%	35%
2	WATER CONSERVATION DEVICES Out of XX million properties in the Anglian Water area, the proportion that receive water conservation devices is	5%	3%
3	NEW WATER METERS FITTED Out of XX million properties in the Anglian Water area, the proportion with water meters is	60%	65%
4	RIVER WATER FLOW LEVELS Miles of river classified as having 'low flow' in your area	50 out of 900 miles of river	80 out of 900 miles of river
5	A BAN ON USING THE HOSE PIPE FOR 5 MONTHS beginning in May and ending in September because of drought The chance that this happens at your property in any one year is	1 in 10	1 in 10
6	An UNEXPECTED INTERRUPTION to the water supply at your property lasting between 3-6 HOURS . The chance that this happens at your property in any one year is	1 in 30	1 in 40
7	The CHANGE IN YOUR ANNUAL WATER BILL above inflation to provide the service quality above is (This change is added to a £5 increase in your bill by 2020 due to other factors affecting your water supply and sewerage service. The bill change continues to apply in all years after 2020.)	Increase of £20 by 2020 Gradual increase by £4 every year between 2015 and 2020	Increase of £40 by 2020 Gradual increase by £8 every year between 2015 and 2020

Source: NERA

B.4.3.2. Expanding the role of deliberative and qualitative research

As noted above, the complexity associated with asking respondents to choose the appropriate level of alternative water resource options meant some companies chose to value it through more qualitative and deliberative research. More time is available at deliberative events to explain concepts to participants, allowing them to pay closer attention to the questions and scenarios.

While useful valuation information could be extracted from the form of SP instrument illustrated in Figure B.4, we see significant value in supplementing this research with more deliberative research, ie. to support a triangulation of values. For instance, water resources deliberative events could culminate in participants being asked how much of a premium they would be willing to pay for the water company increasing the use of certain water resource management options, holding constant other service attributes they may value for other reasons (environmental benefits, resilience, etc).

Anglian may also wish to consider exploring customer understanding and reaction to the relationship between metering, pipe ownership and leakage. Metering can be associated with reductions in leaks in customer supply pipes, since a metered customer is more incentivised to reduce their water demand.

B.4.3.3. RP methods and “indirect” SP

RP techniques have been considered for assessing customer attitudes toward water conservation, and could also be applied, indirectly, to value reductions in mains water leakage, by assuming customers’ preferences towards water wastage in their household is equivalent to the extent they expect the network to reduce “wastage”.

Cascade Consulting, in research commissioned by Ofwat in 2011, recommended that the purchase of more water efficient appliances (dishwashers and washing machines) could be applied as an instrument for estimating avertive behaviour with regards to water efficiency, with data sourced from consumer insight (by market research agencies) on the aggregated sales of products, or surveys of households and business expenditure.¹⁸⁵ For a true relationship to be present, the consumer must be fully aware of the relative water efficiency of different appliances, and for it to be a consideration when they decide to purchase a new appliance. As such, surveys of consumers may be required to determine the extent to which they take account of efficiency when deciding between appliances, before it can be determined if any relationship would be spurious.

It may also be possible to apply SP methods to scenarios involving the purchase of different household appliances, with water efficiency as one of a number of attributes which the respondent would trade-off. This would generate a WTP for reduced water consumption, by using factors besides the water bill as a payment vehicle for estimating customer valuation for water conservation measures. In addition, testing attitude to water efficiency away from the context of water resource options may be useful, particularly as a triangulation exercise, should it be found that participants are more or less willing to pay for this attribute when considered in the context of a private purchasing decision.

In addition, metered customers may chose water efficient appliances in order to reduce their private costs, and not due to their altruistic preference for water conservation. However, some RP information could still be gleaned from non-metered customers’ expenditure on water efficiency devices, while noting that the non-metered segment of the population may not be representative of the wider population.

¹⁸⁵ Cascade (2011), p. 25.

B.4.3.4. BT

As for other attributes, there may be possible to use BT methods, drawing on the findings from previous AW valuation research. However, for the reasons set out above, we have some concerns with the form of SP instrument that was used to value these alternatives, so this approach should be implemented with particular care.

B.4.4. Conclusions

RP methods are unlikely to provide a full assessment of the value that customers place on alternative water resource methods. However, they could provide some background to a case that customers value water conservation. For instance, demonstrating that non-metered customers spend money to conserve water at their own premises could support this case, but it would still be unclear whether they are valuing water conservation for its own sake or because of perceived environmental benefits.

SP is potentially a useful tool to test whether customers value certain water resource options above others, but some improvement would ideally be needed compared to those methods, as set out above, in particular by controlling for the factors that customers could associate with some conservation measures in order to tease out the values customers place on certain types of measure “for their own sake”.

B.5. Environmental Services

Anglian is responsible for a number of environmental services relating to the quality of public bodies of water as well as coastal waters in the region. Societal valuation is required for some other environmental attributes, including customers’ valuation for reducing the number of pollution incidents (such as sewer overflows) and specific habitats.

B.5.1. Anglian Water’s approach at PR14

In its Main Stage survey, Anglian asked respondents about three environmental attributes, which were grouped together as a single ‘block’, and tested in the same choice experiment:¹⁸⁶

- Number of pollution incidents per year;
- Number of coastal waters achieving ‘excellent’ quality; and
- River water quality assessments meeting ‘good’ or better.

A show card explained the three attributes and to what extent the water company can affect the number of these incidents. The show card also explained that ‘pollution incidents’ related directly to incidents in relation to waste water, and were generally caused by sewer overflows after heavy rain. Respondents were also shown a map which noted the 2011 classifications of water quality at beaches in the Anglian Region, and a further show card explaining the attributes of a “good” quality river, alongside two graphic examples.

¹⁸⁶ Eftec and ICS Consulting (2012), Table 3.3.

A second stage Survey was carried out on the environment which focussed on river quality, although it also asked qualitative questions about customer attitudes towards the environment. The survey estimated customers' relative ranking of pollution incidents of different severity, as well as improvements to river quality according to different levels ("good", "medium" and "poor").¹⁸⁷ Customers' ranking of attributes of river quality were also estimated, relating to fish and animal life, plant life, water flows and levels, and the amount of litter and debris in the water.¹⁸⁸ Show cards were used, containing pictures and definitions to explain the difference between the three river quality rankings and pollution incident severities.

The second stage survey allowed for attributes of river quality to be represented by an index, which was then applied to Cascade Consulting's 'Ready Reckoner' tool for estimating impact on the Water Framework Directive water quality assessments.¹⁸⁹

Anglian subsequently estimated valuation of changes in coastal water quality to and from different levels by using the relative weights from an Environment Agency study which considered changes in quality across a number of levels, to the estimate for movements from "sufficient/good" to "excellent" from Anglian's Main Stage survey.¹⁹⁰

Independent of the SP studies, Anglian estimated the value of investment in shellfish waters using market prices, by considering the relative value of shellfish harvested from water of different qualities.¹⁹¹

Anglian valued "specific habitats", namely the five Anglian Water Parks (located at Anglian's reservoirs), using the travel cost method, estimating the distance travelled by visitors to each site, the cost and value of time spent travelling and the value of the leisure time itself.¹⁹²

As at PR09, there were a number of service measures related to the environment for which societal valuation was not conducted, for example, carbon emissions and the value of important habitats (Sites of Specific Scientific Interest). Instead, Anglian used government issued values and academic literature, ie. a BT method.

B.5.2. Industry practice and guidance

In the 2011 UKWIR guidance, cognitive testing was carried out to check for overlaps between customer understanding of the 'pollution incidents' and 'river water quality' attributes. This found that there was little confusion between the two attributes, allowing for their continued use alongside each other in SP surveys.¹⁹³

¹⁸⁷ Eftec and ICS Consulting (2013d), "*Anglian Water Environment Study: River Quality and Pollution*", p. 9.

¹⁸⁸ Eftec and ICS Consulting (2013d), p. 8.

¹⁸⁹ Eftec and ICS Consulting (2013d), p. 13.

¹⁹⁰ Eftec and ICS Consulting (2013e), "*PR14 Customer Research: Completion Report*", p. 21.

¹⁹¹ Eftec and ICS Consulting (2013e), "*PR14 Customer Research: Completion Report*", p. 37.

¹⁹² Eftec and ICS Consulting (2013e), "*PR14 Customer Research: Completion Report*", p 68-69.

¹⁹³ UKWIR (2011), p. 38.

Across the three key environmental attributes, UKWIR recommended that regional or national research would be suitable for separately eliciting customers' valuation of improvements to the environmental attribute beyond a 30-mile radius.¹⁹⁴ This would go some way to separating the altruistic (existence) and private (use) values of consumers. They also suggested that a distance decay measure could be obtained if a sufficient number of customers were questioned, determining the extent to which valuation of these attributes is affected by the proximity to rivers and beaches, and, by incorporating a distance component, a potentially more reliable valuation of these attributes could be found.¹⁹⁵

There was no standard category used to ask for valuation of pollution incidents across water companies and even for those considering the same category of incident, aggregated valuations varied hugely.¹⁹⁶ One firm estimated total WTP for preventing a single category 3 incident at £26,572, while another estimated the value of reducing a single category 2 incident (i.e. a less serious incident) at £3,665,228, a difference in magnitude of over 140 times. This suggests that valuations were especially sensitive to the survey instrument used and/or the definitions presented to participants.

In general, firms at PR14 asked customers to value an improvement in river quality to a "good" status, although again, some firms also asked about improvements to different standards. There was substantial variation in valuations between regions. While different units and definitions make comparisons difficult,¹⁹⁷ some reasons for this variation could include since rivers being more prominent and prevalent than others, existing river water quality differences across areas, and customers in rural regions may place more value on clean rivers than those in urban areas.

Not all firms asked customers to value bathing water quality, although some companies' regions contain few or no coastal areas. From a sample of nine companies, all used improvements in the category of sites as the unit of measurement, although the category (good, sufficient or excellent) varied from firm to firm.¹⁹⁸

B.5.3. Wider options and recommendations

B.5.3.1. SP valuation research

SP has a long track record of use to value environmental attributes, both in the water and other industries. One reason for this is that it takes account of 'existence value' better than RP methods or market data. Existence value is the value that people place on simply knowing that the natural environment in general or a specific environmental asset is protected and preserved, beyond any value from visiting or taking advantage of the environment in question; as such it would not be picked up in any RP method.

¹⁹⁴ UKWIR (2011), p. 37.

¹⁹⁵ UKWIR (2011), p. 37.

¹⁹⁶ Accent (2014), p. 18.

¹⁹⁷ Accent (2014), p. 20.

¹⁹⁸ Accent (2014), p. 21.

However, the wide variation in valuations for environmental attributes found at PR14, suggests that the valuations reported by customers were significantly dependent on the nature of the survey carried out and the context in which the questions were asked.

Given the wide range of valuations for environmental attributes across regions, it may be helpful to carry out cognitive testing on various different versions of the show cards, interviewer scripts and choice cards; particularly if it is found that subtle changes in the information presented lead to significantly different understanding of the issue. In essence, Anglian may wish to programme in more cognitive testing of alternative SP designs if environmental valuations are important elements of the business plan. For instance:

- In Anglian's PR14 Main Stage survey, a large amount of information was presented to customers compared to other attribute blocks. There is potential for large amounts of information to "overload" and confuse survey respondents.
- Although, conversely, failure to present sufficient information to the customer when valuing complex, specific, attributes, is likely to result in insufficient understanding, and can generate an unreliable estimate of WTP.

It is worth noting that there was not an especially strong disparity between the online and telephone survey estimates of household customers' WTP for the three environmental attributes.¹⁹⁹ This could suggest (although this hypothesis would require testing) that any issues with the choice experiment are likely to be related to wider customer understanding of the attributes or the way in which they are presented, as opposed to the extent to which customers were able to comprehend the information presented to them.

B.5.3.2. Extended use of qualitative research

Less prescriptive, qualitative research may also produce useful insight into customer preferences for various environmental attributes. Anglian asked a number of introductory questions in the environment study on attitudes towards the environment and specific environmental attributes.²⁰⁰ While it is not possible directly to compute a WTP for specific service measures from such questions, it may be possible to estimate customer preference for directing investment towards specific environmental services over others. While less precise than a quantifiable WTP estimate, it may be more appropriate if there is concern that the WTP estimate is inaccurate.

More deliberative events could also be used to inform customers on the nature of choices facing the company and then to ask them to answer WTP questions. In common with our suggestions and recommendations for other complex attributes, deliberative exercises could help to determine if well informed customers exhibit a different WTP from other customers.

¹⁹⁹ For the three environmental services attributes, willingness to pay estimates from the CATI surveys were on average 60% higher than the online survey, compared to an average difference of 54%.

Eftec and ICS (2012), p. 47.

²⁰⁰ Eftec and ICS (2013d), Annex 3.

Innovative SP methods (such as those discussed above with reference to resilience in Section B.2.2, and new considerations discussed in Chapter 5) are likely to be a particularly helpful in assisting customer understanding of environmental options, due to the complexity and need for good customer understanding.

It may be appropriate to measure WTP for local and regional customers separately, reflecting the distinction between altruistic values and private use values for environmental attributes. UKWIR guidance suggests that an appropriate limit for local valuation is 30 miles, although in the case of coastal water quality in particular, the extent to which a valuation is altruistic or personal may be less related to distance, since people may travel further afield to use beaches and do not necessarily use the one most local to them.

A distance decay function could be applied to estimates of WTP for coastal and river water quality. This would take account of valuations being highest for respondents located closest to the environmental attributes in question.

B.5.3.3. Hedonic pricing

Hedonic pricing in relation to environmental assets would involve estimating the “price premium” paid for properties in close proximity to environmental assets. While controlling for other demand factors likely to influence the price of a property, econometric modelling could determine the extent to which property buyers value the additional utility from an environmental asset. In practice, it may be difficult to find appropriate data, and equally difficult to isolate a relationship, since such a wide range of factors determine property prices. Estimating the difference in valuation of properties near to rivers or coastal areas of different *quality* may be even more difficult.

Another issue for coastal water quality, is that house prices are likely to reflect a number of other attributes in relation to the ‘seaside’, for example value derived from leisure facilities, aesthetic features of the coast, and enjoyment of the sea unrelated to the cleanliness of the bathing water. This could be a particular problem should these attributes be correlated with the variable of interest, bathing water quality. As the ‘river water quality’ attribute encompasses a wider range of features of a river’s attractiveness, it is less likely to be problematic, although there are still likely to be some aesthetic features of a river which would affect property prices irrespective of the quality of the river according to its water quality assessment.

A way around this challenge could be to conduct case studies of areas where beaches have or rivers have been cleaned up, to evaluate the impact on property prices relative to those areas where the quality of local rivers or beaches has not changed. Of course, this would require relatively targeted data, and it may still be challenging to control for other local factors that influence property prices in local areas. Another approach could be to conduct “indirect” hedonic pricing research, interviewing estate agents or surveyors about the change in house prices that could arise due to changes in the local environment. This approach would represent an innovation that, as far as we are aware, has not been attempted in the UK water industry before.

B.5.3.4. Travel cost method

The travel cost method seeks to value environmental improvements by decomposing the demand for outdoor recreational activities into its constituent parts, including the quality of the environmental facility and other costs of accessing the facility.

In applying the travel cost method, a lower bound of a customers' valuation is estimated based on the component costs of visiting a site. Costs include travel expenditure (fuel, public transport tickets, parking), admission fees, travel time, and the opportunity cost of making a journey. For example:

- As part of wider work to value ecosystems, recent research carried out by the ONS has applied the travel cost method to value recreational attributes of freshwater in the United Kingdom.
- This paper uses data on visits, travel cost and admission fees to approximate total WTP for recreational visits, with data sourced from government commissioned surveys.²⁰¹
- The authors chose not to include an estimate of the value of visit time (opportunity cost of visiting this site rather than another activity, recreational or otherwise), but recognise that such information should be included in estimates.²⁰²
- This survey presented estimates of the recreational value of freshwater for each year from 2008 to 2012, perhaps indicating the difficulty in obtaining suitable data for a full set of years.

This ONS Freshwater valuation study represents a relatively advanced example of application of the travel cost method; however, given that this data omits a valuation of travel time, it probably underestimates WTP for the recreational value of freshwater. This indicates the difficulty in applying the travel cost method when reliant on data from various sources.

Finally, it must be noted that any valuations carried out by Anglian using the travel cost method will need to “translatable” into the units applied to the water resource management plan, business plan and other components of the price control. In applying the travel cost method to *marginal* increases in river and coastal water quality, visitor numbers (and time spent travelling) would need to be estimated for specific rivers and beaches of different qualities. This may be difficult, and, in common with the hedonic pricing method, may make it particularly hard to find a statistically significant relationship.

A potentially simple survey based approach applying the travel cost method to improvements in river and coastal water quality may be to survey people who use beaches and rivers in the Anglian area, to understand the reasons why they choose to visit those which are not closest to them. For any who chose to visit further away recreation sites due to the water quality, the

²⁰¹ Office for National Statistics (2015), “UK Natural Capital – Freshwater Ecosystem Assets and Services Accounts”, p. 25.

²⁰² Office for National Statistics (2015), “UK Natural Capital – Freshwater Ecosystem Assets and Services Accounts”, p. 24.

additional travel time and expenditure could define an estimate of WTP for improvement in a site closer to their home.

B.5.3.5. BT

As for other attribute groups, previous relevant SP studies, both for the Anglian region and other water companies, may be useful for BT to the next price control, either as a substitute for new research, or to triangulate other estimates. However, the huge variation in definitions used across attributes related to environmental services at PR14 makes BT from other regions particularly difficult.

BT is a widely used practice in RP research for valuing environmental areas, for example a largescale project valuing Nearshore Natural Capital on British Columbia's Lower Mainland, by transferring estimates from a large number of studies which used various RP approaches, including estimated opportunity cost, the travel costs method and hedonic pricing with regards to property prices. When transferring values from other studies, costs were scaled according to the relative area covered by the two areas. The project set out to value this specific environment across a number of attributes, including its recreational value, which was estimated at between \$22,612 million and \$44,181 million dollars.²⁰³

For instance, the National Water Environment Benefit Survey (NWEBS) provides a useful benchmark for valuing river water quality improvements in Anglian's region. The NWEBS values, based on the 2007 NERA and Accent study for Defra,²⁰⁴ were updated in 2013 by the Environment Agency. This study estimates per kilometre values for improvements in river quality from bad to good, poor to moderate, and moderate to good, while also estimating per kilometre valuations for individual rivers, allowing for a relatively simple estimate to be applied to the Anglian region.²⁰⁵

B.5.3.6. The "Natural Capital" Approach

In its most recent guidance on environmental valuation, the Environment Agency has encouraged companies to use an "ecosystem services" approach when evaluating the environmental costs of investment options at WRMP19.²⁰⁶ This approach aims to evaluate the value of an ecosystem interpreted as an asset for the society, as part of the country's "Natural Capital".

The UN Millennium Assessment (2005) taxonomy provides a framework under which to consider the value of Natural Capital services, including those provided by the river

²⁰³ Molnar, M. et. al., (2012), "*Valuing the Aquatic Benefits of British Columbia's Lower Mainland. Nearshore Natural Capital Valuation*", p. 87.

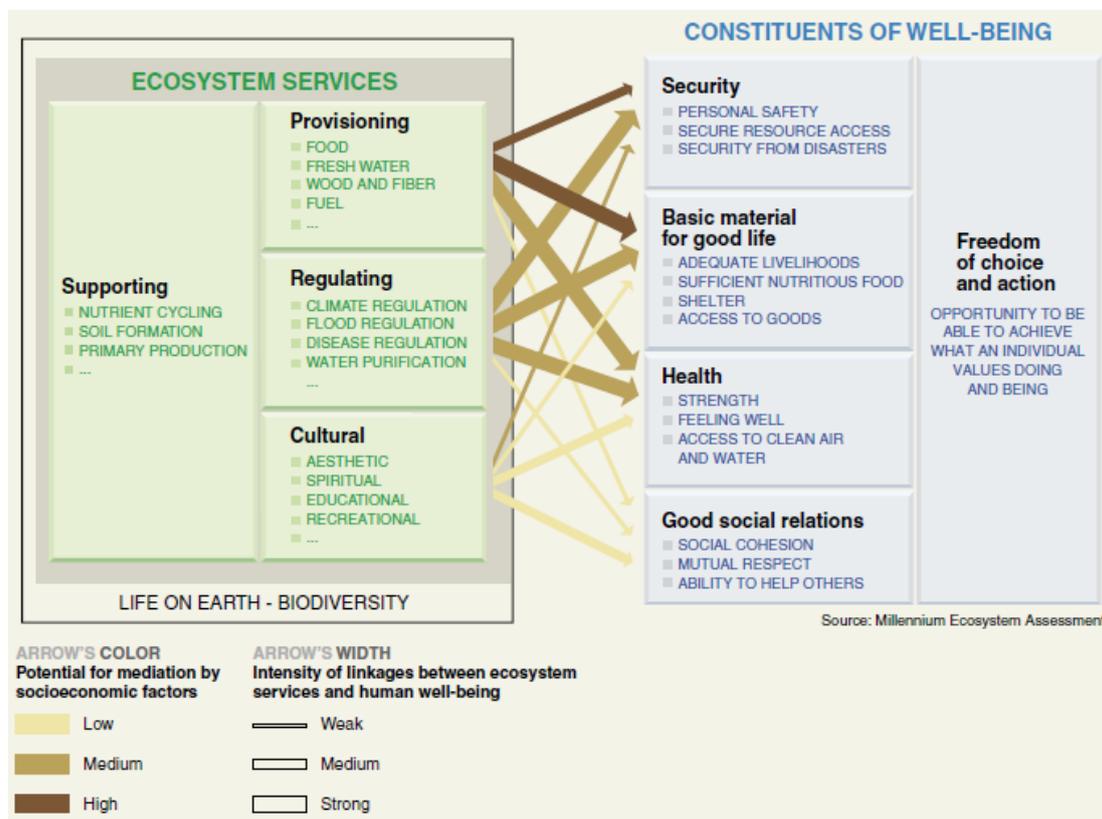
²⁰⁴ NERA for Defra (2007), "*National Water Environment Benefits Survey*".

²⁰⁵ Environment Agency (2013), "*Updating the National Water Environment Benefit Survey values: summary of the peer review*", Annex.

²⁰⁶ Environment Agency (October 2016) "Environmental valuation in water resources planning - additional information"

environment. This method classifies the benefits provided by an ecosystem into four types of services – supporting, provisioning, regulating and cultural – as set out in Figure B.5.²⁰⁷

Figure B.5
Linkages Between Ecosystems and Well-Being



Source: UN Millennial Assessment (2005)

Under this framework, each type of service can be evaluated using a different method, including the SP, RP, and BT options described above. For example, “cultural” ecosystem services can be evaluated using travel cost data (or targeted SP), “provisioning” services can be evaluated using market data (in a similar way as Anglian used shellfish market data at PR14), and “regulating” services can be evaluated using BT from environmental studies.

The ONS (2015) study used this taxonomy to estimate the economic value of the UK freshwater ecosystem assets.²⁰⁸ Table B.1 shows the ecosystem services that the study considered; supporting services were not included, to avoid double-count. The study estimated that the total “asset” value of these services was of £39.5 billion (NPV) in 2012. This result should be considered as a lower bound, since it did not include many of the service categories listed (due to the lack of available data).

²⁰⁷ UN Millennial Ecosystem Assessment (2005) “Ecosystems and Human Well-Being”, p.50

²⁰⁸ ONS (2015) “UK Natural Capital – Freshwater Ecosystem Assets and Services Accounts”

Table B.1
Ecosystem Services Assessed by ONS

Provisioning Services	Regulated Services	Cultural Services
Fish extraction (✓)	Carbon sequestration (✓)	Recreational (✓)
Water abstraction (✓)	Hydrological regimes	Educational (✓)
Peat extraction (✓)	Pollution and detoxification	Recreational fishing
Hydropower	Erosion protection	Spiritual, inspirational and aesthetic
Navigation	Flood protection	
Plants	Fire protection	

Source: Adapted from ONS (2015)

Note: services marked with a (✓) were monetised.

This method could be applied to evaluate the Natural Capital value of Anglian's rivers (or bathing water bodies) when their environmental assessment is "good", when it is "medium", and when it is "poor". This would require an appropriate understanding of the consequences of each of these statuses over each of the ecosystem services in the framework.

The main challenge of this approach is to be able to obtain a valuation for each of the ecosystem services. If a significant part of the services cannot be evaluated due to the lack of available data, this method can only be used as a cross-check of the more established SP methods, or as a lower bound in the "triangulation" process.

B.5.4. Conclusion

SP has previously been the predominant method for valuing environmental attributes in the UK water industry, while there is a relatively large existing body of work applying various RP techniques to the valuation of environmental assets and attributes. Most existing examples of RP valuations of environmental assets, are limited in their ability to value incremental changes in the *quality* of an environmental asset.

If Anglian's business plan is not sensitive to environmental attributes at present, or if they are not considering any strategic investments related to these service areas, it may be that extensive new research in this area is not necessary, and should instead be directed towards other attribute areas, despite apparent difficulty in the existing methods used by water companies for this attribute group. However, additional new RP research could be useful in identifying a lower bound on customer valuations.

B.6. Flooding and Sewage Plant Nuisance

This category of attribute relates primarily to service measures affecting waste water customers, in particular sewer flooding and nuisance incurred by properties located close to sewage plants. In addition, this section also considers mains water flooding incidents.

B.6.1. Anglian Water's approach at PR14

The PR14 Main Stage survey considered three attributes related to wastewater services: two aspects of sewer flooding (flooding inside properties and flooding in external areas), and the

number of properties affected by sewage plant nuisance.²⁰⁹ All attributes were described in a show card, which made clear that internal sewer flooding has greater impacts than external sewer flooding. The show card for sewage plant nuisance explained that nuisance includes odours and the presence of a large number of flies. While at present 5,000 properties are affected by sewage plant nuisance per year, this could be reduced substantially to 500 in the highest cost scenario.²¹⁰

A second stage SP survey focussed on customer's views of the nature of potential flooding events, including water mains flooding, and consideration of the severity and property types affected by sewer flooding.²¹¹ Factors included the property types affected, the location (internal or external), the severity of the flood, the frequency, and whether the flood water is mains water or sewage.²¹²

The second stage survey also estimated customers' relative preference for three flooding solutions; sewer construction, surface water drainage, and "Customer Solutions" (i.e. providing support for customers removing hard surfaced outdoor areas.

B.6.2. Industry practice and guidance

Anglian's approach to valuing flooding and nuisance at PR14 appears to have been broadly similar to other companies and to the guidance provided to the industry. The UKWIR guidance recommended that all three sewage attributes were presented altruistically, that is "at other people's properties".²¹³

The guidance recommended that sewer flooding be valued in two variables, one for internal flooding, getting "into other people's properties" and one for external sewer flooding, getting into gardens/carparks, public places, or close to other people's properties, potentially with gardens and carparks used only for residential and non-residential properties respectively.²¹⁴

For both types of sewer flooding, the guidance recommended that the level descriptor should be presented as a chance rather than as the total number of incidents, in order to maximise consistency amongst level descriptors and to aid understanding.

UKWIR's guidance recommended that "Odour from Sewage Treatment Works" be tested, with the descriptor stating the number of properties affected per year, with definitions suggesting, for example, that properties are affected about 12 times per year for a day at a time.²¹⁵

²⁰⁹ Eftec and ICS (2012), Table 3.3.

²¹⁰ Eftec and ICS (2012), Table 3.3.

²¹¹ Eftec and ICS (2013b), "*Anglian Water PR14 Second Stage Flooding Survey: Final Report*", p. 1.

²¹² Eftec and ICS (2013b), p. 17.

²¹³ UKWIR (2011), p. 26.

²¹⁴ UKWIR (2011), p. 45-46.

²¹⁵ UKWIR (2011), p. 47.

Definitions used in valuation work at PR14 for sewer flooding and nuisance attributes varied from company to company, and there was a large range in the estimated unit value per property affected. For example, from a sample of nine firms valuing internal property flooding, there was a ratio of smallest to largest greater than 1 to 9.²¹⁶ It appears fewer firms valued sewage plant nuisance, while definitions and descriptions varied. Some companies chose to specify that it would probably happen 12 times a year, while others did not; one firm explicitly stated it could happen “on an almost daily basis”, suggesting it was valuing a different type of problem.²¹⁷

B.6.3. Wider options and recommendations

B.6.3.1. SP valuation research

SP techniques appear to be relatively well established for valuing customer WTP for reducing the number of flooding incidents, although the wide variation in results between water companies suggests there was some difficulty in understanding the attribute or the valuation was particularly sensitive to the definitions, service levels or units presented.

Separately asking for valuations for sewer flooding inside properties and in external areas appears a useful (and well established) way to ensure that respondents “impression” of the disruption and damage caused by the specific flooding even in question is broadly similar across all respondents. Asking for both valuations in the same exercise is likely to reduce confusion, although cognitive testing should ensure that respondents are clear about the difference between the two types of sewer flooding event.

The 2011 UKWIR guidance, discussed above, recommended that surveys should elicit altruistic valuations of sewer flooding, but should also avoid using discrete numbers to represent the number of properties affected by flooding, instead using a ‘1 in X’ chance (probability). While Anglian chose to use a discrete number, this was consistent with its practice across attributes in the Main Stage survey, and was thus unlikely to cause particular confusion; it also avoided potential problems which arise from misunderstanding amongst respondents around the relative likelihood of low probability events. Should the same practice be employed again, cognitive testing of respondent understanding of the attributes may be advisable, as may sensitivity testing to determine how valuations change when the same probability is presented differently.

Sewer flooding exhibited the largest CATI to online survey mode disparity out of all of the attributes tested in the Main Stage survey.²¹⁸ There are a number of reasons why this may be the case. This may reflect difference in valuation between different demographics (given the online sample had a slightly different demographic profile), but may also reflect that understanding of the attributes varied according to the mode of the survey. (see Section 5.7).

²¹⁶ Accent (2014), p. 17.

²¹⁷ Accent (2014), p. 38.

²¹⁸ Eftec and ICS Consulting (2012), “*Anglian Water PR14 Willingness to Pay Survey: Final Report*”, p. 49.

Compared to other attributes, sewage plant nuisance is a relatively simple concept for customers who have not experienced it to understand or imagine. However, valuations for this attribute are likely to be highly dependent on the manner in which the attribute is defined. Therefore, in the presentation of the attribute, we would recommend stating precisely the effects of nuisance and how long it lasts to avoid customers forming their own assumptions that may differ from the reality.

It may also be feasible to value sewage plant nuisance in a targeted survey aimed at properties affected, either alongside, or instead of, asking for an altruistic valuation in the region-wide survey. Those affected are well informed about the disutility cost of the nuisance, while they are also well aware of the current level of the nuisance. Converting results from a targeted survey is, however, more difficult to present as a region-wide WTP for marginal improvements in the attribute.

B.6.3.2. RP methods

The 2011 Cascade report on RP options for UKWIR suggested that the avertive expenditure method could be applied to sewer flooding, by estimating expenditure on flood resistance and resilience methods.²¹⁹ This expenditure would need to be estimated from surveys, since the expenditure could relate to a wide range of materials and fittings (eg. raising electrical wiring can be a flood resilience exercise, yet the majority of expenditure of wiring will be driven by other demand factors). This method is likely to be of limited use, since sewer flooding accounts for only a small proportion of flood events which properties face. The majority of properties who invest significant sums in flood protection are likely to be those at risk of coastal or river flooding.

However, given the focus of SP valuations on obtaining altruistic values for improvement in sewer flooding attributes, we see considerable value in supplementing SP valuations with information on the costs of settling insurance claims following these incidents. The range between the altruistic valuation alone and the sum of the altruistic value and the cost of insurance claims could provide a reasonable range of values for sensitivity analysis and triangulation.²²⁰

Hedonic pricing is likely to be an appropriate method for valuing sewage plant nuisance. The method has previously been applied to estimating the cost of proximity to industrial sites.²²¹ Houses and commercial properties near to a water recycling centre are likely to be lower in value as a result of their proximity, while reductions in the odours emitted by the plant are likely to reduce the extent to which property values are negatively affected. There are specific challenges in estimating a marginal WTP from the hedonic pricing method; if the data collected does not contain enough properties affected by *different* levels of sewage plant

²¹⁹ Cascade (2011), p. 26.

²²⁰ While an altruistic valuation alone is probably a material understatement of the societal cost of sewer flooding, as it excludes the significant inconvenience costs incurred by those affected by flooding incidents, adding it to the cost of insurance claims could produce a slight overstatement of the value, if respondents to a SP exercise factor in an expected impact on insurance premia through reductions in the likelihood of flooding incidents.

²²¹ Boxall, P. et. al (2004), “*The Impact of Oil and Natural Gas Facilities on Rural Residential Property Values: A Spatial Hedonic Analysis*”.

nuisance, it may be impossible to find a statistically significant relationship. There are also challenges associated with disentangling the many different determinants of property prices.

A potentially more useful hedonic pricing method could be to carry out surveys of estate agents or surveyors, to determine how they account for sewage plant nuisance when they value properties. Similar hedonic pricing information could also be obtained by asking estate agents about the effect on property values if it is known that a particular property has suffered sewer flooding, as it may create the impression amongst potential buyers that such an incident is more likely to happen again to that property in the future (even if this is not the case in reality). This approach could provide information on the private (rather than altruistic) value of avoiding sewer flooding incidents.

B.6.3.3. BT

As with other attribute groups, BT may be a useful, cost effective means to triangulate variations generated in new research. In the case of both flooding and sewage plant nuisance, altruistic SP valuations gathered from other water companies may be useful as Benefit Transfers, since altruistic valuations can be applicable across regions. However, since previous valuations for this attribute have exhibited a large range of WTP estimates, and appear particularly sensitive to the customer understanding of the attributes and the manner in which they are presented, previous studies may prove inappropriate in this case.

Similarly, the FHRZ's (Flood Hazard Research Centre) Multi-Coloured Manual, which is a key resource in estimating the costs and benefits of flood risk management in the UK, may provide a source of BT through data on the cost of flood damage. The manual considers damage to residential and non-residential damage separately, and provides a number of datasets on the "MCM-online" platform which may provide triangulation opportunities. In estimating the benefit of flood management schemes, the manual estimates the costs of damage caused by flooding across 140 datasets, considering different types of property, age of building, duration of flood, type of floodwater etc.²²² The dataset also provides a consideration of 'intangible' effects of flooding, including physical and psychological health effects.²²³ In applying this data as a BT, a number of assumptions are required, including, vitally, the depth of the flood water; in addition "surrogate values" are recommended for aspects such as intangible losses, and much of the component parts rely on estimation of national averages.²²⁴ Despite the inclusion of valuation of intangible losses, any such "bottom up" estimate of costs may still omit aspects which would (in theory) be factored into customers' WTP responses to SP surveys. As such, this information may be best suited for triangulation, representing a lower bound value, compared to the valuations obtained using SP.

²²² Penning-Rowsell, E. et. al. (2013), "Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal", p. 87.

²²³ Penning-Rowsell, E. et. al. (2013), "Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal", p. 119.

²²⁴ Penning-Rowsell, E. et. al. (2013), "Flood and Coastal Erosion Risk Management: A Manual for Economic Appraisal", p. 127.

B.6.4. Conclusion

Sewer flooding attributes are particularly challenging to value given they are experienced by relatively few properties. They cause serious effects and entail a mix of altruistic and private valuations. SP probably represents the best basis for obtaining altruistic values, but this could be supplemented by the hedonic pricing methods (eg. by surveying estate agents) and insurance claim data to inform a “triangulated” valuation.

For nuisance attributes, such as noise or odour from sewage treatment plants, both SP and hedonic methods could also be used to inform the valuation.

Appendix C. Literature on Impacts of Online Survey Methods

C.1. Cook et. al. (2007)

This paper considered how WTP estimates change if participants are given additional time to consider their choices, in a study related to Cholera and Typhoid vaccines.²²⁵

- Half of participations answered immediately, while half were given overnight to consider their answers. It was hypothesised that those with extra time would think more carefully about their answers, fatigue would be reduced (reducing chance of inconsistent or seemingly illogical answers), while also reducing any interviewer influence (without removing the ability for the interviewer to help or clarify answers).
- Respondents with extra time violated fewer internal validity tests of utility theory, such as transitivity, stability and monotonicity.
- WTP estimates for all bundles of vaccine were lower in the subsample of participants given time-to-think. The authors are unable to conclude if this lower WTP is a consequence of fewer utility theory violations or a separate mechanism.

This paper compares two types of “face to face” interview, but the distinction between answering immediately and taking time to answer can be applied to a difference in the procedure in online and face-to-face surveys, since the respondent in an online survey is unlikely to feel “pressure” to answer quickly, whereas in the presence of an interviewer (or telephone interviewer) a respondent may feel they are wasting the interviewers time if they take additional time to think about their answer.

C.2. Szolnoki and Hoffman (2013)

A survey on consumers’ preferences relating to wine consumption, albeit not including any WTP questions, found:²²⁶

- A face-to-face survey with 2000 respondents was compared to a telephone survey of 1000 participants, and two online surveys of 2000 and 3000 respondents, via the quota and snowball sampling techniques respectively.²²⁷
- All results apart from the snowball survey were found to be demographically representative.
 - This potentially suggests that telephone surveys need fewer participants to produce representative samples as an online or face-to-face survey.

²²⁵ Cook, J. et. al. (2007), “*Reliability of stated preferences for cholera and typhoid vaccines with time to think in Hue Vietnam*”, *Economic Inquiry*

²²⁶ Szolnoki, G., and Hoffman, D. (2013), “*Online, face-to-face and telephone surveys - Comparing different sampling methods in wine consumer research*”, *Journal of Wine Economics and Policy*.

²²⁷ Note, snowball sampling is a technique where existing participants recruit subsequent respondents, also called “chain referral sampling”.

- Face-to-face, followed by telephone, followed by online quota provided the results more reflective of behavioural characteristics.

C.3. Lindhjem and Navrud (2011)

This paper compares online and face-to-face in-home interviews in a CV survey of biodiversity protection plans.²²⁸ It finds broadly similar results from both, with "little evidence of social desirability bias", and thus supportive of the use of internet surveys for CV.

- Notes survey modes are likely to lead to different responses "if they have different effects on the ways in which respondents come up with an answer".²²⁹
- The same survey was used on 300 face-to-face participants and 385 online respondents.
- The authors find no statistically significant difference in the number of non-responses ('don't knows'), although rates of 8% and 11.1% for face-to-face and online may suggest sample was too small.
- The less time a participant spent on a particular choice card, the more chance of a don't know answer.²³⁰
- The mean WTP is found to be higher in an internet survey than the face to face survey, but again, not with strong statistical significance (ie. at the 5 percent significance level).²³¹
- The authors note they are "cautious of generalisation to other goods and survey types, as our CV survey relates specifically to a complex, environmental good of potentially high non-use values in a European country".²³²

C.4. Yeager and Krosnick (2011)

This paper compares the accuracy of RDD (Random Digit Dialling) telephone surveys with online survey techniques, by comparing a RDD telephone survey with seven online surveys, one in which participants were recruited via a telephone call (using RDD to select participants) and six in which participants were recruited online.²³³

- The survey questions all related to statistics for which the true proportions applying to the population could be compared to the results of the survey (for example, the proportion of respondents holding driving licences was compared to figures from the US Federal Highway Administration).

²²⁸ Lindhjem, H. and Navrud, S. (2011), "Are Internet surveys an alternative to face-to-face interviews in contingent valuation?", *Ecological Economics*, 70(9).

²²⁹ Lindhjem, H. and Navrud, S. (2011), p. 5.

²³⁰ Lindhjem, H. and Navrud, S. (2011), p. 18.

²³¹ Lindhjem, H. and Navrud, S. (2011), p. 20.

²³² Lindhjem, H. and Navrud, S. (2011), p. 26.

²³³ Yeager, D. S., and Krosnick J. A. (2011), "Comparing the Accuracy of RDD Telephone Surveys and Internet Surveys Conducted with Probability and Non-Probability Samples", *Public Opinion Quarterly*, 75(4).

- The study found lower response rate amongst probability sample, which were lower surveys conducted online compared to those on the telephone (15.3% compared to 35.6%). Nonetheless, these surveys were quite accurate. Probability sample surveys were more accurate (i.e. close to official figures) than non-probability surveys.
- Stratification sometimes improved the accuracy of non-probability sampled surveys, but also sometimes reduced the accuracy, suggesting stratification cannot be reliably used to control for representation issues in online surveys.

Appendix D. Detailed Societal Valuation Framework for PR19

In this appendix we include our detailed recommendations for Anglian's PR19 Societal Valuation Framework. Following the process described in Chapter 6, we assess each attribute of service included in Anglian's WRMP and wider Business Plan, and propose a set of studies and methodologies to derive the corresponding societal valuations.

D.1. Drought Resilience

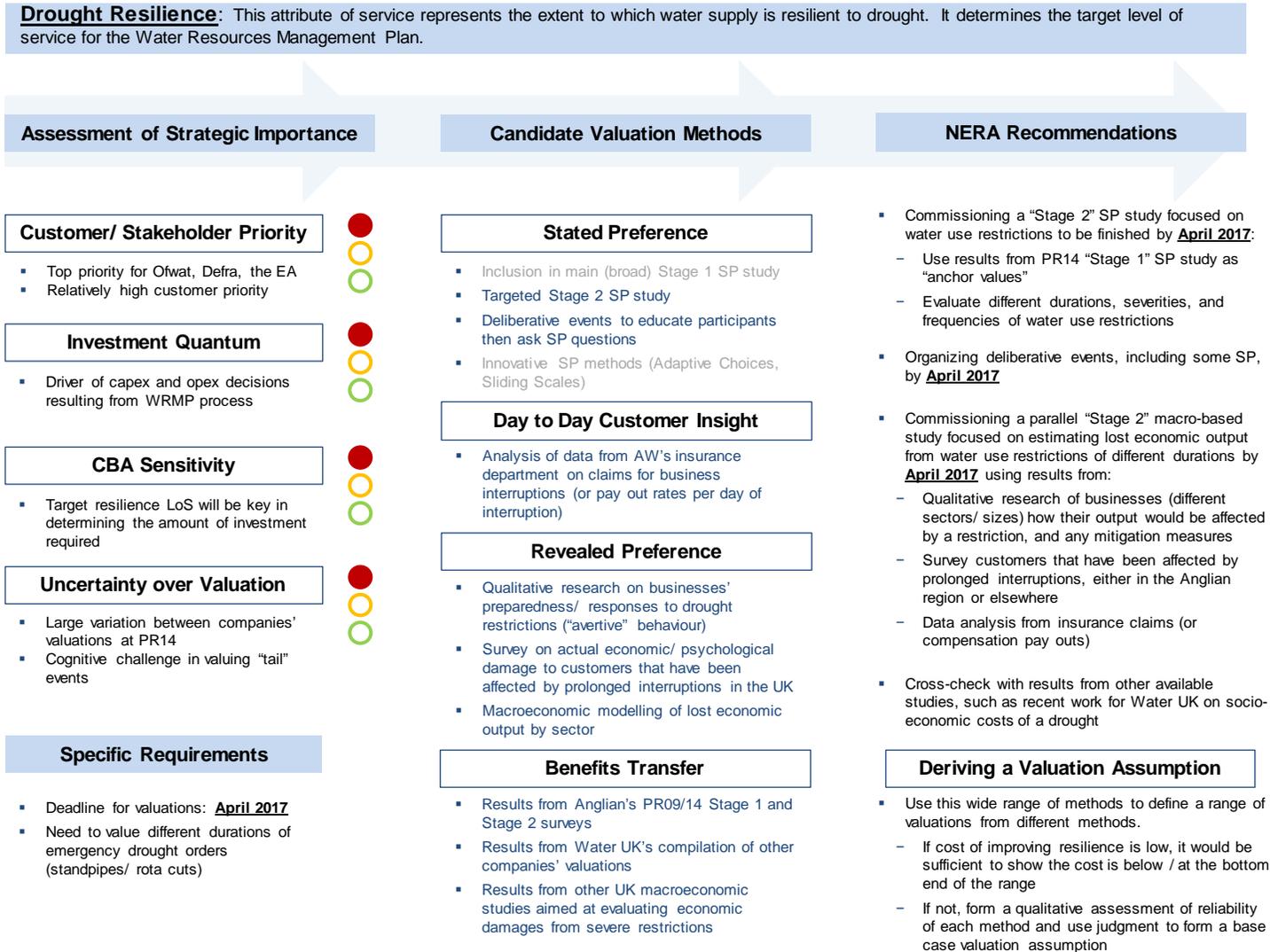
Figure 6.1 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for drought resilience. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of drought resilience in the WRMP and business planning process. As the figure shows, we identify this area as an important strategic priority against all the criteria identified in Chapter 3, so we show red lights against each of them in the figure.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value drought resilience. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by "triangulating" a valuation.

In this case, the relative importance of the drought resilience attribute means that we recommend deploying a relatively large number of valuation techniques through a series of studies. Then, to "triangulate" a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to identify as robustly as possible a lower bound valuation for resilience. This reflects the assumption, which will need to be tested as the business planning process progresses, that the economic value of drought resilience is high relative to the costs of the schemes Anglian is considering.

Also, given the short timeframe over which the drought resilience attributes need to be valued, we have suggested that it may be necessary to draw primarily on existing evidence to value drought resilience in preparing the draft WRMP (such as from the recent Water UK study on drought resilience), then provide new evidence to test/support this assumption later in the programme.

Figure D.1 Societal Valuation Framework Applied to Drought Resilience



D.2. Resilience to “Catastrophic” Incidents

Figure D.2 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for resilience to “catastrophic incidents”, ie. unexpected, severe rare events which may restrict water supply for relatively long periods of time. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of resilience to “catastrophic” incidents in the business planning process. As the figure shows, we identify this area as an important strategic priority against all the criteria identified in Chapter 3, so we show red lights against each of them in the figure.

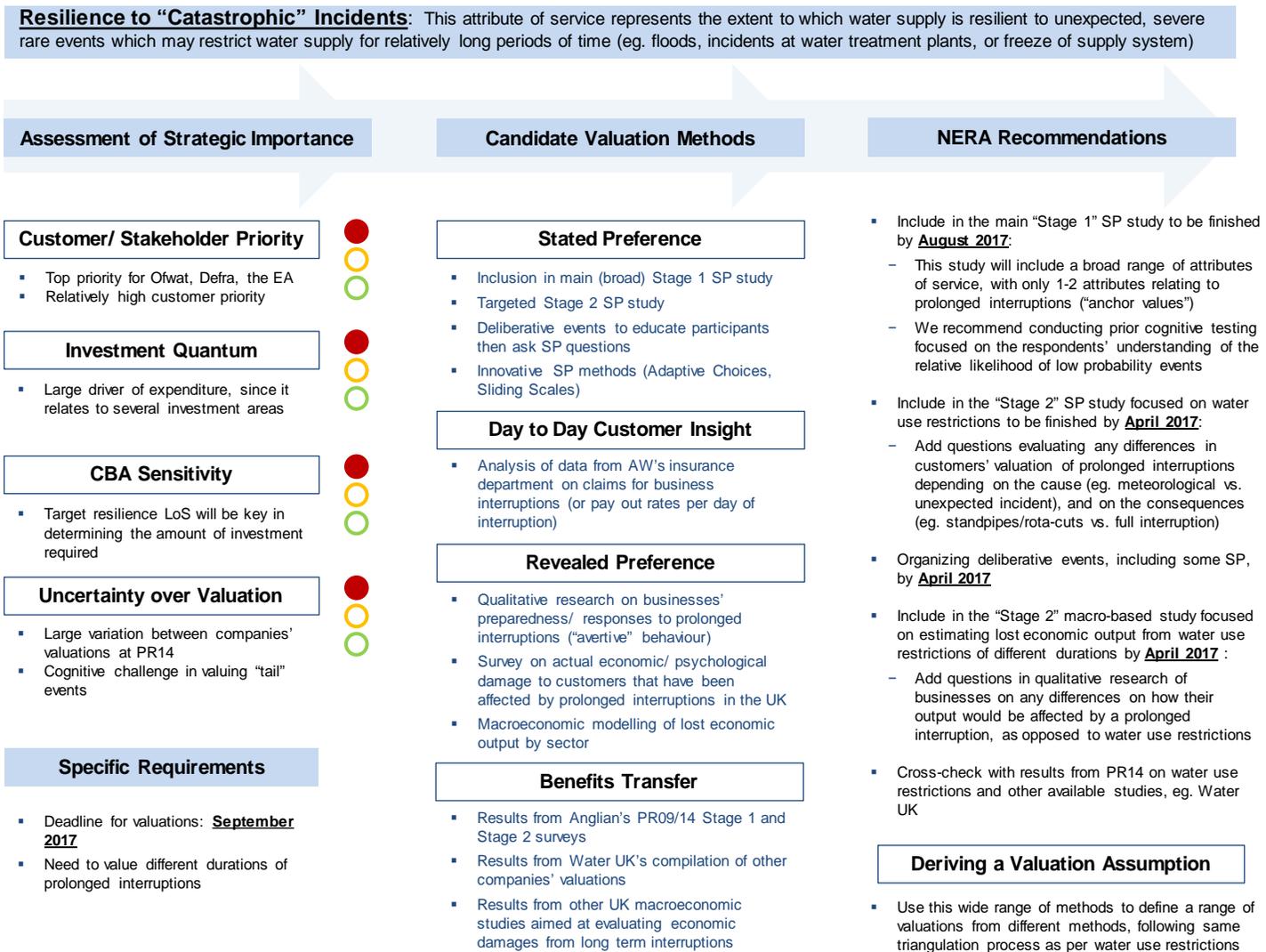
The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value resilience to “catastrophic” incidents. In this case, given the relative importance of the attribute and feasibility of the methods, all available methods are in dark blue text, which indicates that we consider that all methods should be deployed to value this attribute.

Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

Similar to the case of drought resilience, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to identify as robustly as possible a lower bound valuation for resilience. This reflects the assumption, which will need to be tested as the business planning process progresses, that the economic value of resilience to “catastrophic” events is high relative to the costs of the schemes Anglian is considering.

We recommend including most of the analysis as part of the studies targeted to drought resilience, given the similarity of the proposed methods. Therefore, in order to meet the timelines of the WRMP with respect to drought resilience, the results from the “Stage 2” studies related to resilience to “catastrophic” incidents will be available by April 2017. However, since resilience to “catastrophic” incidents is only used for the business plan, final valuations only need to be available by September 2017. Therefore, Anglian will be able to use the results from the new main “Stage 1” stated preference study within the “triangulation” process.

Figure D.2 Societal Valuation Framework Applied to Resilience to “Catastrophic” Incidents



D.3. Supply Interruptions

Figure D.3 Figure D.2 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for supply interruptions.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of supply interruptions in the business planning process. As the figure shows, we identify this area as a high customer and business priority, while noting medium uncertainty and CBA sensitivity around valuation assumptions for this attribute. In particular, we highlight that most of the uncertainty around the valuation of this attribute lies on the relationship between duration of the interruption and willingness to pay to avoid it.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value supply interruptions. In this case, given the relative importance of the attribute, most of the available methods are in dark blue text, ie. we consider that they should be deployed to value this attribute.

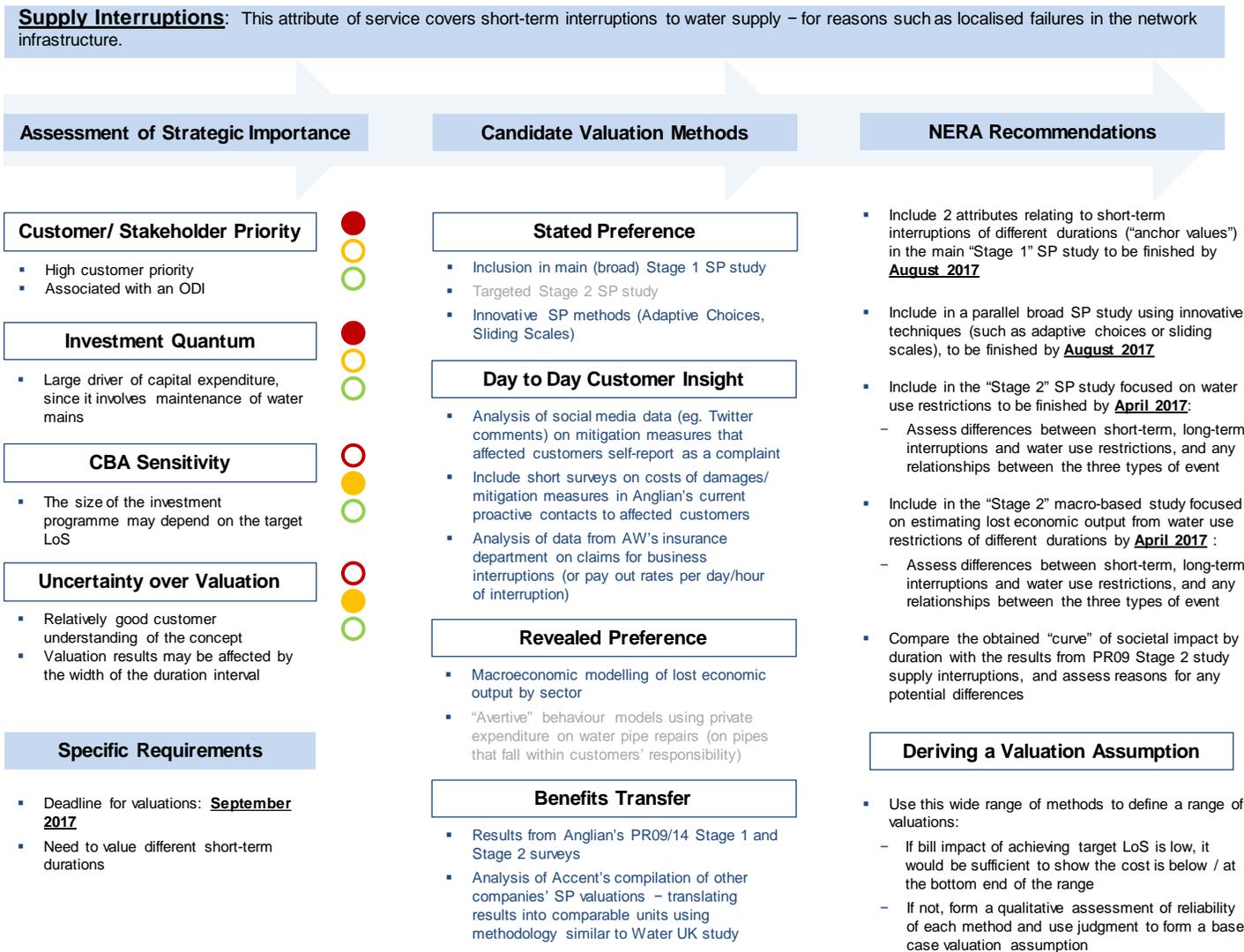
Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

Similar to the case of drought resilience, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to identify as robustly as possible a lower bound valuation for resilience. This reflects the assumption, which will need to be tested as the business planning process progresses, that the economic value of avoiding supply interruptions is high relative to the costs of the schemes Anglian is considering.

We recommend including most of the analysis as part of the studies targeted to drought resilience, given the similarity of the proposed methods. Therefore, in order to meet the timelines of the WRMP with respect to drought resilience, the results from the “Stage 2” studies related to supply interruptions will be available by April 2017. The combination of these studies will provide an estimation of a “curve” of societal impact of an interruption by duration of the incident. As part of the triangulation process, we recommend comparing these results with the curve obtained from the results of Anglian’s PR09 “Stage 2” study on supply interruptions, and assess the reasons for any potential differences.

Since the supply interruptions attribute is only used for the business plan, final valuations only need to be available by September 2017. Therefore, Anglian will be able to use the “anchor values” resulting from the new main “Stage 1” stated preference study.

Figure D.3 Societal Valuation Framework Applied to Supply Interruptions



D.4. Demand Management Strategy

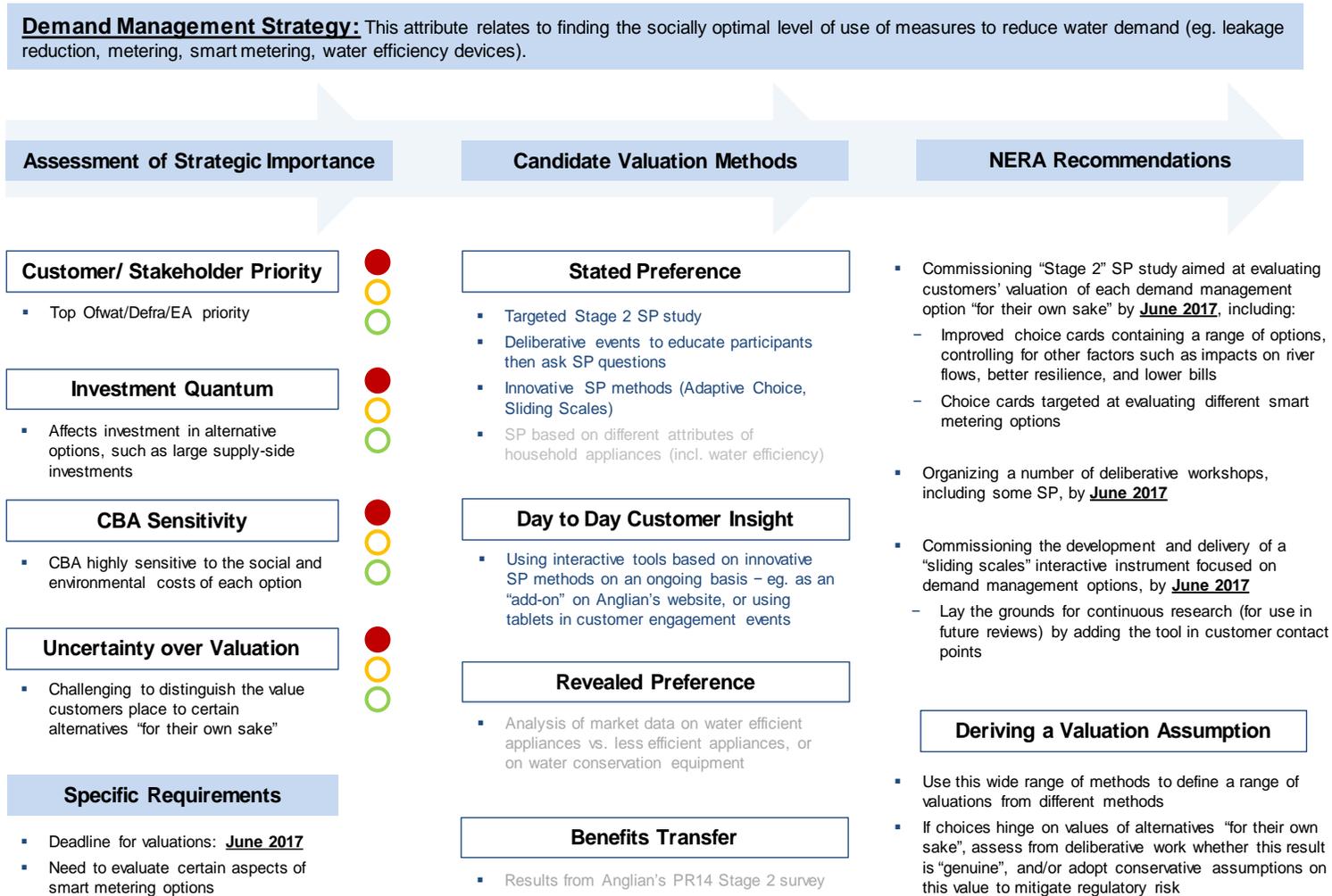
Figure D.4 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for demand management options. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of Anglian's demand management strategy in the WRMP and business planning process. As the figure shows, we identify this area as an important strategic priority against all the criteria identified in Chapter 3, so we show red lights against each of them in the figure.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to evaluate different demand management options. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by "triangulating" a valuation.

In this case, given the relative importance of Anglian's demand management strategy, we recommend developing a range of innovative stated preference instruments specially targeted to evaluating customers' valuation of each demand management option "for their own sake", ie. after controlling for other impacts that are already evaluated through other attributes (eg. resilience, environment, or bill impacts). During the triangulation process, we recommend assessing whether these results are indeed not biased by any other external factors, drawing from findings from deliberative workshops, and/or adopt conservative assumptions on these values in order to mitigate the risk of bias.

As described in more detail in Section 3.2.6, the valuation results for this area of service will be required internally by June 2017, in order to align with the draft WRMP submission timelines.

Figure D.4 Societal Valuation Framework Applied to Demand Management Strategy



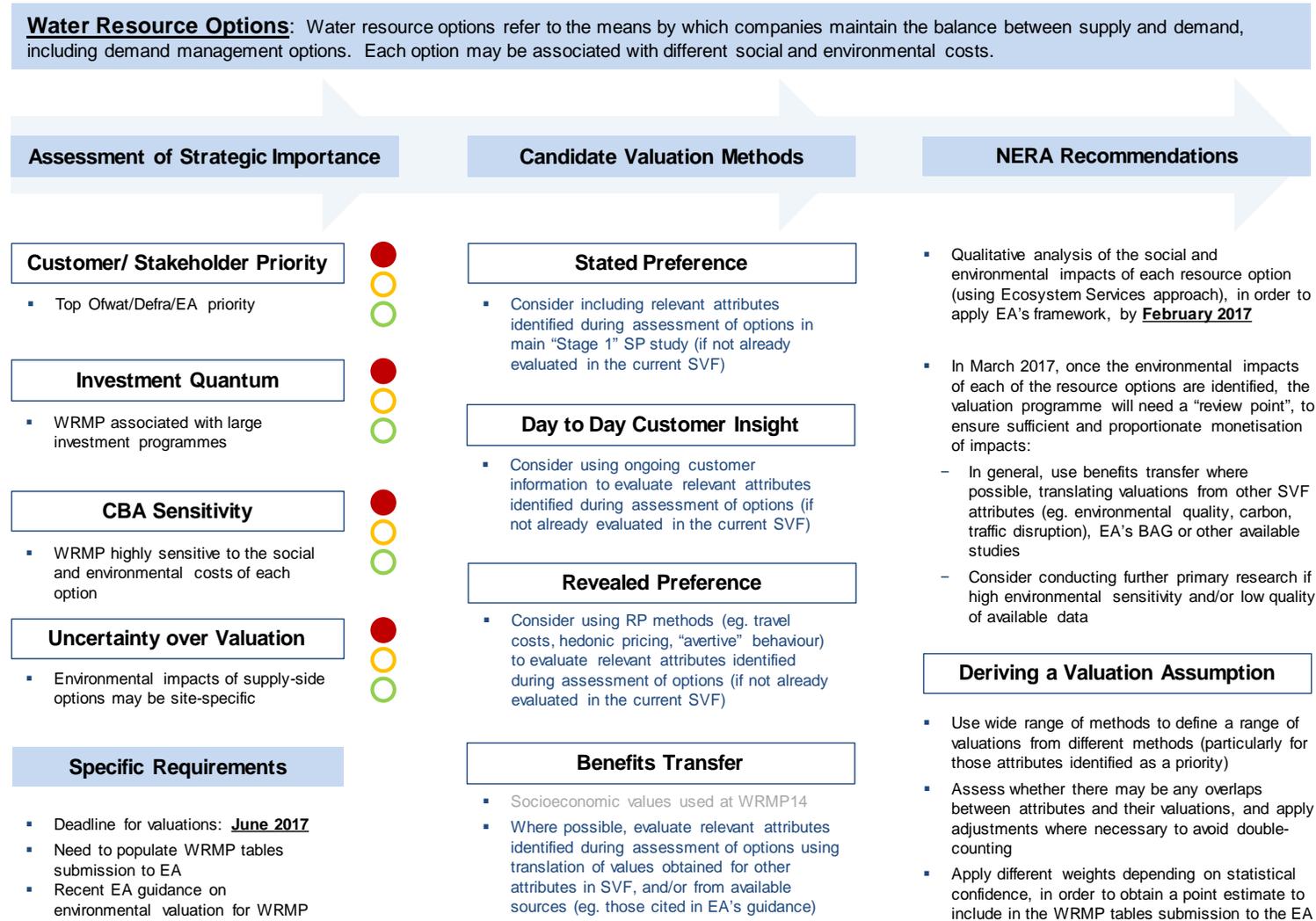
D.5. Water Resource Options

Figure D.5 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for water resource options. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of the evaluation of water resource options in the WRMP and business planning process. As the figure shows, we identify this area as an important strategic priority against all the criteria identified in Chapter 3, so we show red lights against each of them in the figure.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to evaluate the societal costs and benefits of different water resource options. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing.

As described in more detail in Section 3.2.5, Anglian will need to conduct a detailed assessment of each water resource option in order to identify, at a qualitative level, the specific environmental impacts associated with each option. This will be followed by a strategic assessment of these impacts and of the currently available societal valuations, which will inform any needs for primary research for a proportionate monetisation of these impacts. In order to ensure that Anglian has sufficient time to commission this potential further research, we recommend that Anglian finalises this assessment by February 2017.

Figure D.5 Societal Valuation Framework Applied to Water Resource Options



D.6. Wastewater Capacity Solutions

Figure D.6 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for wastewater capacity solutions. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of the evaluation of wastewater solutions in the business planning process. As the figure shows, we identify this area as an important strategic priority against all the criteria identified in Chapter 3, so we show red lights against each of them in the figure.

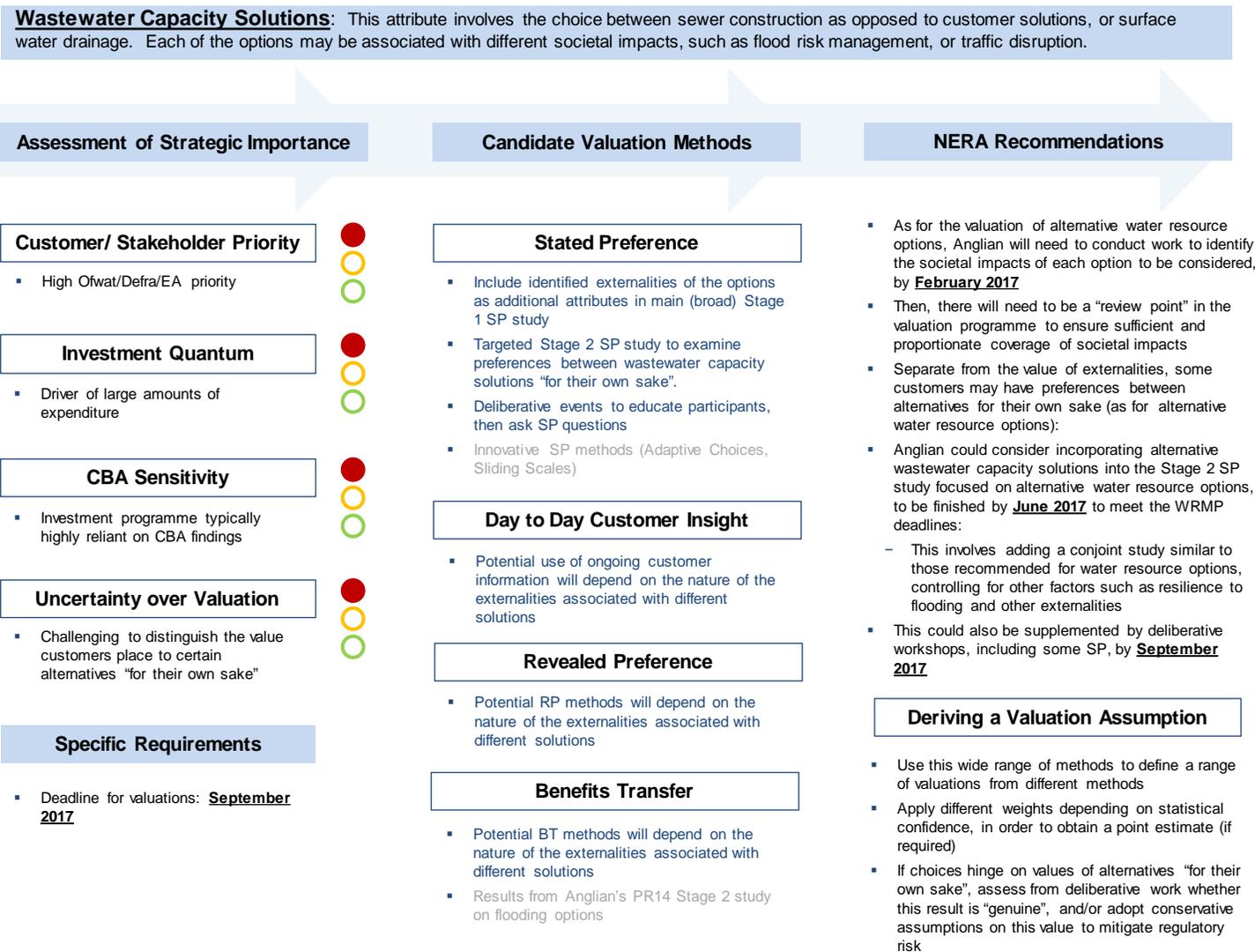
The middle column then lists the range of valuation methods that we have identified as those that could be deployed to evaluate the societal costs and benefits of different water resource options. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing.

As for water resource options, Anglian will need to conduct a detailed assessment of each wastewater capacity solution in order to identify, at a qualitative level, the specific social environmental impacts associated with each option. This will be followed by a strategic assessment of these impacts and of the currently available societal valuations, which will inform any needs for primary research for a proportionate monetisation of these impacts. In order to ensure that Anglian has sufficient time to commission this potential further research, we recommend that Anglian finalises this assessment by February 2017.

Furthermore, given the relative strategic importance of this area of service, we recommend incorporating an instrument targeted at wastewater capacity solutions into the “Stage 2” stated preference study focused on demand management options. The objective is to evaluate customers’ valuation of each wastewater solution “for their own sake”, ie. after controlling for the externalities identified during the qualitative assessment.

During the triangulation process, we recommend assessing whether these results are indeed not biased by any other external factors, drawing from findings from deliberative workshops, and/or adopt conservative assumptions on these values in order to mitigate the risk of bias.

Figure D.6 Societal Valuation Framework Applied to Wastewater Capacity Solutions



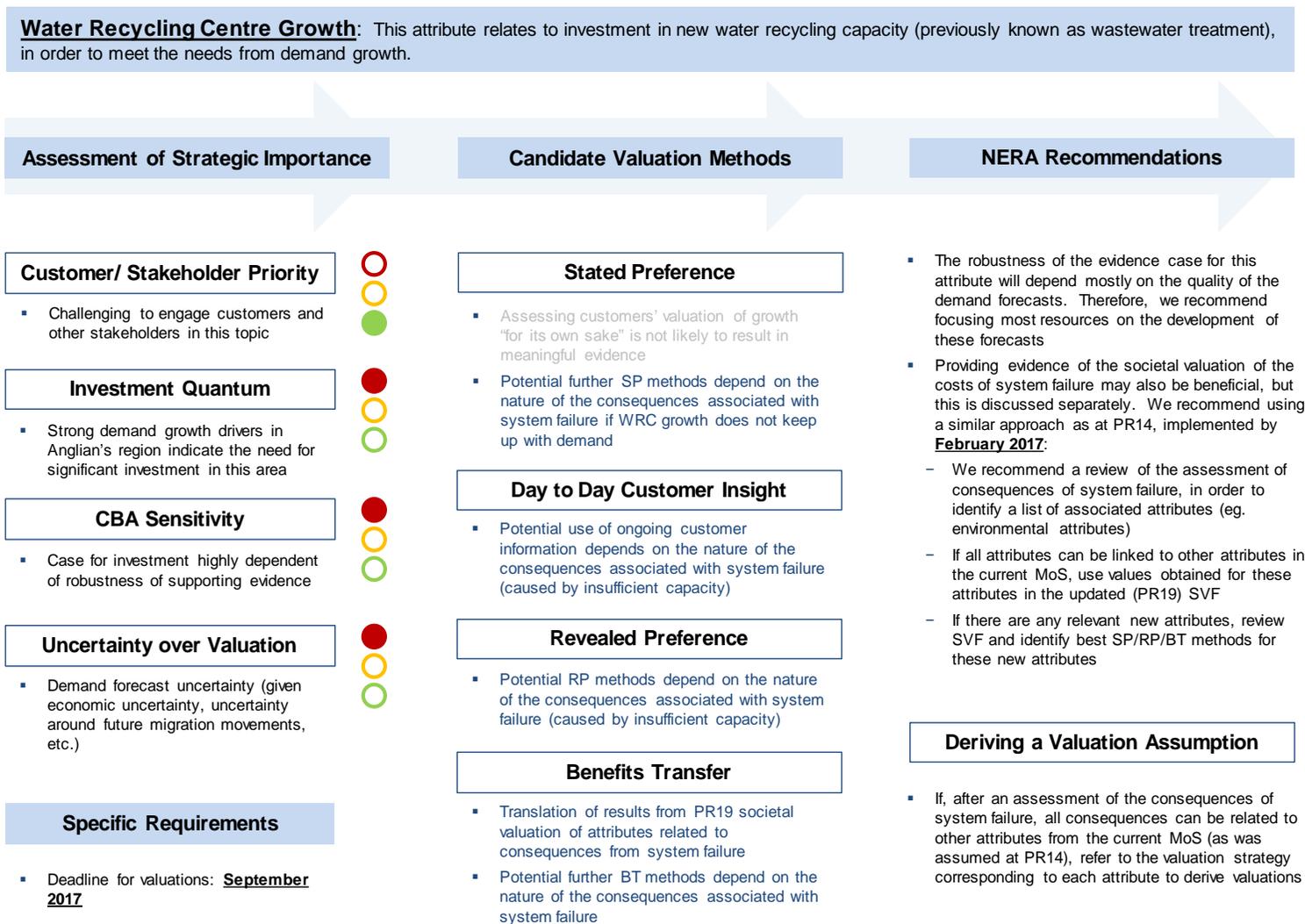
D.7. Water Recycling Centre Growth

Figure D.7 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for water recycling centre growth. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of water recycling centre growth in the business planning process. As the figure shows, we identify this area as an important strategic priority against most of the criteria identified in Chapter 3, noting that it is typically challenging to engage customers and other stakeholders in this topic.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to evaluate the societal costs and benefits of different water resource options. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing.

Similarly to our recommendations for water resource options, we recommend that Anglian conducts a detailed qualitative assessment of the social and environmental impacts of wastewater system failure. This will be followed by a strategic assessment of these impacts and of the currently available societal valuations, which will inform any needs for primary research for a proportionate monetisation of these impacts. In order to ensure that Anglian has sufficient time to commission this potential further research, we recommend that Anglian finalises this assessment by February 2017.

Figure D.7 Societal Valuation Framework Applied to Water Recycling Centre Growth



D.8. River Water Quality

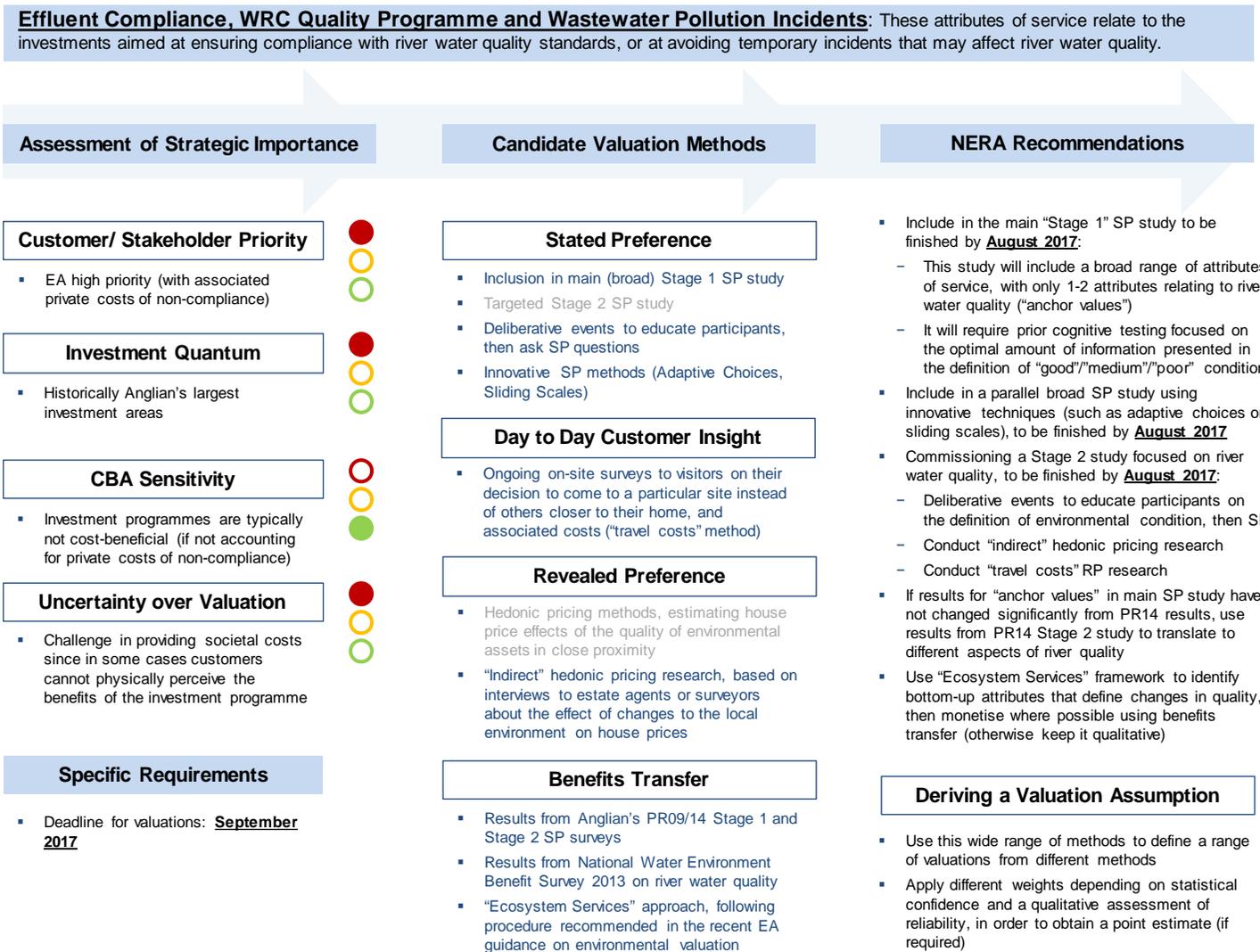
Figure D.8 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for those attributes related to river water quality, ie. effluent compliance, water recycling centre quality programme and wastewater pollution incidents.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of river water quality in the business planning process. As the figure shows, we identify this area as an important strategic priority against most of the criteria identified in Chapter 3, noting that the sensitivity of the outcomes of the CBA to the valuation assumptions is relatively low.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value river water quality. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

In this case, the relative importance of river water quality means that we recommend deploying a relatively large number of valuation techniques through a series of studies. Then, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on a qualitative assessment of the reliability of the outputs from each piece of analysis. This will enable Anglian to identify a “central estimate” using relative weights for each valuation assumption, as well as a set of valuation ranges around this estimate, with increasing different degrees of confidence, to inform sensitivity analysis.

Figure D.8 Societal Valuation Framework Applied to River Water Quality



D.9. SSSI Habitats and Recreation Sites

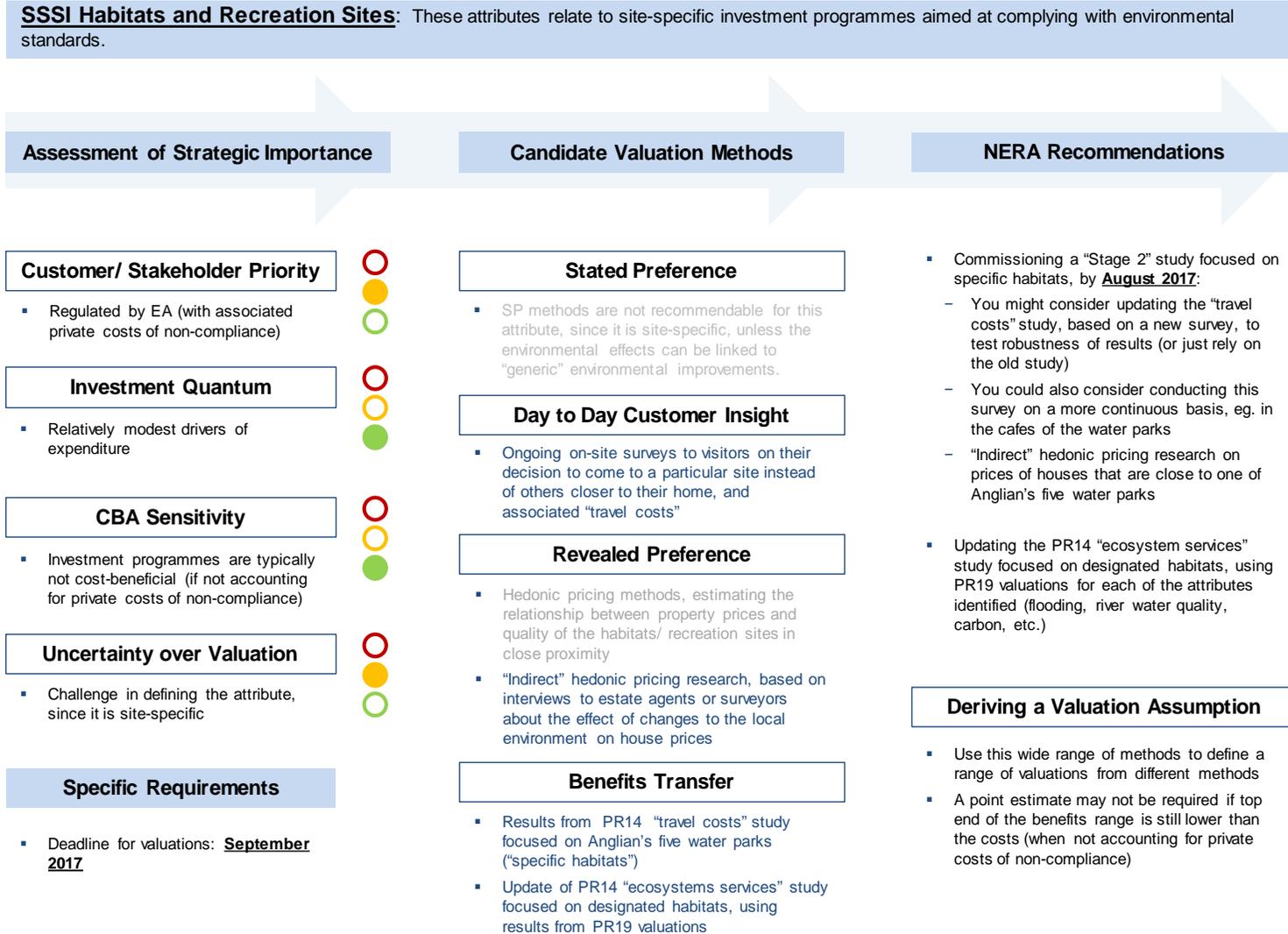
Figure D.9 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for Anglian's SSSI habitats and recreation sites.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of these attributes in the business planning process. As the figure shows, we identify this area as a relatively low strategic priority against most of the criteria identified in Chapter 3, noting that these attributes are regulated by the Environment Agency, which indicates a certain degree of stakeholder interest.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value these attributes. Those in dark blue text are those we consider should be deployed to value these attributes, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by "triangulating" a valuation.

In this case, the medium-to-low importance of this attribute means that we recommend deploying a relatively small number of valuation techniques, most of them based on an (improved) update of the methods used at PR14. Then, to "triangulate" a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to identify as robustly as possible an upper bound valuation for these attributes. This reflects the possibility, which will need to be tested as the business planning process progresses, that the societal value related to these attributes could be lower than the costs of the schemes Anglian is considering.

Figure D.9 Societal Valuation Framework Applied to SSSI Habitats and Recreation Sites



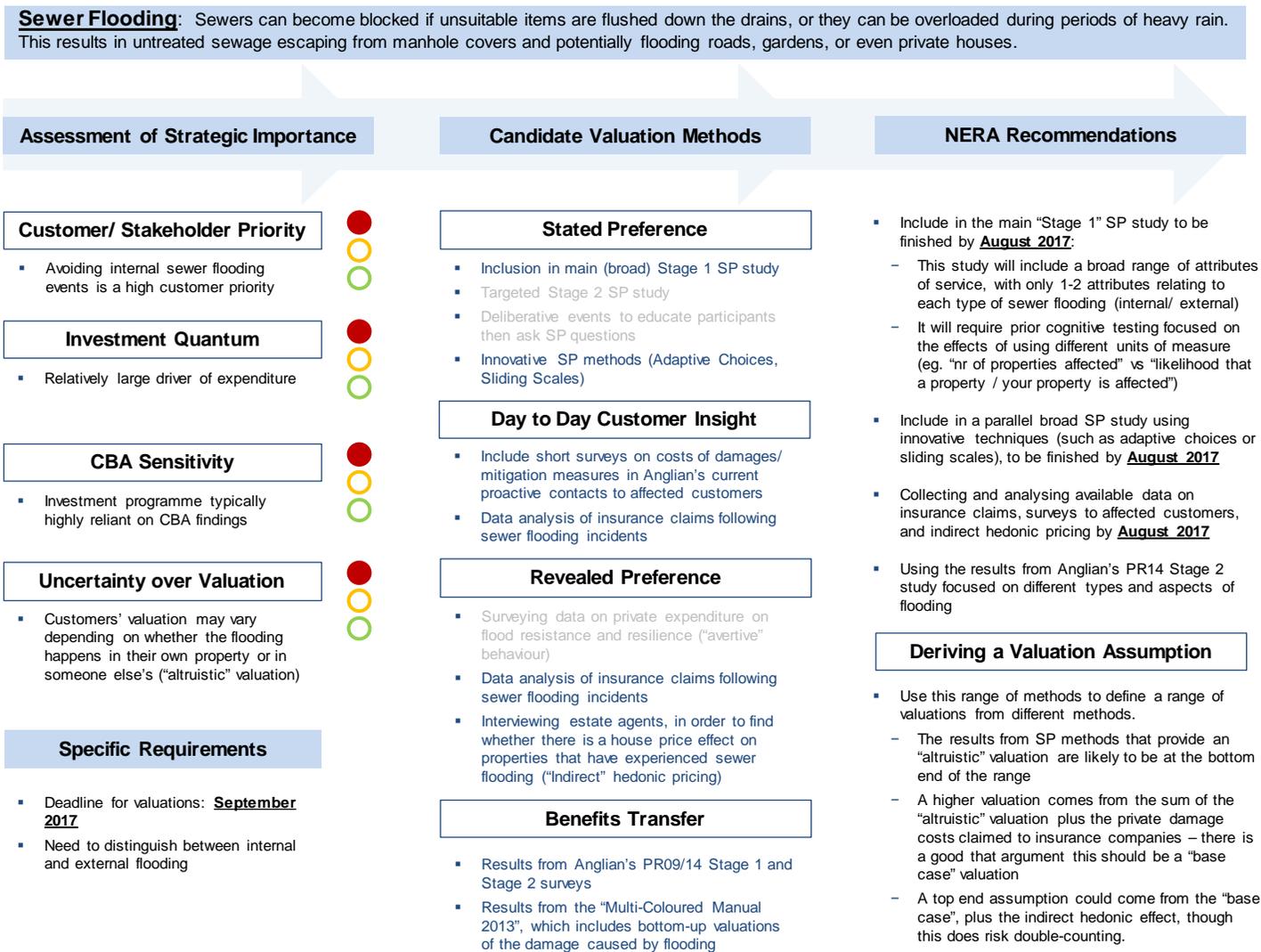
D.10. Sewer Flooding

Figure D.10 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for sewer flooding. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of sewer flooding in the business planning process. As the figure shows, we identify this area as an important strategic priority against all the criteria identified in Chapter 3, so we show red lights against each of them in the figure.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value sewer flooding. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

In this case, the relative importance of sewer flooding means that we recommend deploying a relatively large number of valuation techniques through a series of studies. Then, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to form a valuation range. We also set out our considerations on where the results from each method are most likely to be placed within the range, eg. depending on whether the method estimates “altruistic” or rather “private” customer valuations.

Figure D.10 Societal Valuation Framework Applied to Sewer Flooding



D.11. Water Mains Flooding

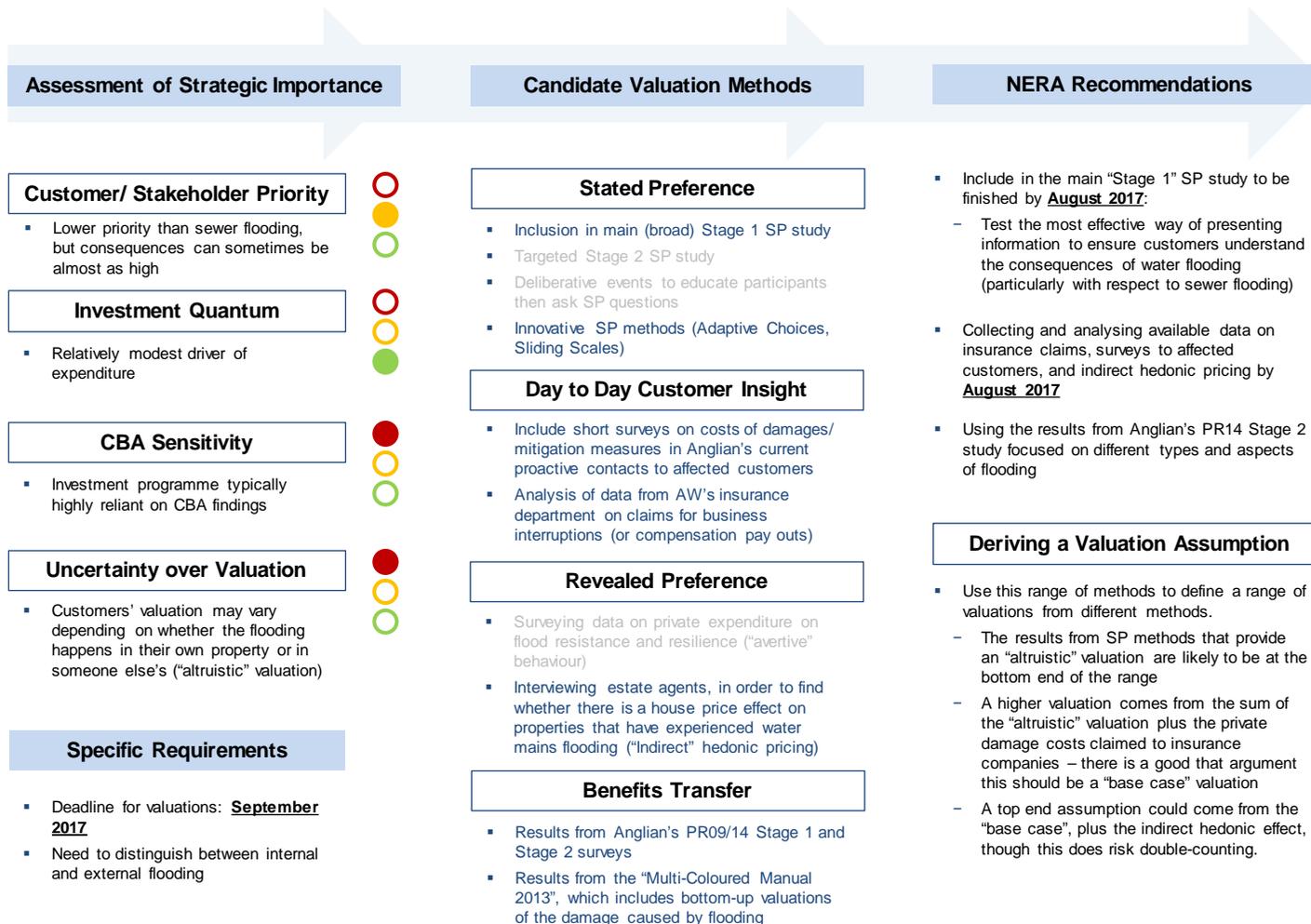
Figure D.11 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for water mains flooding. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of water mains flooding in the business planning process. As the figure shows, and based on the criteria identified in Chapter 3, we identify this area as a lower strategic priority than sewer flooding, albeit noting that it is associated with similar levels of valuation uncertainty and CBA sensitivity.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value water mains flooding. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

In this case, given the high sensitivity of the investment programme on CBA findings for this attribute, and the potential for synergies with the valuation programme for the sewer flooding attribute, we recommend deploying a relatively large number of valuation techniques through a series of studies. Then, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to form a valuation range, using a similar procedure as for sewer flooding. Therefore, we have set out our considerations on where the results from each method are most likely to be placed within the range, eg. depending on whether the method estimates “altruistic” or rather “private” customer valuations.

Figure D.11 Societal Valuation Framework Applied to Water Mains Flooding

Water Mains Flooding: Flooding can occur when pipes that supply water to houses and other properties burst. This can lead to flooding of roads, and also gardens and homes and other properties.



D.12. Customer Contacts

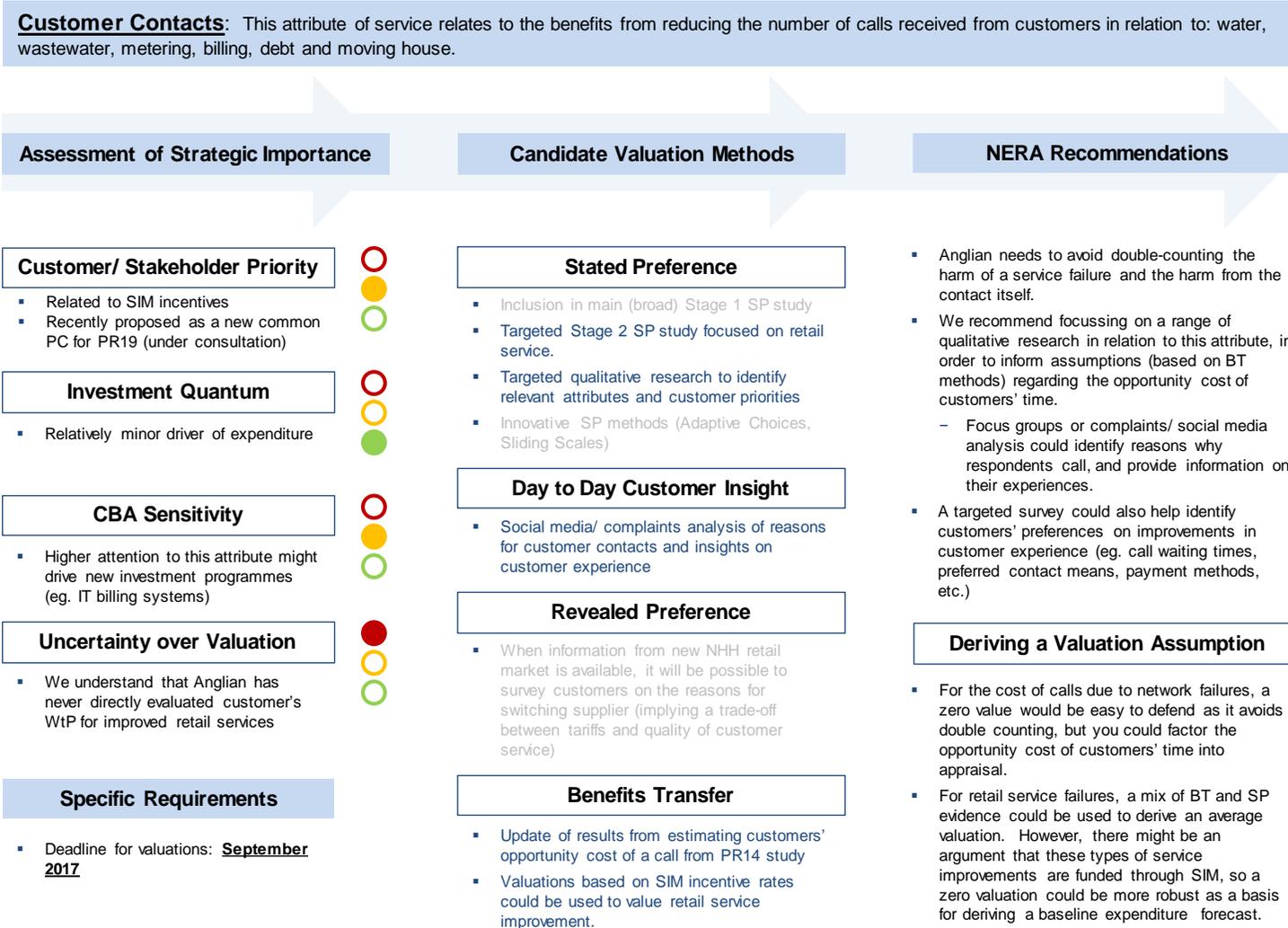
Figure D.12 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for customer contacts. Within this category, we have also considered the direct evaluation of improvements in retail services.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of retail customer experience in the business planning process. As the figure shows, we identify this area as a medium strategic priority against most of the criteria identified in Chapter 3, noting that it is associated with relatively minor expenditure amounts.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value retail services. Those in dark blue text are those we consider should be deployed to value these attributes, and those in grey we do not recommend pursuing.

In this case, the medium-to-low importance of this attribute means that we recommend deriving valuation assumptions based on an (improved) update of the methods used at PR14, informed by qualitative findings from deliberative events and social media/ complaints analysis.

Figure D.12 Societal Valuation Framework Applied to Customer Contacts



D.13. Water Quality Notices

Figure D.13 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for water quality notices.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of water quality notices in the business planning process. As the figure shows, we identify this area as a high customer and business priority, while noting the relatively low uncertainty and CBA sensitivity around valuation assumptions for this attribute.

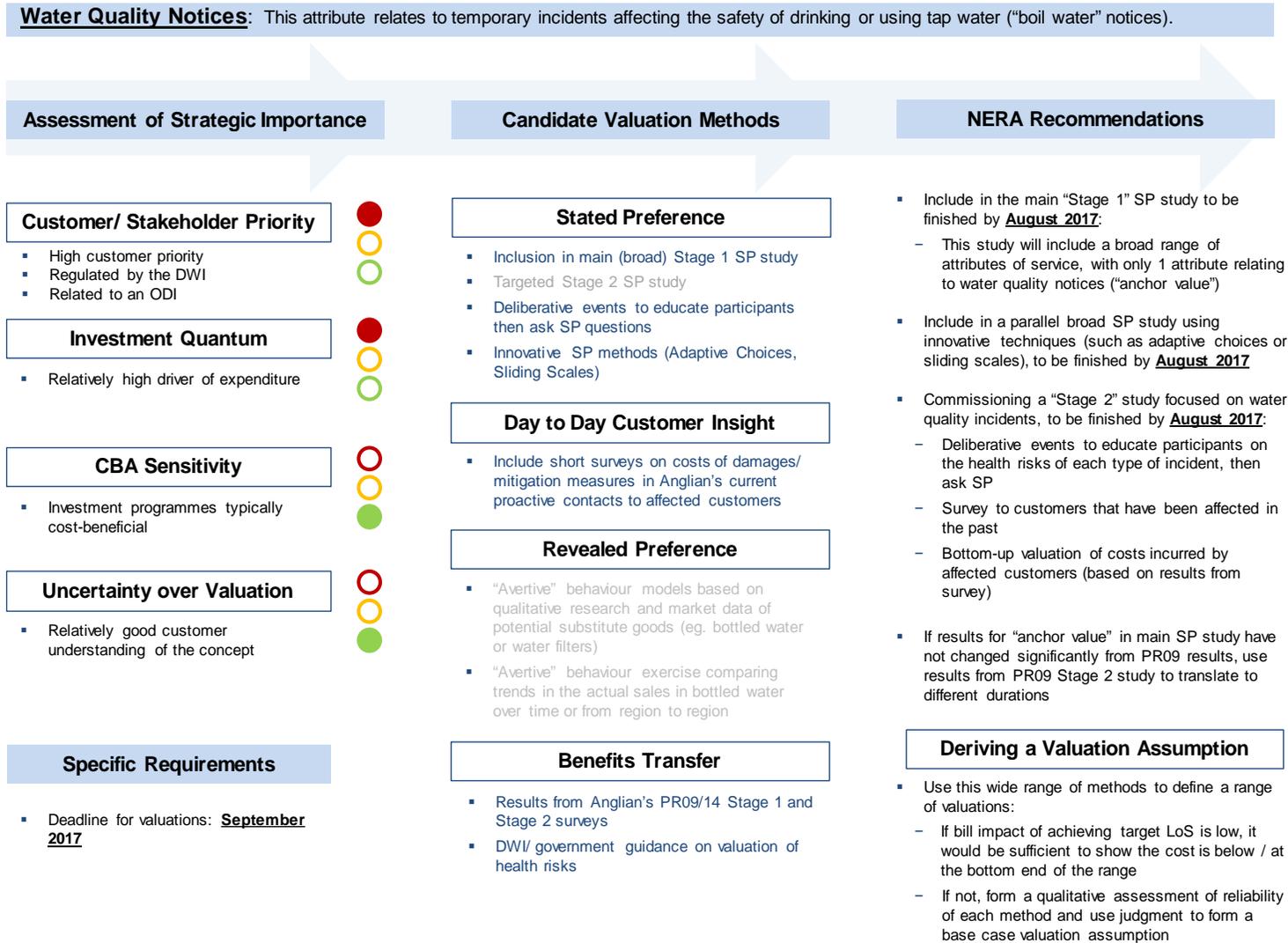
The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value water quality notices. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

Given the relatively high strategic importance of this attribute, we recommend including this attribute in the innovative stated preference instrument which will use “sliding scales”, described in more detail in Section 5.4. However, given the relatively low CBA sensitivity and uncertainty around the valuation assumptions, we only recommend a small number of alternative methods to be included in the “triangulation” process.

Similar to the case of supply interruptions, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to identify as robustly as possible a lower bound valuation for water quality notices. This reflects the assumption, which will need to be tested as the business planning process progresses, that the economic value of avoiding water quality notices is high relative to the costs of the schemes Anglian is considering.

The combination of these studies will provide an estimation of a “curve” of societal impact of a water quality notice by duration of the incident. As part of the triangulation process, we recommend comparing these results with the curve obtained from the results of Anglian’s PR09 “Stage 2” study on water quality notices, and assess the reasons for any potential differences. If the results have not changed significantly, we recommending filling any potential gaps in the PR19 “curve” using the relationships obtained at PR09.

Figure D.13 Societal Valuation Framework Applied to Water Quality Notices



D.14. Discolouration, Taste and Odour

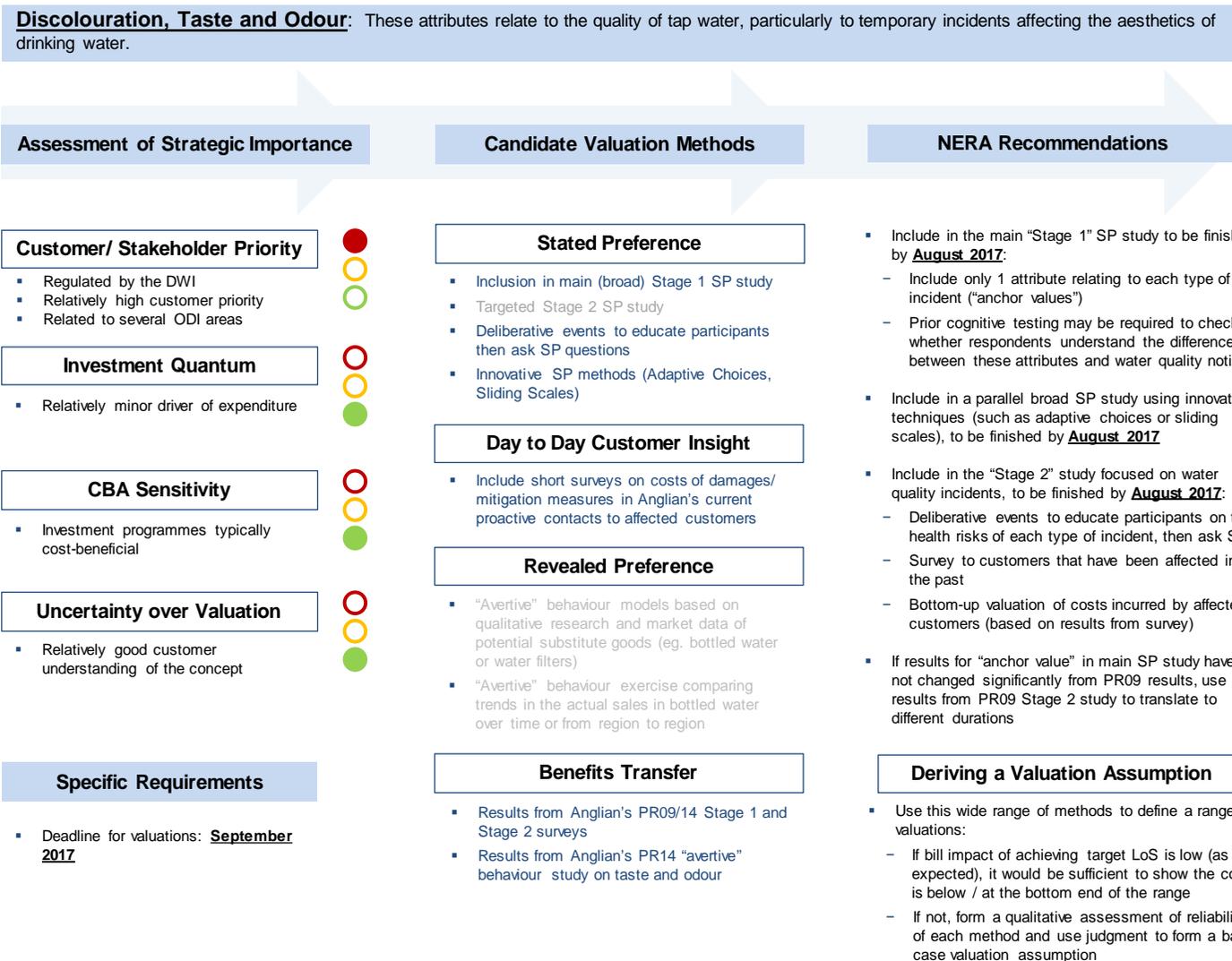
Figure D.14 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for discolouration, taste and odour. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of these water quality attributes in the business planning process. As the figure shows, and based on the criteria identified in Chapter 3, we identify this area as a relatively lower business priority than water quality notices, albeit noting a high customer and stakeholder interest in the attributes.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value these attributes. Those in dark blue text are those we consider should be deployed to value these attributes, and those in grey we do not recommend pursuing. Then the final column maps these methods onto a range of valuation studies and notes how the valuation results emerging from this set of studies could be used to derive a valuation assumption, ie. by “triangulating” a valuation.

In this case, given the high customer and stakeholder interest in these attributes, and the potential for synergies, we recommend including these attributes within the valuation programme for water quality notices. Prior cognitive testing may be required to ensure customers understand the differences between each of the water quality attributes and their consequences on the customer.

Then, to “triangulate” a valuation assumption from this set of analyses, we have recommended drawing on the outputs from the analysis to identify as robustly as possible a lower bound valuation for each of these attributes. This reflects the assumption, which will need to be tested as the business planning process progresses, that the economic value of avoiding discolouration, taste and/or odour is high relative to the costs of the schemes Anglian is considering.

Figure D.14 Societal Valuation Framework Applied to Discolouration, Taste and Odour

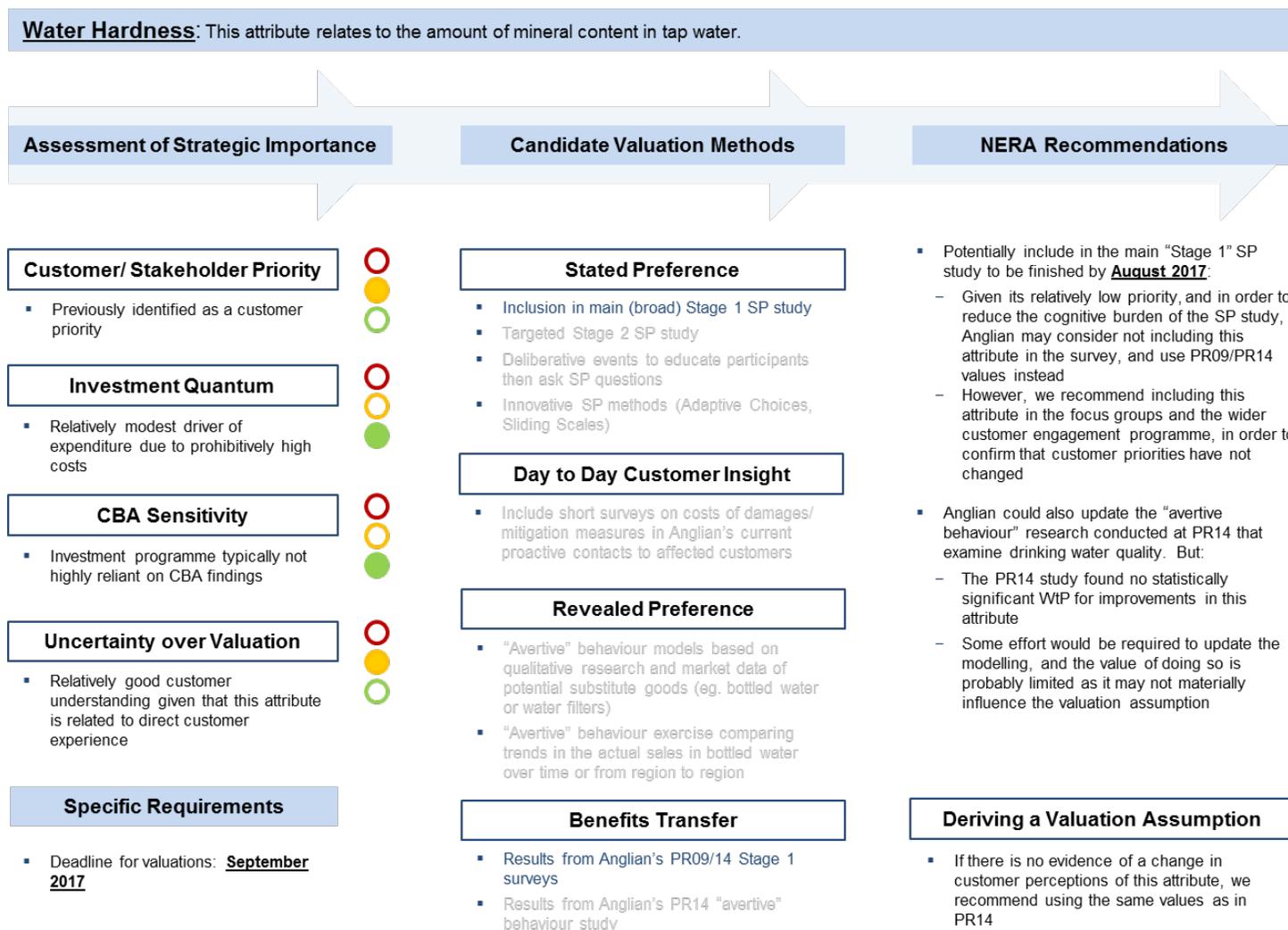


D.15. Water Hardness

Figure D.15 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for water hardness. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of water hardness in the business planning process. As the figure shows, we identify this area as a low strategic priority against all the criteria identified in Chapter 3. While this attribute has been identified in the past as a customer priority, the costs of improving water hardness tend to be prohibitively high. Hence, we show green lights against the CBA sensitivity and investment quantum criteria.

We recommend including this attribute in focus group research. However, if the costs of improving water hardness remain extremely high relative to the likely benefits, we would not suggest any further valuation research beyond BT analysis (eg. to inflate the PR19 valuation).

Figure D.15 Societal Valuation Framework Applied to Water Hardness



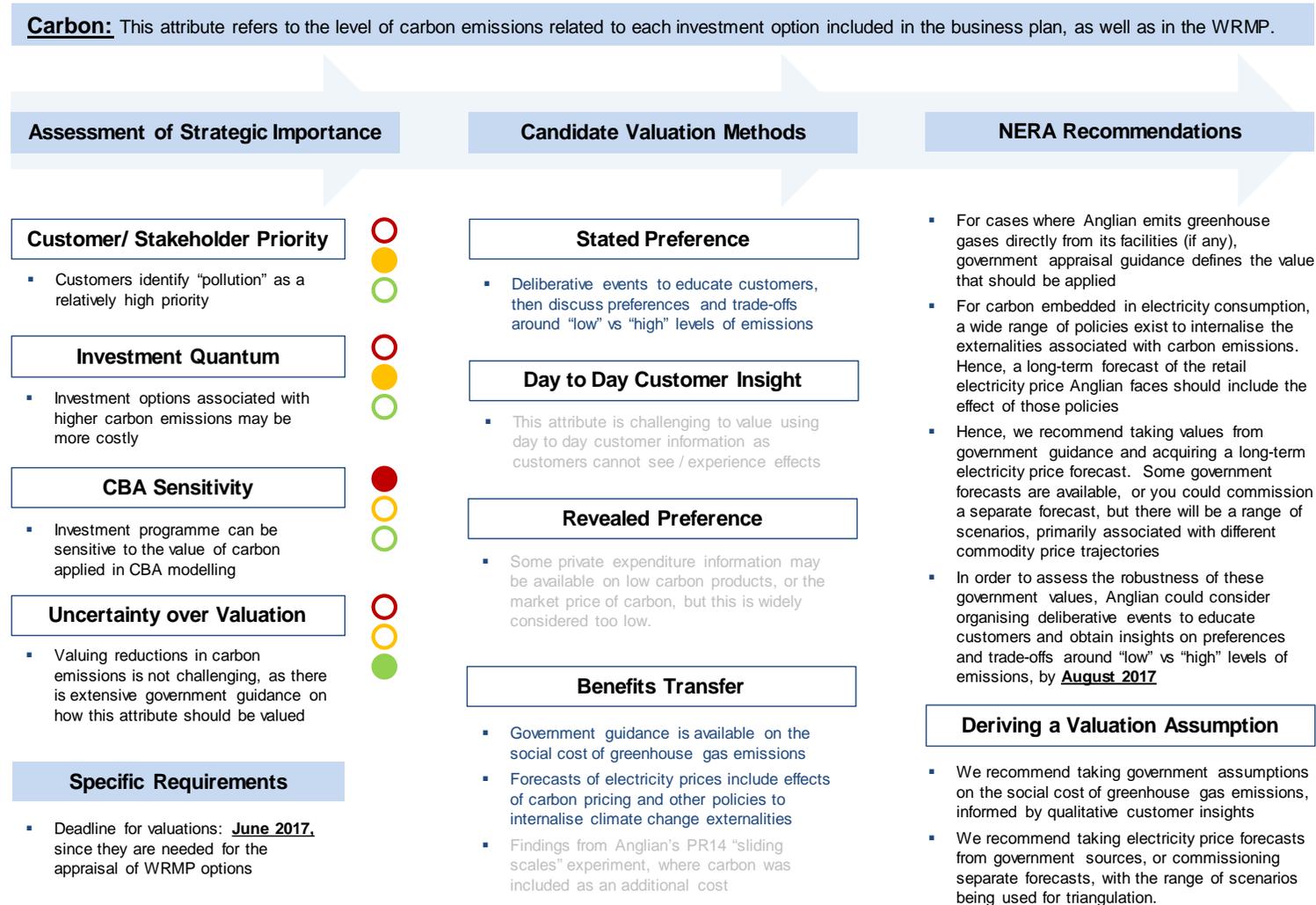
D.16. Carbon

Figure D.16 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for carbon.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of carbon in the WRMP and the business planning process. As the figure shows, and based on the criteria identified in Chapter 3, we identify this area as a medium strategic priority, albeit noting the very low degree of uncertainty around the valuation assumptions, given the existence of extensive government guidance on how this attribute should be valued.

Given the relatively high strategic importance of the attribute, we recommend assessing the robustness of these publicly available assumptions using the findings from targeted qualitative deliberative events.

Figure D.16 Societal Valuation Framework Applied to Carbon



D.17. Odour and Flies

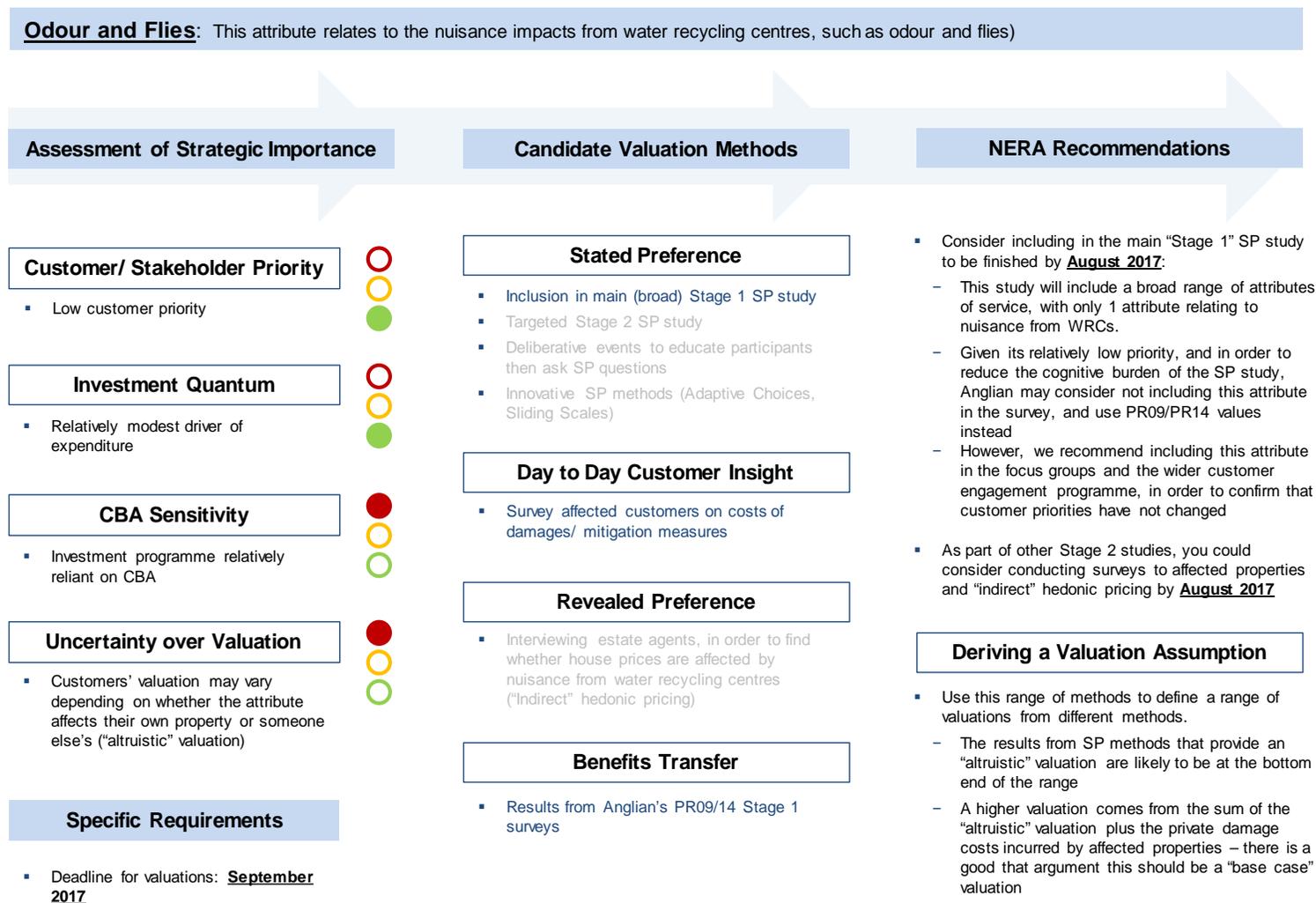
Figure D.17 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for nuisance impacts from water recycling centres, such as odour and flies.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of these nuisance impacts in the business planning process. As the figure shows, and based on the criteria identified in Chapter 3, we identify this area as a relatively low stakeholder and business priority, while noting relatively high uncertainty and CBA sensitivity around valuation assumptions for this attribute.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value odour and flies. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing.

Given the findings from the strategic assessment of this attribute, we recommend using only a limited number of valuation methods. Then, to “triangulate” a valuation assumption from this set of analyses, we recommend drawing on the outputs from the analysis to form a valuation range. We also set out our considerations on where the results from each method are most likely to be placed within the range, eg. depending on whether the method estimates “altruistic” or rather “private” customer valuations.

Figure D.17 Societal Valuation Framework Applied to Odour and Flies



D.18. Coastal Waters

Figure D.18 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for coastal waters.

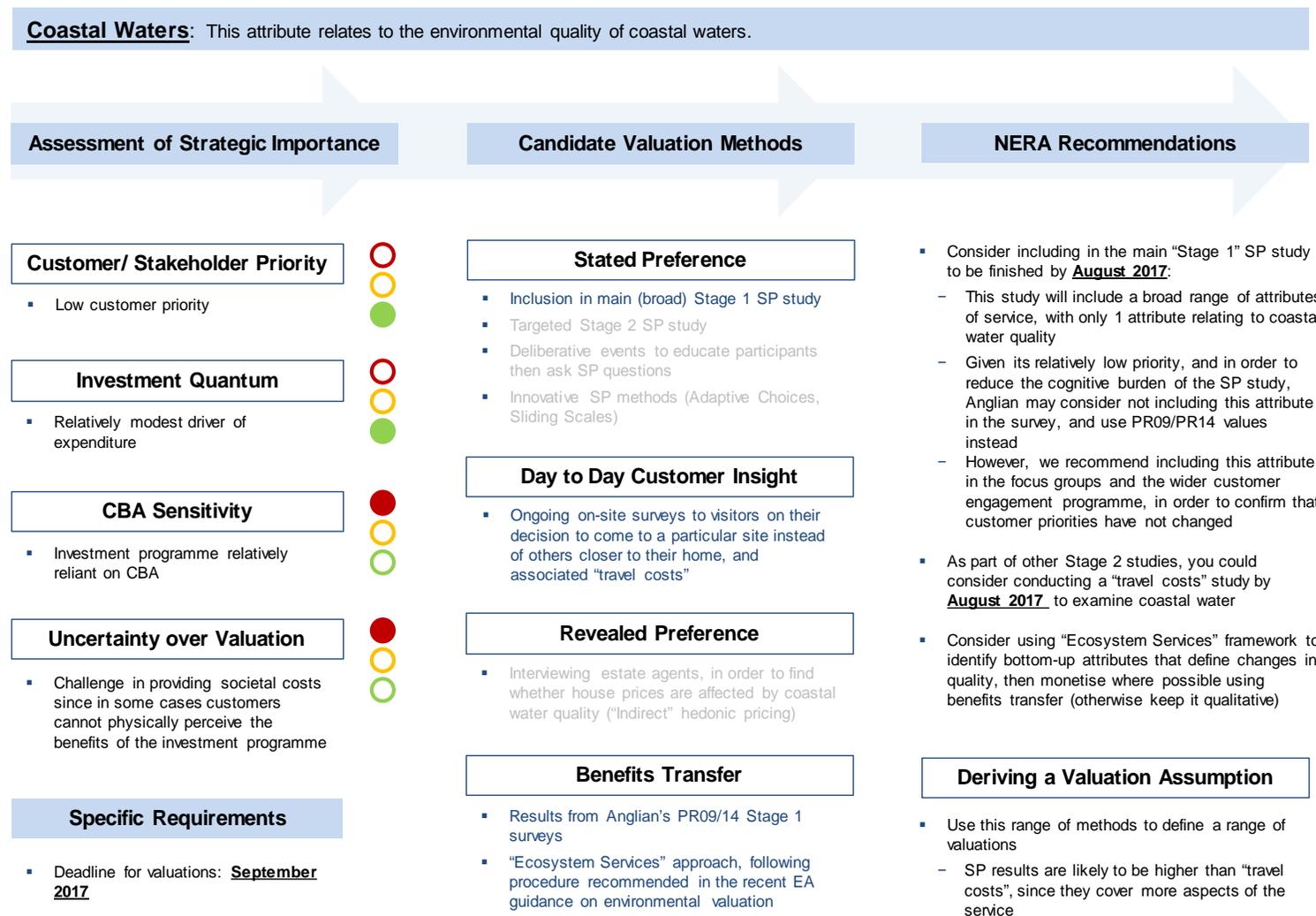
On the left hand side of the figure, we summarise the high-level assessment of the relative importance of coastal waters in the business planning process. As the figure shows, and based on the criteria identified in Chapter 3, we identify this area as a relatively low stakeholder and business priority, while noting relatively high uncertainty and CBA sensitivity around valuation assumptions for this attribute.

The middle column then lists the range of valuation methods that we have identified as those that could be deployed to value coastal waters. Those in dark blue text are those we consider should be deployed to value this attribute, and those in grey we do not recommend pursuing.

Given the findings from the strategic assessment of this attribute, we recommend using only a limited number of valuation methods. Then, to “triangulate” a valuation assumption from this set of analyses, we recommend drawing on the outputs from the analysis to form a valuation range.

We also set out our considerations on where the results from each method are most likely to be placed within the range, eg. stated preference results are likely to be higher than “travel cost” estimates, since the former may cover more aspects of the service than the latter.

Figure D.18 Societal Valuation Framework Applied to Coastal Waters



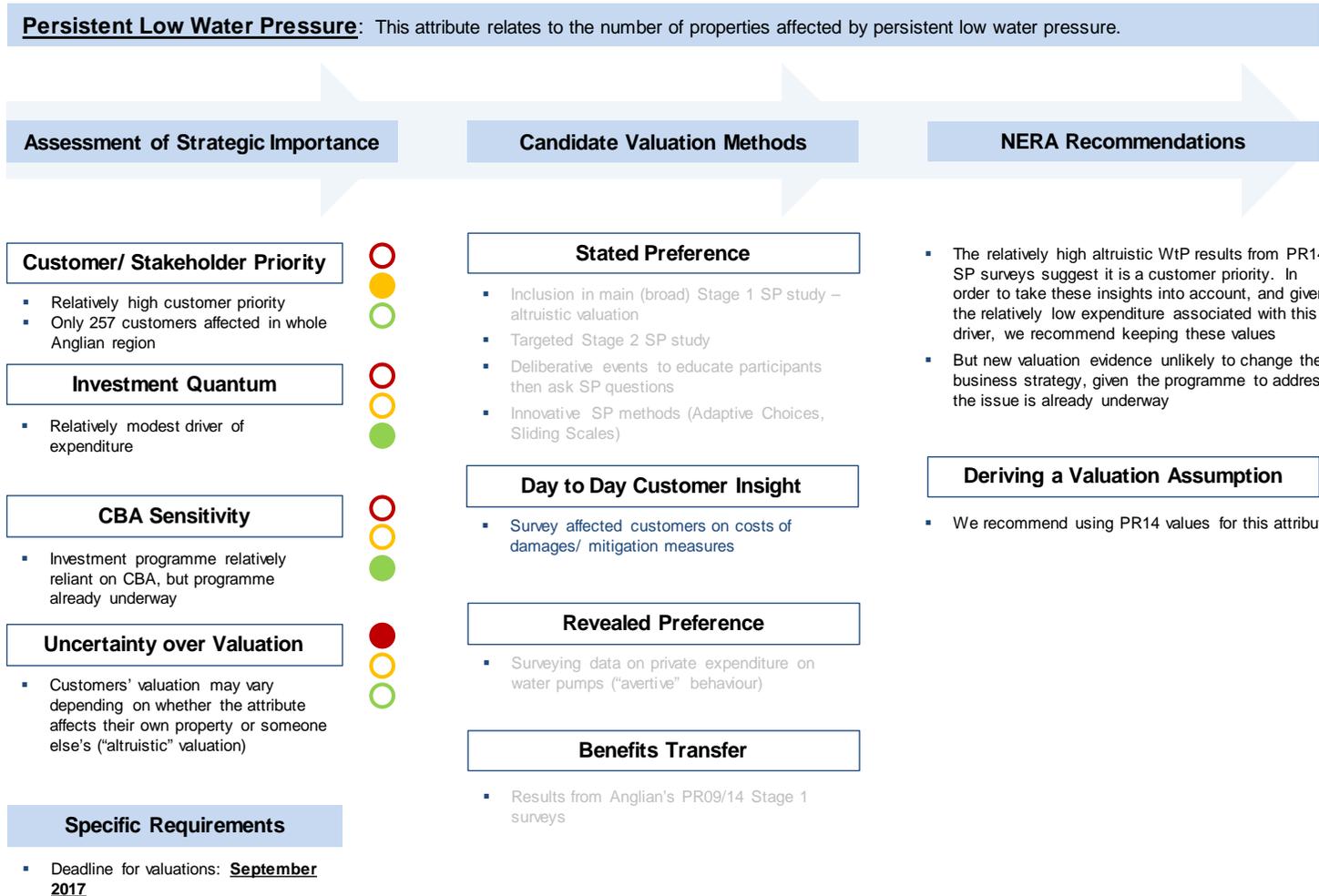
D.19. Persistent Low Water Pressure

Figure D.19 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for persistent low water pressure. On the left hand side of the figure, we summarise the high-level assessment of the relative importance of this attribute in the business planning process, based on the criteria identified in Chapter 3.

While this attribute has been identified at PR14 as a customer priority, which would normally justify acquiring a relatively sound/broad basis of valuation evidence, in this case we understand that the company is now part way through an investment programme to address the problem. Moreover, the costs per household to improve service are materially less than the likely value that would emerge from a valuation programme.

Therefore, we have recommended that BT evidence (ie. by inflating PR14 values) should form the basis for the PR19 valuation.

Figure D.19 Societal Valuation Framework Applied to Persistent Low Water Pressure



D.20. Traffic Disruption

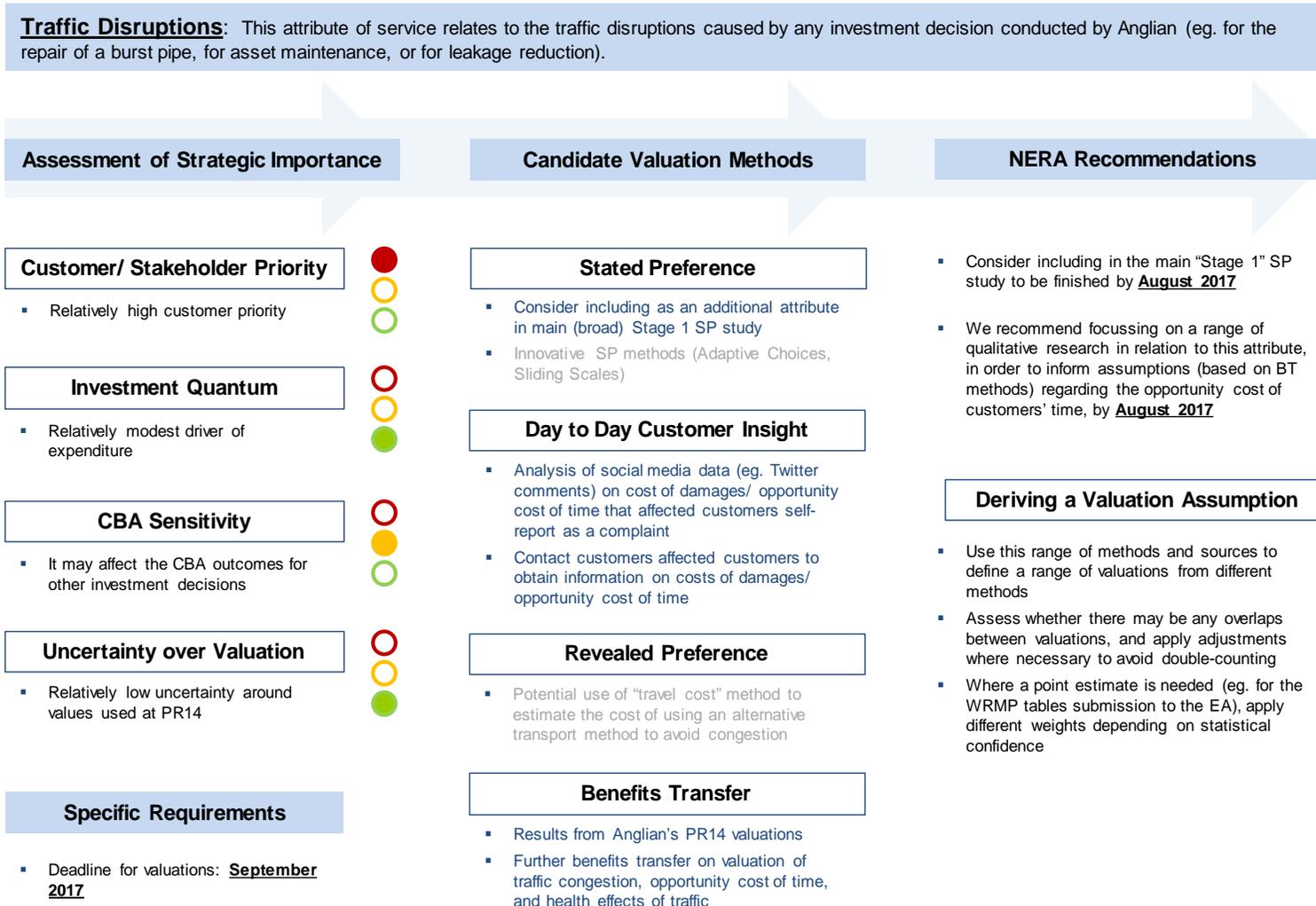
Figure D.20 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for traffic disruptions.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of this attribute in the business planning process. As the figure shows, and based on the criteria identified in Chapter 3, we identify this area as a relatively low business priority. However, emerging findings from social media and complaints analysis indicate that this attribute may be a relatively high customer priority.

Therefore, we recommend using benefits transfer from a wide range of publicly available sources on related topics (such as traffic congestion, opportunity cost of time, and health effects of traffic), and informing these assumptions with customer insights from qualitative research, such as ongoing surveys to affected customers and further social media and complaints analysis. Anglian may also wish to consider obtaining further insights by including this attribute in the main “Stage 1” stated preference study.

We note that, when “triangulating” the results from this wide range of sources, Anglian will need to assess whether there may be any overlaps between the different types of valuations, and apply adjustments where necessary to avoid risk of double counting. Where a point estimate is needed (eg. for inclusion as an additional societal cost of some water resource options in the WRMP tables submission to the Environment Agency), we recommend assessing the robustness of each of the results in order to determine different weights for each valuation.

Figure D.20 Societal Valuation Framework Applied to Traffic Disruptions



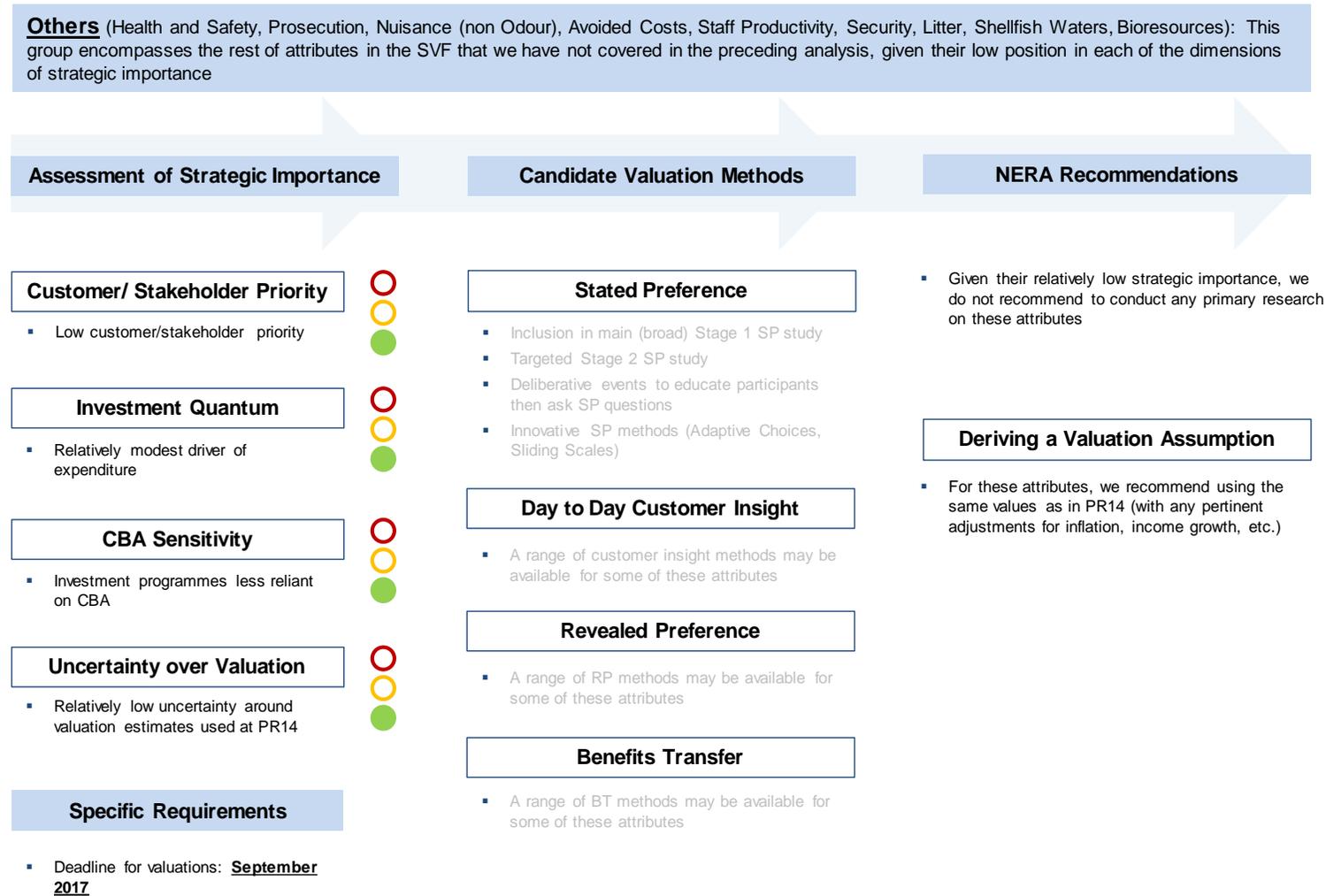
D.21. Other Attributes

Figure D.21 shows how we have applied our framework to assess, and develop our recommendations on, the societal valuation strategy for the rest of attributes that we have not covered in the sections above. These include: health and safety, prosecution, nuisance (non-odour), avoided costs, staff productivity, security, litter, shellfish waters, and bioresources.

On the left hand side of the figure, we summarise the high-level assessment of the relative importance of these attributes in the business planning process. As the figure shows, we identify these areas as relatively low strategic priorities against all the criteria identified in Chapter 3, so we show green lights against each of them in the figure.

Therefore, we recommend that BT evidence (ie. by inflating PR14 values) should form the basis for the PR19 valuation of these attributes.

Figure D.21 Societal Valuation Framework Applied to Other Attributes



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