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ICS consulting

South Staffs Water PR14 Stated Preference Study: Final Report

Report Submitted to South Staffs Water

June 2013

This document has been prepared by:

Economics for the Environment Consultancy Ltd (eftec)
73-75 Mortimer Street
London
W1W 7SQ
www.eftec.co.uk

and

ICS Consulting Ltd
Pear Tree House, Main Street
Little Smeaton, North Yorkshire
WF8 3LG
www.icsconsulting.co.uk

Study team:

Amanda Borrmann (ICS Consulting)
Allan Provins (eftec)
Ali Chalak (ICS Consulting and American University of Beirut, Lebanon)
Lisa Gahan (ICS Consulting)
Martin Baker (ICS Consulting)
Scott Reid (ICS Consulting)

Peer reviewer:

Ken Willis (University of Newcastle)

Field work:

FACTs International
Facts Centre
3 Henwood
Ashford
Kent
TN24 8FL
http://www.facts.uk.com

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EXECUTIVE SUMMARY

E.1 Introduction

In preparation for the 2014 periodic review South Staffs Water has commissioned this study to help understand the willingness to pay of their customers. The study aims to assess which service areas domestic and non-domestic customer's value. Values are derived for the service areas included in the survey with the view that these will be compared to costs to help determine potential areas for investment at PR14.

The requirements for the study included:

- To estimate the value to customers - in monetary terms – of the impact of changes in water service levels;
- To ensure that the values are appropriate for use in CBA; and
- To build on work the outputs of recent UKWIR studies concerning the application of WTP studies and CBA.

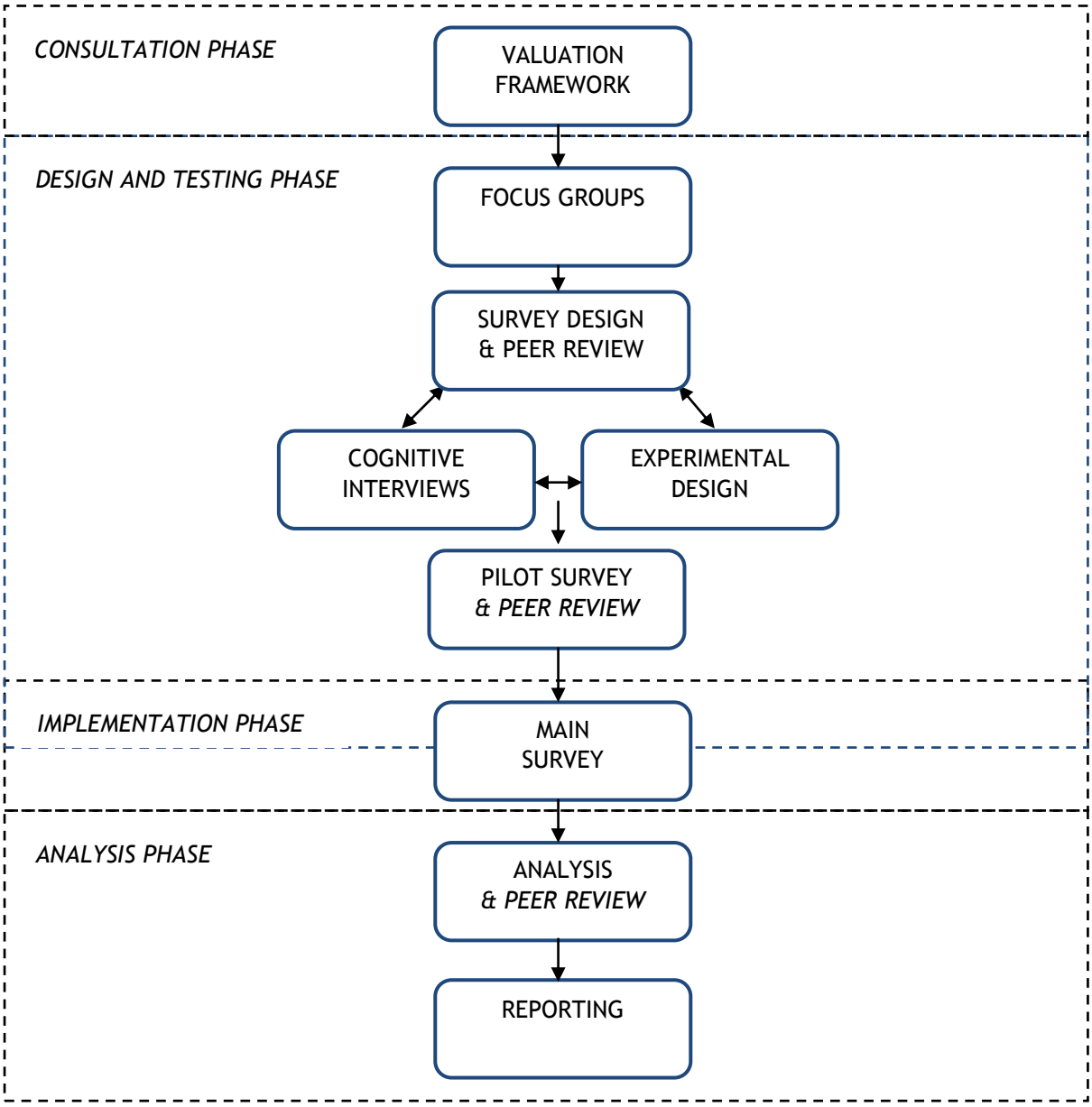
The study applies a combination of the 'choice experiment' (CE) and 'contingent valuation' (CV) methods. These are questionnaire-based stated preference techniques that involve asking survey respondents – a sample of domestic and non-domestic customers – to complete choice tasks that gather information on their preferences for changes in service levels. Respondents are presented with differing trade-offs between improvements and deterioration in different water service areas along with changes in bill levels. The trade-offs that respondents are willing to make between service levels and bill amounts reveals the value or 'benefits' of investments that maintain or improve service. In particular the trade-offs measure in monetary terms what customers are prepared to 'give up' to secure a specified level of service. This trade-off is the 'willingness to pay' (WTP) measure of benefits and is the appropriate input to CBA.

E.2 Approach

Study Framework

The study framework is consistent with good practice for the implementation of stated preference surveys. Figure ES.1 documents the main stages of the study. Each stage of the study is discussed in greater detail in Section 3 of the main report.

Figure ES.1: Approach to study



ES.3 Methodological approach

The survey contained two types of WTP question: Choice Experiment and Contingent Valuation. These approaches and the types of results derived are summarised below.

- **Choice experiment:** choice experiment exercises are designed to understand independent values for changes in service. They involve offering customers a series of choices. In this study each choice contained three scenarios showing a mixture of improvements and deteriorations to service. One of the scenarios was always shown as the current situation or level of service. To avoid presenting too much information and overloading the customer leading to inaccurate results the service areas are grouped into three 'blocks'.

  The result from the choice exercise allows us to examine how values change for different levels of service. An important effect to assess is gains-loss asymmetry. This is where it is commonly observed that unit losses are valued greater, in absolute terms, than unit gains of the same

magnitude. Not accounting for gains-loss asymmetry can potentially lead to over-estimation of WTP for service improvements. When gains-loss asymmetry is accounted for the results for deteriorations to service are known as Willingness To Accept (WTA). These estimates measure the level of compensation a customer would require if the level of service was reduced. These values can be used to understand the value of maintaining current service levels.

The study also examined the potential for diminishing marginal benefits, where successive units of service improvement are valued at a decreasing rate, due to a satiation effect. Again, not accounting for diminishing marginal benefits can lead to the over-estimation of WTP for service improvements.

- **Contingent Valuation:** CV exercises ask customers directly how they value a service change and were used in this study to test for potential '**package effects**'. This refers to the case where summing independently valued WTP estimates from choice experiments can over-estimate the value of large and multiple improvements in service levels. The CV exercise is used to examine customer values for multiple and simultaneous improvements to service by giving the customers a choice between the current situation and improvements to the maximum possible level. The contingent valuation component of the survey provided a set of 'package values' to compare to the choice experiment values from which 'scaling' factors can be estimated for use in CBA.

ES.4 Deciding the Water Services in the study

A key part of the WTP study was the development of the Valuation Framework. The Valuation Framework was developed prior to undertaking the customer surveys.

At the heart of the approach to investment planning and cost benefit analysis within South Staffs Water is the Output Performance Measure (OPM) framework. This contains the full set of service measures that are of interest, either because they are valuable to customers or to South Staffs Water. The OPM framework includes a number of service measures such as different durations of supply interruptions, properties affected by water flooding, discoloured drinking water, etc.

The Valuation Framework involved taking the PR09 OPM framework and updating it to meet the business requirements for PR14. The findings from customer qualitative research (including the focus groups from this study), a review of complaints data, lessons learnt from PR09 and recent UKWIR studies around customer valuation were then used to update and amend the OPM framework to ensure it met customer requirements and would align with what can be valued using customer valuation studies.

The recommendation from the valuation framework was that the PR14 measures to be included in the study should be:

Table ES.1: Water services

Service area	Unit of measure
Boil water notice	Number of properties affected in any one year
Discoloured tap water	Number of properties affected each year
Taste and smell of tap water	Number of properties affected each year
Hard water	Number of properties affected each year
Hosepipe ban	The chance that a hosepipe ban will be required in any one year
Non-essential use ban	The chances that a non-essential use ban will be required in any one year
Minor pollution incident	The chance in any one year that South Staffs Water causes one minor pollution incident
Low water levels and flow in rivers and streams	The percentage of rivers out of 339 miles experiencing low flow in the South Staffs region
Low water pressure	Number of properties affected each year
Unexpected supply interruption lasting 3 to 6 hours	Number of properties affected each year
Internal water flooding	Number of properties affected each year
Leakage	The amount of water lost through leaks each year. Number of properties that could be supplied.

These services areas were grouped into the following three blocks:

Table ES.2 Blocks

Block	Service areas
Drinking water quality	Boil water notice, Discoloured tap water, taste and smell of tap water and hard water
Water availability and the environment	Hosepipe Ban/Non-essential use ban, minor pollution incidents, low water levels and flow in rivers and streams
Reliability of water supply	Low water pressure, unexpected supply interruptions lasting 3 to 6 hours, internal water flooding, leakage

For each service area up to five levels of service were specified based on South Staffs Water's performance data: the current level of service (status quo), two improved levels of service (+1 and +2), and two deteriorated levels of service (-1 and -2). The balance of two improved and two deteriorated levels provides an appropriate range to non-linear effects to be examined.

The study also included an additional question to explore the relative value of different length interruptions and the impact on a customer of being informed about an interruption prior to the event. The results from this question can be linked to the WTP results to produce a set of WTP values covering a variety of scenarios for duration and resilience.

E.5 Main survey implementation

The main survey was implemented as follows:

- Domestic customers using Computer Aided Personal Interviews (CAPI) – in home interviews: A total of 506 South Staffs Water customers were interviewed. Customers had to be responsible for the bill and were representative by gender, ages and socio-economic group.
- Non-domestic customers using Computer Aided Telephone Interviews (CATI) to online: this approach used random telephone recruitment of respondents followed by an online survey. A total of 300 South Staffs Water customers were interviewed. Business customers were representative by industry and bill.

The non-domestic version of the questionnaire had identical structure and content to the domestic version, with exception of:

- the recruitment section which contains screening and quota questions
- the non-domestic customers answered questions relating to non-essential use bans instead of a hosepipe ban due to relevance
- the omission of non-relevant questions for business customers, such as household income

E.6 Customer preferences

The study results present a consistent view of customer preferences. For a large number of service area, the majority of domestic and non-domestic customers indicated that they were satisfied with the current level of service experienced. This finding was prevalent in the qualitative testing, pilot survey and main survey results. A notable exception is dissatisfaction with water hardness across both domestic and non-domestic customers.

Customer satisfaction with current services levels is also borne out by analysis of the choice experiment data, which shows a preference for both domestic and non-domestic customers for maintaining current levels of service. It should though be noted however, that this does not imply that improvements in services are not valued by customers. The econometric modelling consistently identifies positive and statistically significant WTP for improved levels of service. The interpretation instead is that in the choice tasks respondents were prepared to select improved service levels if they were judged to offer 'value for money' or if they thought that the service area would affect them directly. This is also supported by feedback provided by respondents. For both domestic and non-domestic customers a large proportion of respondents stated that they chose the options which 'offered the most improvement relative to cost' and 'affect or are most likely to affect the household/business directly'.

The study also provided some evidence that customers do not wish to see reductions in their bill (in addition to inflation) if service also reduced. 3% of domestic customers and 2% of business customers chose this scenario when offered scenarios that also included bill and service remaining unchanged or service improvement for a corresponding increase in bill. These views were evident in the choice exercises where some reluctance to select reductions was observed. This behaviour is reflected in the values presented and aligns with views observed in the focus groups where some customers expressed concerns about reduced investment impacting on the ability to maintain service in both the short and longer run.

When 'package effects' are taken into account domestic customers concentrate a majority of their value on drinking water quality service areas whilst non-domestic customers valuations are fairly evenly distributed across service areas.

ES.7 Benefit estimates - Choice exercises

This section presents the results for the choice exercises in three parts:

- The results for one domestic customer for step changes to the improvement and deterioration levels shown in the survey from the current situation.
- As above for the non-domestic customers. The values for non-domestic customers are shown as the percentage change in the business bill.
- The results for all customers for a smaller unit change, e.g. one property affected. This is the results aggregated across the entire customer base of 535,243 domestic properties and 33,666 non-domestic properties

Both Willingness To Accept (WTA) estimates for losses and WTP estimates for gains are presented. The benefit values presented are real values (i.e. excluding inflation). In the survey customers were informed about the potential impacts of inflation.

Domestic Customers

The results for the domestic customers are shown in figures ES.2 to ES.4.

Figure ES.2 Drinking Water Quality

		Change in Service Level			
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Boil Water Notice	*Properties affected*	*5,970*	*970*	*-30*	*N/a*
	Annual £ WTP per household	**-101**	**-16**	**0.08**	
Discoloured water	*Properties affected*	*2,500*	*1,000*	*-500*	*-1,000*
	Annual £ WTP per household	**-52**	**-21**	**1.44**	**2.87**
Taste and smell	*Properties affected*	*500*	*250*	*-250*	*-500*
	Annual £ WTP per household	**-14**	**-7**	**0.74**	**1.47**
Hard water		*N/a*	*N/a*	*All moderately hard*	*All soft*
	Annual £ WTP per household			**3.51**	**7.28**

Figure ES.3 Water availability and the Environment

		Change in Service Level			
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Hosepipe Ban	*% change in likelihood*	*2.5*	*0.8*	*-1.5*	*-2.5*
	Annual £ WTP per household	**-11**	**-4**	**1.85**	**3.08**
Pollution incident	*% change in likelihood*	*10.0*	*4.0*	*-3.0*	*-5.0*
	Annual £ WTP per household	**-53**	**-21**	**3.03**	**5.05**
Low levels/flow in rivers	*% change in length affected*	*N/a*	*N/a*	*-3.1*	*-9.1*
	Annual £ WTP per household			**1.33**	**3.89**

Figure ES.4 Reliability of Water Supply

		Change in Service Level			
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Low pressure	*Properties affected*	*2,000*	*1,000*	*N/a*	*N/a*
	Annual £ WTP per household	**-66**	**-33**		
3 to 6 hour interruptions	*Properties affected*	*2,040*	*1,040*	*-660*	*-1,160*
	Annual £ WTP per household	**-43**	**-22**	**2.06**	**3.62**
Internal Water flooding	*Properties affected*	*200*	*50*	*-25*	*-45*
	Annual £ WTP per household	**-80**	**-20**	**1.53**	**2.76**
Leakage	*Properties supplied*	*N/a*	*N/a*	*-5,000*	*-10,000*
	Annual £ WTP per household			**2.35**	**4.70**

Overall, the results indicate that service improvements across the range of water services are valued by household customers.

The results show that the highest value for a move to the +2 level is for hard water. Households also value pollution and leakage. However, it is important to note that comparison of these results is not straight forward as the value depends on the change in service level presented.

When comparing reductions to service household value avoiding deterioration to the level of service for boil water notices the most. This is followed by internal water flooding and low tap water pressure.

Non-domestic Customers

The results for the domestic customers are shown in figures ES.5 to ES.7.

Figure ES.5 Drinking Water Quality

				Change in Service Level	
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Boil Water Notice	*Properties affected*	*5,970*	*970*	*-30*	*N/a*
	Annual % WTP per business	**-34**	**-6**	**0.06**	
Discoloured water	*Properties affected*	*2,500*	*1,000*	*-500*	*-1,000*
	Annual % WTP per business	**-26**	**-10**	**1.69**	**3.38**
Taste and smell	*Properties affected*	*500*	*250*	*-250*	*-500*
	Annual % WTP per business	**-7**	**-4**	**0.93**	**1.86**
Hard water		*N/a*	*N/a*	*All moderately hard*	*All soft*
	Annual % WTP per business			**3.15**	**2.57**

Figure ES.6 Water availability and the Environment

				Change in Service Level	
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Non-essential use ban	*% change in likelihood*	*1.8*	*1.0*	*-0.5*	*-1.5*
	Annual % WTP per business	**-9**	**-5**	**1.03**	**3.08**
Pollution incident	*% change in likelihood*	*10.0*	*4.0*	*-3.0*	*-5.0*
	Annual % WTP per business	**-30**	**-12**	**3.37**	**5.61**
Low levels/flow in rivers	*% change in length affected*	*N/a*	*N/a*	*-3.1*	*-9.1*
	Annual % WTP per business			**1.35**	**3.96**

Figure ES.7 Reliability of Water Supply

				Change in Service Level	
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Low pressure	*Properties affected*	*2,000*	*1,000*	*N/a*	*N/a*
	Annual % WTP per business	**-24**	**-12**		
3 to 6 hour interruptions	*Properties affected*	*2,040*	*1,040*	*-660*	*-1,160*
	Annual % WTP per business	**-24**	**-12**	**2.28**	**4.01**
Internal Water flooding	*Properties affected*	*200*	*50*	*-25*	*-45*
	Annual % WTP per business	**-32**	**-8**	**1.34**	**2.41**
Leakage	*Properties supplied*	*N/a*	*N/a*	*-5,000*	*-10,000*
	Annual % WTP per business			**2.80**	**5.60**

Overall, the results indicate that service improvements across the range of water services are valued by non-domestic customers.

The results show that the highest value for a move to the +2 level is for leakage and pollution. Households also value interruptions highly. When comparing reductions to service household value avoiding deterioration to the level of service for boil water notices the most. This is followed by internal water flooding and pollution.

It was found that hard water was not statistically significant. This means that although the average value is shown the uncertainty is such the result may have occurred by chance. It is expected that this is due to a diverse range of views among non-domestic customers.

All customer values

The study results have been applied to the customer base to form aggregate benefits estimates for the water services.

The findings show that where the results are expressed in comparable units, such as per property, internal water flooding is a priority for both domestic and non-domestic customers. When the detailed results are examined non-domestics customers also have a relatively strong preference to avoid interruptions to supply, taste and odour and pressure issues and domestic customer have a preference to avoid deteriorations in pressure.

Figure ES.8 All customer values for 1 unit deterioration or improvement to service

		Change in Service Level	
Service Attribute	**Units**	**Reduction £**	**Improvement £**
Boil Water Notice	*1 property affected*	10,320	1,915
Discoloured water	*1 property affected*	13,490	2,290
Taste and smell	*1 property affected*	17,610	2,400
Hard water	*1 property affected*	N/a	8
Low Pressure	*1 property affected*	20,260	N/a
Interruption	*1 property affected*	13,830	2,440
Flooding	*1 property affected*	249,970	44,680
		Reduction £k	**Improvement £k**
Hosepipe ban	*1% change in likelihood*	2,447	659
Non-essential use ba	*1% change in likelihood*	1,072	455
Pollution incident	*1% change in likelihood*	3,516	789
Low levels and flow i	*1% change*	N/a	325
Leakage	*1000 properties supplied*	N/a	376

Notes: Values are rounded to nearest £10 or £1000. Values are aggregated over 535,243 domestic properties and 33,666 non-domestic properties based on average non-domestic bill (£658). Leakage is shown as 1000 properties as this is equivalent to 1.01Ml/d.

Table ES.5 All customer values for interruptions (£/year/property affected)

Interruption type	WTA	WTP
Planned 0-3	1,420	240
Planned 3-6	4,730	830
Unexpected 0-3	7,420	1,280
Unexpected 3-6	**13,830**	**2,440**
Unexpected 6-12	21,650	4,020
Unexpected 12-24	28,660	5,520
Unexpected 24-48	29,780	5,780

The overall package

As expected, significant package effects were observed for valuations associated with large simultaneous improvements to multiple water services. These values reported control for non-linear effects and package effects.

The findings from the survey suggest the maximum package is a £9.80 limit on domestic bill increases for all service improvements, with a corresponding 5.13% for businesses. Information from the package exercises in the survey combined with the choice exercise results allows us to allocate the value of the full package between the service areas.

The domestic customer's results also indicate that removing hard water is a priority whilst the non-domestic customer's views appear to be mixed.

Figure ES.2 Allocation of Household Package Values

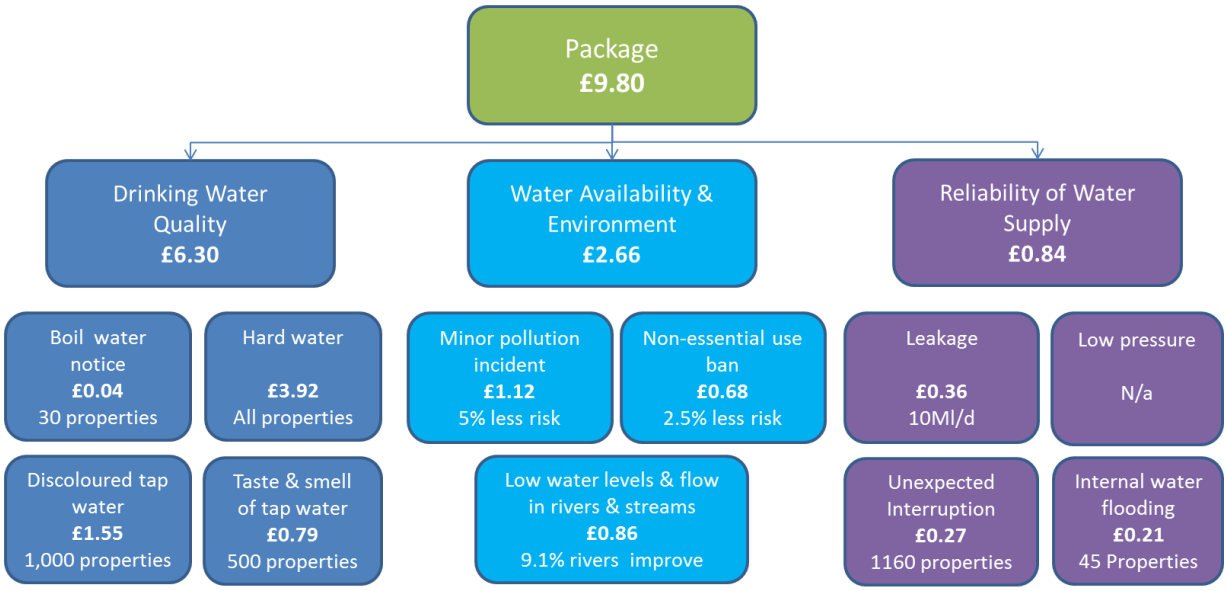
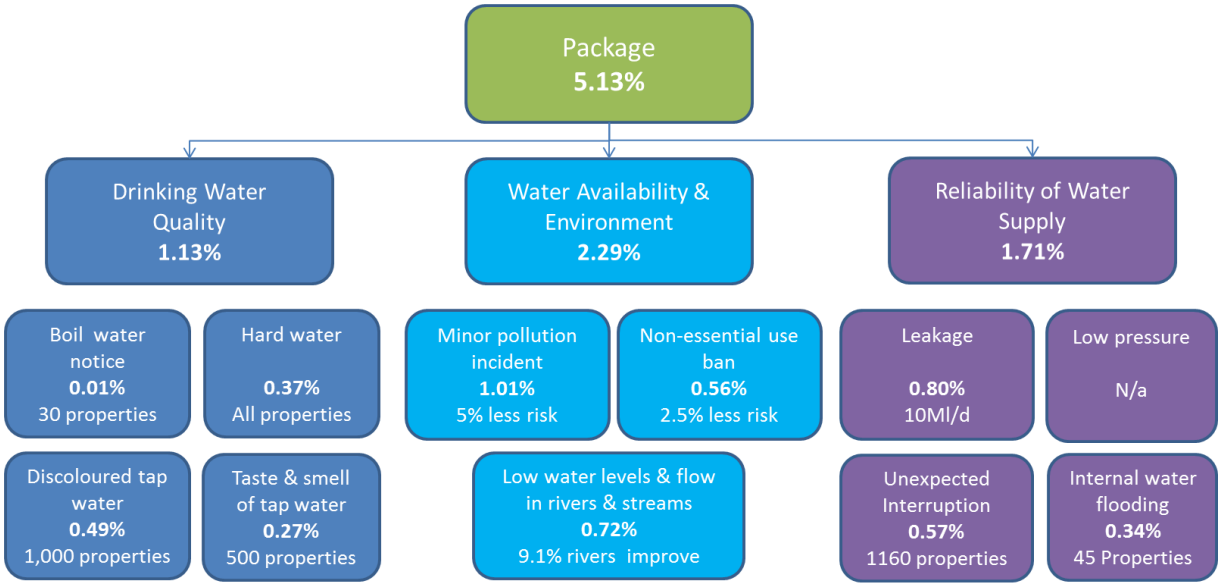


Figure ES.3 Allocation of Business Package Values



E.6 Conclusions

The overall objective of *the PR14 Willingness to Pay study* was to provide benefit estimates that input to the cost-benefit analysis that will support the development of South Staffs Water's Business Plan. The design built on good practice recommendations from recent UKWIR studies. The analysis and results of the study are based on a large scale sampling of domestic and non-domestic customers. Comprehensive econometric modelling has been undertaken to examine customer preferences for water services.

Overall, the study provides robust benefits estimates that are 'fit for use' in PR14 investment planning. Confidence in these results can be gained from the following:

- The design of the questionnaire is consistent with best practice and the study featured a comprehensive design and testing phase of work, which was used to iteratively refine the stated preference survey.
- The results are consistent with expectations.
- Debriefing and motivational questions included in the survey indicate that a majority of respondents views were assessed as valid and the main drivers for customer decisions related to choosing the best improvement relative to cost and whether the impact would affect them. This is rational behaviour.

Overall, the valuation estimates presented can be considered to be meaningful measures of SWW customers' values for the range of services, and service levels, contained within the survey, and we recommend them for use in cost benefit analysis of proposed service changes.

The one exception to this is the value for pollution where the results show that the value is much higher than expected suggesting that customers are indicating that they do not wish to observe pollution incidents. As a result it is recommended that an alternative value is used, such as the Environment Agency value for cleaning up pollution incidents, which provides a lower bound value for avoiding pollution incidents.

Further conclusions include:

- **Service reductions:** There is evidence that many customers have a strong preference to avoid reductions to service. This is indicated in the focus groups and both the qualitative questions that were used to set the context for the questionnaire and the benefit estimates that have been presented.
- **Package effect:** As expected a package effect has been observed when large improvements to multiple water services are valued. These results account for substitution effects between service areas valued in different choice experiments (known as blocks) and have been used to estimate a set of scaled (reduced) values. The details are presented in section 6 of the main report. It is appropriate to use these values if the application of CBA indicates that a large programme of improvements to the maximum improvement level across multiple service areas is beneficial. If smaller changes are being considered it is more appropriate to use the values from the choice experiments. The use of the 'unscaled' choice experiment values (with constraints around the maximum increase in bills) will allow the maximum scope of investment to be identified.

Estimating WTP allows us to measure benefit in monetary terms to customers from potential change to their level of water service. Comparing these estimates of benefit to cost will allow South Staffs Water to determine the most economic level of service using Cost Benefit Analysis. As the values presented represent estimates of the benefit values it not possible to draw conclusions on the appropriate scale of an investment programme or customer preferences from this study.

1 INTRODUCTION

1.1 Background

For the 2014 Price Review (PR14) South Staffs Water wants to ensure that the investments proposed in its Business Plan are worthwhile and represent value for money for customers. In the policy statement '*Involving customers in price setting'* Ofwat (2011) established that water companies are directly responsible for customer engagement, with the underlying expectation that this engagement will play a significant role in shaping the PR14 Business Plans, both in terms of the investment priorities that are identified and the acceptability of service levels that are subsequently delivered.

The development of South Staffs Water's Business Plan is supported by the use of cost-benefit analysis (CBA) to appraise all potential investments. The use of CBA enables South Staffs Water to directly compare the financial costs of investments – which, ultimately, are paid for by customers' bills – to the benefits of those investments, in terms of maintained or improved service levels to customers. At the heart of the approach to investment planning and cost benefit analysis within South Staffs Water is the Output Performance Measure (OPM) framework. This contains the full set of service measures that are of interest, either because they are valuable to customers or to South Staffs Water. The OPM framework includes a number of service measures such as different durations of supply interruptions, properties affected by water flooding, discoloured drinking water, etc.

The Valuation Framework involved taking the PR09 OPM framework and updating it to meet the business requirements for PR14. The OPM framework was updated using information on customer complaints data, feedback from the PR14 customer research, lessons learnt from PR09, and regulatory and business requirements. The resulting OPMs was then reviewed to assess the appropriate method for valuation. This included using the findings of the recent UKWIR studies around customer valuation and lessons learnt from PR09. It is a subset of this framework that is included in this stated preference research.

1.2 Aims and objectives

The objective of this study - *the PR14 Stated Preference Study* – is to provide benefit estimates that will inform South Staffs Water's PR14 investment planning by designing and implementing a stated preference (SP) study to estimate household and business customers' willingness to pay (WTP) and willingness to accept compensation (WTA) for changes in water service levels provided by SSW.

The specific aims of this research study are:

1. To provide monetary values for changes in water service levels that will inform the development of an investment plan for AMP6.
2. To explore if the monetary values differ for increases or decreases in service (WTP and WTA).

Stated preference methods are a form of quantitative customer research, which elicit customer preferences for service priorities and improvements and the value of changes in service levels. While results of the study primarily feed into the CBA, it also forms part of the wider customer research and engagement that has been established by South Staffs Water.

As documented subsequently, the implementation of the study has involved a comprehensive design and testing phase of work for the development of the stated preference survey, along with

sampling of domestic and non-domestic customers in the main survey implementation. This was followed by wide ranging analysis of the survey data. The approach taken has ensured that the results of the study are robust and 'fit for use' in PR14 investment planning.

1.3 Report outline

This report presents the methodology and results from the PR14 WTP study. It is structured as follows:

- **Methodology:** Section 2: provides a conceptual overview of the approach to estimating the benefits of water investments, covering the basic methodological principles and key issues to be addressed in the survey design.

- **Survey design and testing:** Section 3 documents the development of the SP survey, covering the findings from qualitative testing, the specification of service attributes and levels, experimental design; and the survey administration and sampling.

- **Analysis and results – household customers:** Section 4 summarises results for the domestic customer survey, including sample representativeness and profile, and the econometric analysis and WTP estimates.

- **Analysis and results – business customers:** Section 5 summarises results for the non-domestic customer survey, including sample representativeness and profile, and the econometric analysis and WTP estimates.

- **Application of benefit estimates**: Section 6 presents the aggregated benefits estimates to be applied by South Staffs Water in cost-benefit analysis.

- **Conclusions**: Section 7 concludes the report with a summary of the main findings and recommendations from the study.

The content of the report is supported by the following Annexes:

- Annex 1: Final household customer survey questionnaire and showcards
- Annex 2: Final business customer survey questionnaire and showcards
- Annex 3: Household survey statistical summary
- Annex 4: Business survey statistical summary
- Annex 5: Econometric results
- Annex 6: Peer review

2 METHODOLOGY

This section provides an overview of the concepts that underpin the use of stated preference methods to estimate the benefits of improvements in water services. It includes discussion of key issues for the survey design and analysis, particularly in terms of building on the collective experience of water companies in using stated preference surveys to support PR09 Business Plans.

2.1 Estimating the benefits of water investments

The purpose of the PR14 Stated Preference study is to provide benefit estimates to input to the cost-benefit analysis (CBA) that will support South Staffs Water's PR14 investment planning. The study applies the 'choice experiment' (CE) and 'contingent valuation' (CV) method, which are complementary stated preference techniques. Both involve asking survey respondents – a sample of domestic and non-domestic customers – to complete choice tasks that gather information on their preferences for changes in the provision of water service levels. In the choice tasks, respondents are presented with differing trade-offs between improvements and deterioration in different service areas - for example a reduction in the number of customers affected by unexpected interruptions to supply – along with changes in bill levels.

The trade-offs that respondents are willing to make between different service levels and bill amounts reveals the benefits of investments that maintain or improve service levels. Specifically the trade-off measures – in monetary terms - what customers are prepared to give up in order to secure a specified level of service. This trade-off is the 'willingness to pay' (WTP) measure of benefits and is the relevant metric for valuing improvements in service. The choice tasks implemented in this study also reveal the trade-offs that respondents are willing to make between declining water service levels and reductions in bills. This trade-off is the 'willingness to accept' compensation (WTA) measure of benefits and is the relevant metric for valuing *avoided* deteriorations in service.

An important point to recognise – since it is often a source of misconception with stated preference studies – is that the bill amounts that are presented to respondents in the choice tasks do not reflect the actual costs associated with the programme of investments that will maintain or improve services (or the cost saving associated with not undertaking the investments). Rather the water bill amount is the 'vehicle' that is used to elicit the trade-off between the respondents' household budget (i.e. what they are willing to give up from their overall income) and the service improvements/deteriorations of interest[1].

The basis for using stated preference methods to value the benefits of water service investments has been rehearsed in various documents in recent years. As noted in UKWIR (2010) stated preference methods offer considerable flexibility in terms of their applicability to the full range of water services of interest. In particular the objective of valuation is to establish the value that customers place on the benefits received through water services. Since customers pay only a single price (the water bill) for these services that provide multiple benefits, it is not possible to observe from the available price information how much customers value, say, reliability as opposed to tap quality or other aspects of service. Similarly alternative valuation methods, which make use of

[1] For example alternative 'payment' vehicles could be used, including other coercive payments (e.g. taxes, charges) or non-coercive payments (e.g. voluntary donations). In the context of valuing changes in water service, water bills represent the most credible payment vehicle for survey respondents.

'revealed preference' relationships between water services and observable market prices, provided only a limited basis for estimating benefits in a select set of service areas[2].

In contrast, appropriate application of stated preference methods provides an internally consistent framework for estimating value of individual components of water services for use in CBA. They also offer the potential to capture all motivations that can drive customers' preferences for water service levels, which encompass:

- Water services as a private good – this captures customer preferences for improving service levels and avoiding service failures that have direct impacts on their household (e.g. e.g. interruptions to supply).
- Public good and non-market goods – customers may also benefit from environmental service improvements that are delivered by water companies, either because they make directly use of the environment (e.g. recreation activities at bathing water sites) or because improved environmental amenity benefits their quality of life (so-called indirect use value).
- 'Non-use' motivations related to services provided by water companies, which stem from valuing benefits received by other customers (altruism value), future generations (bequest value) and, especially for environment-related services, for the benefit of the environment (existence value).

In combination these motivations – the private and public use values and non-use values – sum to the 'total economic value' associated with water services. Significantly stated preference methods provide the only basis for capturing non-use values, since revealed preference methods can only infer valuations from observed use values. It should however be also recognised that, despite their appealing properties in the context for valuing water services, the use of stated preference methods is not without limitations. The reliability of studies is subject to the extent to which customers understand the services, changes in service levels and risks, etc., presented to them in a survey. Where respondents are: (i) unfamiliar with and (ii) cannot develop their understanding of the services as part of the survey process, the results from stated preference studies should not be seen as robust or providing reliable evidence for CBA. This point serves to highlight the importance of the design and testing phase of stated preference studies to ensure that survey questions and materials presented to respondents are understood. Specifically it relates to the assessment of the 'content validity' of a study, which is concerned with the appropriate framing of questions and understanding of respondents (see Section 2.3).

[2] Revealed preference methods can only be applied where purchases of a market (priced) good can inform on the value of some water service. This implies that a combination of methods would be needed to valuing multiple services. For example using travel cost approaches or hedonic property pricing can be used to value impacts on local environmental amenity, and avertive expenditures to value service failures for which market alternatives are available (e.g. tap water). For further discussion see the review undertaken for Ofwat on the scope for applying revealed preference methods to support PR14 CBA (eftec and Cascade Consulting, 2011).

2.2 Stated preference methods

In this section, we outline the theory behind the design and analysis of choice experiments. It is by necessity a technical section.

Consumer demand theory

The application of choice experiments is based on consumer demand theory. This assumes that the utility (benefit) derived from the provision of a 'complex' good is linked to the characteristics of the good. In this study the good is represented by a bundle of water services experienced by domestic and non-domestic customers. Hence the utility derived by each customer is linked to the characteristics of the bundle of services, such as supply reliability, the quality of tap water, etc. A (stated) choice experiment uses this process to derive estimates of respondents' preferences for the various services, by presenting customers with repeated choices across experimentally designed alternative bundles of service characteristics, and asking them to choose their most preferred bundle from the available set in each repeated choice. When one of these characteristics is the cost of the bundle (i.e. the water bill) and customers choose one bundle (a specified package of services) over others, they implicitly reveal their trade-off between their money income and the single services included in each bundle in their choice set. Such a trade-off is the marginal WTP value of that characteristic of the bundled good; i.e. the value of a one unit change in provision of a service.

The cornerstone of any stated preference method is one simple assumption; that individuals know their own preferences and, whatever choice is encountered, they know what is best for themselves. In formal terms we can say that an individual (i) is assumed to choose alternative j over alternative k if the utility derived from attribute bundle j is greater than the utility derived from attribute bundle k; i.e. if $U_{ij} > U_{ik}$, where U_{ij} is the total utility associated with alternative j and U_{ik} is the total utility associated with alternative k. The utility function for respondent i related to alternative j is specified as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} \qquad [1]$$

where V_{ij} is the systematic (non-stochastic) utility function observed by the analyst because it is linkable to the attribute levels of each alternative (e.g. water service attributes, etc.) and ε_{ij} is a random component, which is known to the individual, but remains unobserved to the analyst. This random component (ε_{ij}) arises either because of randomness in the preferences of the individual or the fact that the researcher does not have the complete set of information available to the individual.

Choice Experiment Models

Table 2.1 presents the different types of econometric models that are used to analyse the respondents' choices. These increase in their level of complexity and explanatory power from conditional logit (CL) to mixed logit (MXL) models.

Table 2.1: Types of econometric modelling used for analysing choice experiments

Model	Description
Multinominal logit (MNL) model	This model explains the likelihood of an option being chosen by a respondent by the attributes of the good and the characteristics of the respondent. The multinomial logit (MNL) model represents the basic choice experiment model and was most commonly applied specification in company studies at PR09 (UKWIR, 2010). It is derived by placing some practical, yet restrictive assumptions on this random component of utility. Each ε_{ij} is assumed to be an independently and identically distributed (iid) Type 1 extreme value (Gumbel). If the assumptions implicit in the MNL model do not hold, then MNL model results might be biased. However it is not possible to specify *a priori*, in a study or survey of customers, whether the assumptions of the MNL model will hold.
Nested logit (NL) model	This is an extension of the MNL model. It treats decisions as a 'hierarchical' choice, for example choosing whether or not to pay for improvements to water services (i.e. whether to choose the status quo or a change), and then choosing between alternative improvement options.
Mixed logit (MXL) models	Given its limitations, it is appropriate to conduct more sophisticated econometric analysis and test less restrictive model specifications that relax some of the assumptions of the MNL model. These are represented in the analysis by MXL models. A limited number of companies' PR09 analyses featured the estimation of MXL models to provide a better account of customer preferences (UKWIR, 2010). The different features/models include: • Random parameter logit (RPL) model: the MNL model assumes that respondents' choices are influenced by the same variables in the same way. In other words, the coefficients of the variables are the same over all respondents (i.e. homogeneity in preferences). An RPL model allows for the assumption that different variables influence individual respondents in different ways. In other words, the coefficients vary between individuals (i.e. heterogeneous preferences). • RPL correlated model: this allows unobserved factors to continue to affect individuals' decisions over multiple choices (i.e. different choice cards). • Error corrected (EC) model: this model relaxes the MNL assumptions on the error term in relation to how a decrease in the likelihood of choosing an option is correlated to the chance of selecting an alternative option.
Latent class models	A further advanced model that accounts for heterogeneity in preferences by modelling different groups ('classes') so that coefficient estimates are different between groups.

How these models are implemented to the data collected from this survey are explained in Section 4.4.

Contingent valuation

The objective of analysing the contingent valuation data is to estimate a 'bid function' (also termed 'WTP function') that describes how a set of variables affect the WTP amount stated by a respondent. This can be used to estimate unit WTP values and is also fundamental to testing the results.

The econometric model(s) used in the analysis depend on the elicitation format used and the WTP data that is generated by the survey. Types of WTP data (i.e. responses elicited from respondents in the valuation scenario) are:

- Continuous WTP data: this results from use of an open-ended elicitation format that requires respondents to give one value that represents their WTP for service attribute or good of interest.
- Binary WTP data: this results from use of a single-bounded dichotomous choice elicitation format that requires respondents to state whether their WTP is higher or lower than a bid amount presented to them for the service attribute or good of interest.
- Interval WTP data: this results from elicitation formats that present respondents with a series of bid amounts - i.e. payment card, one and half bounded dichotomous choice, and double-bounded dichotomous choice – which reveals the range in which their WTP for the service attribute or good of interest lies.

In this study, we used a double bounded dichotomous choice elicitation format and hence we have interval WTP data.

There are two main procedures for estimating a bid function and WTP (or WTA) values:

- A parametric model approach: here an assumption is made as to the statistical distribution of WTP; i.e. the 'shape' of the distribution which describes the frequency of WTP across different ranges of value. Common assumptions as to the distribution are: normal distribution, logistic (log) distribution, log-normal distribution, or Weibull distribution.
- A non-parametric model approach: this does not specify any assumptions as to the distribution of WTP; instead the analysis generates a distribution based on the actual WTP survey data. A common procedure for obtaining the distribution of WTP is the Turnbull algorithm (which is also known as the 'pooled adjacent violator algorithm').

The estimation methods we have employed are detailed further in Section 4 for the household survey and Section 5 for the business survey.

2.3 Methodological and practical issues

The review of practice across the sector in applying stated preference methods at PR09 highlighted a number of methodological and practical issues – see UKWIR (2010) *Review of Cost-Benefit Analysis and Benefits Valuation*. In part some challenges have subsequently been addressed by the industry good practice guidance contained in the UKWIR (2010) 'Practitioners Guide' and the follow-on study UKWIR (2011) *Carrying Out Willingness to Pay Surveys*. However in developing the PR14 WTP study for South Staffs Water it has been important to address these issues directly. This is to ensure that they have been appropriately examined within the survey design and testing and that key findings have informed the main survey implementation and econometric analysis. The intention has been to build on the UKWIR (2011) survey template and refine so that the study provides valid and robust benefits estimates for use in CBA, which are in line with the current practice in the use of stated preference methods.

Throughout the study, we sought to explore the following well-established issues for the application of stated preference methods:

- Non-linear effects in WTP estimation (gains-loss asymmetry and diminishing marginal benefits);
- Independent valuation and summation issues (the 'package' effect); and
- Validity testing.

The discussion of these methodological and practical issues leads into the survey design and testing process. Peer review input has inputted throughout the study development, particularly with respect to guiding the refinement of the structure for choice experiment and contingent valuation components of the survey and ensuring they are methodologically sound (see Annex 6).

The role of validity testing

The UKWIR (2010) review of PR09 practice noted that considerable scrutiny was directed on the results of stated preference studies by stakeholders across the sector, but that this was often limited in scope - essentially focusing solely on WTP estimates - without necessarily appreciating the role of validity testing in survey design and analysis. Since the application of stated preference studies is context-specific, the validity of the approach and reliability of results are tested through a set of established steps that relate to questionnaire design, fieldwork and data analysis (see Bateman et el., 2002).

The main components of validity testing are:

- **Content validity:** this refers to whether the survey questionnaire succeeded in achieving meaningful and accurate measures of the respondents' WTP (or WTA) for the good or service being valued. Content validity can be affected by the information provided to respondents on the good or service and concerns how the stated preference questionnaire was developed including issues such as the structure of the choice experiment, and respondent understanding of the survey and choice exercise, perceived credibility of the hypothetical scenarios presented. While it is not possible to directly measure how the respondents' WTP (or WTA) values differed from the actual values they might hold, we can use some different survey data to determine if problems with content validity are evident.

  One possible indicator of poor content validity is the presence of 'item non-response' in a survey, or questions that the respondents refused, or chose not, to answer for any reason. Presence of item non-response can be an indication that the respondents might have had difficulty in answering the survey or in making the choices asked of them. It is also important to identify if there are any systematic biases in responses (i.e. a respondent always choosing the same option in a CE) or evidence of protest responses[3]. Other assessments of content validity include examining responses to questions that assessed the level of the respondents' understanding of the choice experiments. In addition, for CAPI (Computer Aided Personal Interview) surveys interviewers report on respondents' understanding and attentiveness to options presented in the CE exercise.

[3] This is a response to a valuation question where the respondent rejects the valuation scenario that is presented and does not state their genuine WTP (or WTA). The most common type of protest response occurs where the respondent states a zero WTP value, which is often referred to as a 'protest zero'.

- **Construct validity:** this focuses on the analysis and econometric estimation, in terms of how well estimated models fit data (i.e. how well do they explain the choices and preferences of customers) and the extent to which results conform with prior expectations, based on theoretical considerations and empirical results from similar studies.

  One common application is to segment the WTP responses based on socio-economic factors that should influence customers' values. If the results show that WTP (or WTA) is dependent on these variables, this provides further evidence that the results conform to expectations and are theoretically valid. For example, there is an expected relationship between the respondent's income (which can also be proxied by socio-economic group (SEG)) and the choices they make: for the choice option with a higher bill amount (i) the likelihood of accepting that choice will be lower for all SEGs or income groups; but that (ii) the likelihood of acceptance will be higher for higher SEGs or income groups – all else remaining the same. This relationship can also be used to assess distributional issues and the 'acceptability' of investment proposals.

  There are no set prior expectations (theoretical or based on commonly observed empirical results) as to whether different respondent characteristics or experience with the good or service should affect WTP (or WTA). For example, we cannot say if older people are always willing to pay more or the more experienced the respondent with the good the more likely they are to choose a bill increase. These relationships are context dependent.

In general stated preference studies which cannot demonstrate an appropriate level of content validity and/or that perform badly in terms of construct validity should therefore be regarded as less reliable in terms of the robustness of results such as customer WTP values.

In developing the PR14 WTP study, the issue of cognitive burden has been a key consideration. Cognitive limitations preclude respondents simultaneously trading off a large number of service attributes. A commonly cited rule of thumb, which can be traced back to cognitive psychological experiments undertaken by Miller (1956), is that seven, plus or minus two, represents that number of factors that individuals can reasonably be expected to evaluate in a given choice setting[4,5]. When faced with an increasing number of factors it is likely that respondents will make inconsistent choices or resort to simplifying heuristics. While these heuristics can be varied, they are essentially evidenced by 'non-trading' behaviour by respondents, with typical examples including: 'serial' status quo choices (i.e. always opting for the status quo option, if available); always selecting the option with the lowest bill amount; always selecting the option in a particular column; and so on.

Given that the respondents are likely to be initially unfamiliar with the choice task format, it is reasonable to expect that a certain amount of 'learning' is required on the part of the respondent as they become accustomed to the service attributes and improved and deteriorated levels of service on offer. Therefore it is desirable to accommodate this learning process in the number of

[4] Note that a 'factor' represents an individual piece of information. For example in a choice task comprised of four attributes and three alternatives there are 16 pieces of information – the 4 attributes plus their levels in each alternative (3 × 4 = 12). In practice CEs rely on learning effects and the fact that some information remains constant over the repeated choices (i.e. the attributes and often one of the alternatives which usually presents the status quo situation), so that respondents are expected to cope with a manageable set of information closer to Miller's result.

[5] This is also reflected by recent empirical studies. Specific to CE method, Caussade et al. (2005) provide an empirical investigation of complexity and cognitive burden in terms of the number of alternatives, the number of attributes, the number of levels, the range of attribute levels and the number of choice tasks presented to each respondent. They conclude that the number of attributes is one of the most critical design dimensions. Specifically increasing the number of attributes (ranging between 3 and 6 per choice task within their test) was found to have a clear detrimental effect on the ability of respondents to choose, contributing to a higher error variance. The optimal number of choice tasks was found to be 9 or 10.

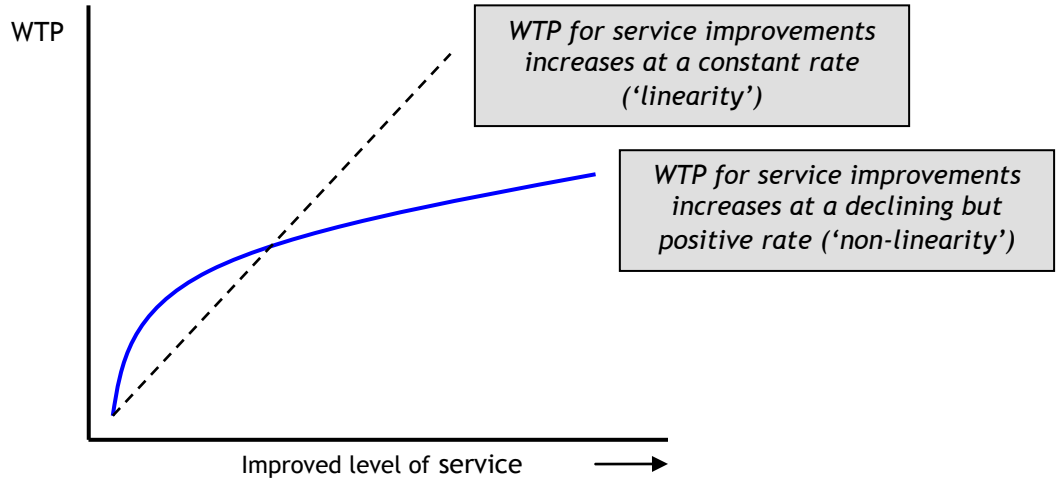
repeated choice tasks given to respondents such that potential inconsistency in initial responses is averaged out over the sample. However beyond a certain point it is likely that inconsistency will return as fatigue and boredom set in from the repetitive nature of choices. Coupled with this there is also a significant link to issues of construct validity where the estimation of more sophisticated MXL models, plus specifications that control for non-linear effects (see below) require more choice task observations per respondents than the basic MNL model. This point serves to highlight the inter-linked nature of key design issues and the need for validity testing to be reflected throughout the study development.

Controlling for non-linear effects

A number of company studies undertaken at PR09 highlighted the importance of controlling for non-linear effects in WTP estimation, particularly when choice experiments covered by service improvements and deteriorations, and when multiple improved levels of service were specified. In particular non-linearity in benefits estimation is concerned with two expectations:

- **Diminishing marginal benefit from improvements in service**: A basic expectation of economic analysis is that of diminishing marginal benefit, where the additional benefit of service improvements declines as the level of service increases. Largely this can be attributed to a satiation effect where larger improvements in service do not generate as great per unit benefits as initial improvements in service. This implies that in most instances (marginal) WTP should be expected to decrease for sequential unit increases in level of water services.

Figure 2.1: Diminishing marginal benefit from improvements in service

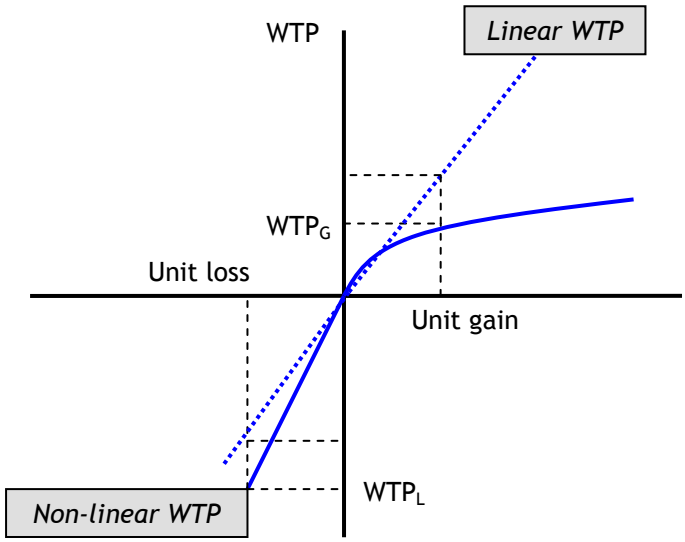


Source: UKWIR (2010) *Review of Cost-Benefit Analysis and Benefit Valuation - Practitioners Guide Part 1.*

The expectation of diminishing marginal benefit is depicted in the stylised example in Figure 2.1. This contrasts a non-linear pattern of marginal benefits from improvements in service to an assumed constant marginal benefit (the 'linear' case). In the case of the latter, there is the potential that for higher levels of improved service, assuming linearity in marginal WTP will result in an over-estimate of benefits.

- **Gains-loss asymmetry**: this is relevant where a study investigates the value of both improvements in service ('gains') and deterioration in service ('losses'). The basic observation with gains-losses effects is that, in absolute terms, the value of unit of a gain in some good is valued lower than a unit loss in the same good.

Figure 2.2: Gains-loss asymmetry



Source: UKWIR (2010) *Review of Cost-Benefit Analysis and Benefit Valuation - Practitioners Guide Part 1.*

The case of gains-loss asymmetry is illustrated in Figure 2.2. With non-linear WTP, losses for the *same unit change are valued greater than gains in absolute terms* (i.e. $WTP_L > WTP_G$). Simply assuming linear WTP across gains and losses will: (i) likely under-estimate WTP (or WTA) for losses; and (ii) over-estimate WTP for gains.

In developing the PR14 WTP study non-linearity was tested for in the pilot survey (see Section 3.4) and examined in the main survey analysis (see Sections 4.4 and 5.3).

Independent valuation and summation

As Section 3.3 details further the number of service attributes specified in the study is too great to present to respondents in a single choice task. Following the example of Willis et al. (2005) the standard practice has therefore been to specify more manageable 'blocks' of attributes which result in a series of choice experiment exercises. As each block has a common attribute in the form of the water bill attribute, in theory, the value of different blocks can be added to each other to generate estimates of the value of such block combinations. However, in combining valuations from choice experiment blocks, two implicit assumptions are made:

(i) That the manner and extent to which income constraints bind on the valuation of single blocks holds for the valuation of dual or multiple blocks; and
(ii) The attributes in one block are not significant substitutes for the attributes in another block.

To the extent to which these implicit assumptions *do not* hold then there will be a tendency for the value of block combinations to be lower than the simple sum obtained by adding together the value of one block valued on its own with the value of another block valued alone. For example, if there are two blocks, *A* and *B* and their value when assessed individually is A_s and B_s, and their value when assessed as a combination is AB_c, then if income constraints bind in a non-linear fashion as the number of blocks considered increases and/or one block is a partial substitute for the other then it is expected that:

$$A_s + B_s > AB_c$$

This 'part-whole' difference is a common phenomenon which affects market as well as non-market goods (see Bateman et al., 1997). In PR09 'terminology' the part-whole difference has been more commonly referred to as the 'package effect'. UKWIR (2010) highlights that package effects may not be a concern in all cases of benefits valuation. However from a practical perspective – particularly in terms of application of benefits estimates in CBA – they are mostly likely to be a significant issue where marginal WTP values from choice experiments are applied to large and multiple simultaneous improvements in services; i.e. where substitution effects may be expected. This would give rise to the potential package effect:

Total value of service improvements valued separately *(i.e. summing choice experiment values)*	**>**	*Total value of components valued simultaneously* *(i.e. value for discrete change from contingent valuation)*

To test for package effects, the independently estimated WTP values for service improvements choice experiments need to be compared to a valuation estimated for a multiple and simultaneous improvement in services. While the ability of respondents to make choices across large combinations of simultaneously assessed attributes and levels is limited (as previously recognised), this can, to some extent, be addressed by holding attributes at a single level (say for example the highest level of service), and then combining across blocks. Although this still represents a considerable number of attributes, the lack of variation in their levels means that a single good (a discrete change) is defined for valuation. Here the contingent valuation method can be used to ask respondents to trade-off the change of moving from the present level of service to that represented in the combined good. The contingent valuation method therefore provides an internal consistency check for benefits values that provides a basis for assessing the extent to which choice experiment values can be combined over large and multiple service improvements in CBA and what adjustments might need to be made for substitution effects.

Taking the independent valuation and summation issue into account in the survey design gives the basis for using the choice experiment and contingent valuation method as complementary components of a stated preference questionnaire:

- The choice experiment component is used to estimate (marginal) WTP for unit changes in the provision of service via a multiple block design; and
- A 'package' contingent valuation question is used to estimate the value of a discrete change that represents the maximum (combined) improvement possible for the combination of service attributes presented to a respondent.

From this package contingent valuation question provides a 'benefits value ceiling' that proxies the combined substitution effects between service attributes; i.e. the maximum WTP for the highest level of improvement across all components of the investment programme. Where package effects are observed, the ceiling value can either: (i) be used to scale the unit value WTP estimates obtained from the choice experiment to mitigate against the potential for over-estimating aggregate benefits of multiple service improvements in CBA; or (ii) provide a constraint that is applied on optimisation of an investment plan through CBA.

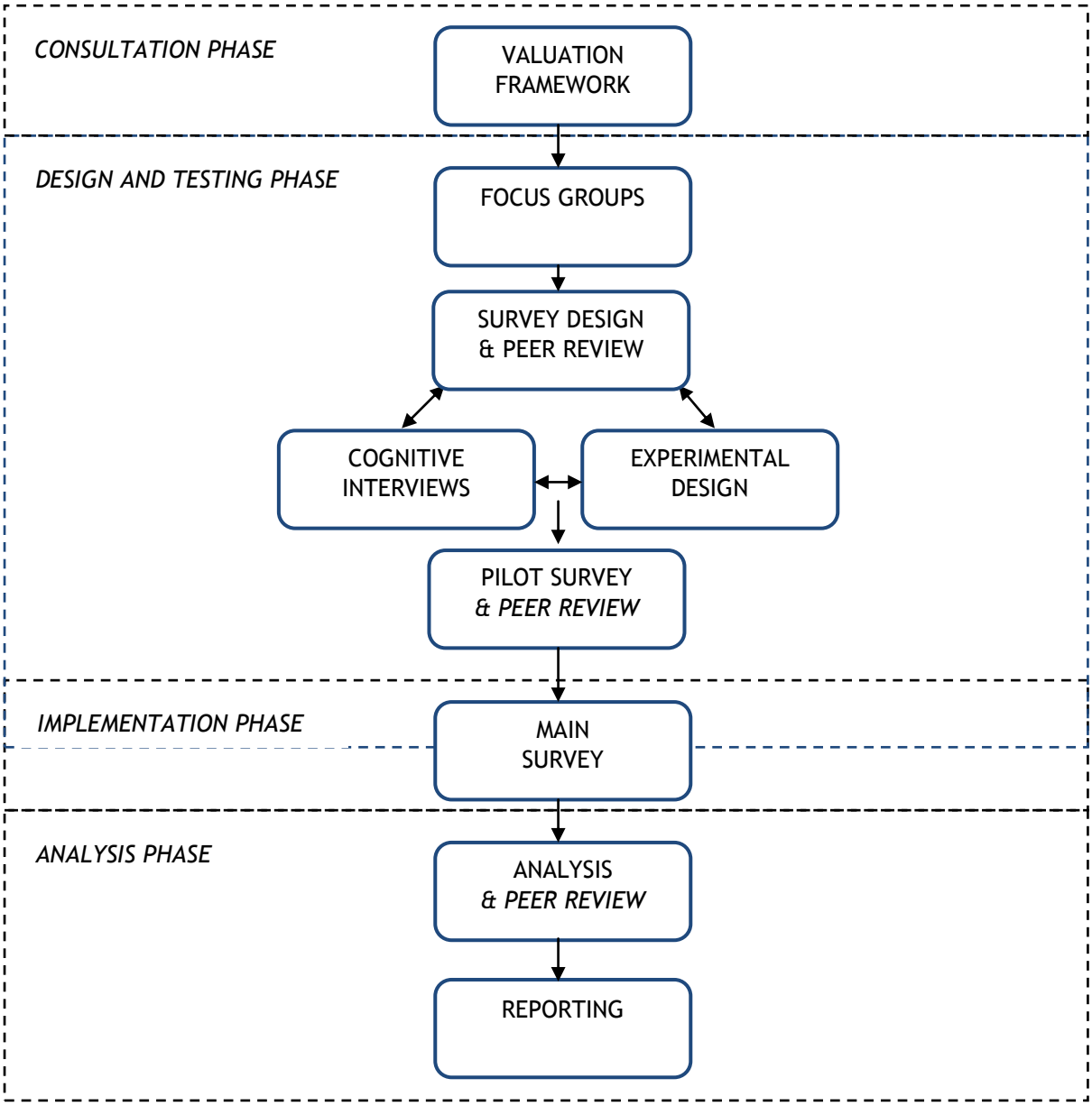
3 SURVEY DESIGN AND TESTING

This section of the report presents the approach taken in the design, testing and implementation of the stated preference survey. It draws on a number of the methodological issues raised in Section 2.3 and how they have been considered in the survey design.

3.1 Approach

Figure 3.1 outlines the overall approach to the study. The iterative (test – re-test) design phase is consistent with good practice for implementation of state preference surveys - see for example Bateman et al. (2002) and UKWIR (2010).

Figure 3.1: Stated preference study implementation



The main features of the approach to the study are summarised as follows:

- **Valuation Framework and Scoping**: initial consultation was carried out with South Staffs Water to confirm the scope of the study and the range of service areas to be considered. This included the alignment of the study with the 'IO Tool', which underpins its application of CBA for PR14 investment planning.

- **Survey design and qualitative testing:** iterative testing of the stated preference questionnaire and materials presented to respondents is a fundamental component of the study implementation. It provides the primary basis for addressing content validity issues concerning respondent understanding and the potential for hypothetical bias influencing results. A substantial programme of qualitative testing was used to aid the survey design, including:

  - Focus groups with domestic customers;
  - Development of an initial survey; and
  - Cognitive testing interviews with both domestic and non-domestic customers.

  Throughout the qualitative testing the stated preference questionnaire – including structure, definitions of attributes presented to respondents, and framing and phrasing of survey questions – was revised and updated based on feedback received from respondents. Refinements focused on improving respondent understanding of the survey material. The findings of the focus groups, 1st peer review and the cognitive testing are presented in Sections 3.2.

- **Experimental design:** in-parallel to the qualitative testing an experimental design was developed for the implementation of the choice experiment component of the study. The design is

- **Pilot survey:** the pilot survey represents the final stage of the design phase of the study. Typically it involves administering a draft questionnaire to a sample of respondents, and requiring them to complete it in the same manner as those who will be recruited for the main survey. It is primarily used to 'fine-tune' the questionnaire and test the experimental design, assessing response patterns to check these are in line with expectations. The findings of the pilot survey are presented in Section 3.4 and were taken into account to revise the questionnaire.

- **Main survey:** the survey of domestic customers used a computer-aided personal interview (CAPI) approach. This means that the interview occurred at the respondent's home conducted by an interviewer using a computer programmed with the survey. This method has the advantage of ensuring the exact meaning is conveyed to the respondent and can lead to more reliable data collection. However, the CAPI interviews may lead to an interviewer effect where respondents do not reveal their true answers on sensitive topics such as income. For non-domestic customers, the computer aided telephone interview (CATI) to online format was used. This is a mixture of an online survey format with telephone recruitment. While this approach avoids the potential for interviewer bias there is greater potential for the exact meaning to not be interpreted correctly.

- **Analysis**: a comprehensive analysis of the survey data was undertaken, including estimation of the range of econometric models described in Section 2.2, along with tests for non-linear effects in WTP and package effects.

3.2 Qualitative testing

Domestic focus groups

Focus groups are semi-structured discussion groups led by a moderator, in which participants are presented with topics pertaining to the design of the stated preference survey. Their use enables customer attitudes and perceptions concerning key issues to be reflected in the design of the stated preference questionnaire, with an emphasis on ensuring credibility and that aspects such as the definition of attributes are meaningful and easily understood.

Six focus groups were carried out with domestic customers in the South Staffs region. The focus groups were undertaken by Opinion Leader and each lasted 1½ hours. All focus groups took place on the 28th and 29th January 2013 and were held in Uttoxeter, Walsall and Sutton Coldfield. Participants were recruited according to four lifestage categories:

- Pre-children – Customers aged 18-34 and living either singly or cohabiting but without young children in the household
- With younger children – Customers aged 25-54 with children aged under 10 in the household
- With older children – Customers aged 25-54 with children aged over 10 in the household
- Empty nesters – Customers aged 55+ whose children no longer live at home

Two focus groups were held at each location: the first included the pre-children customers and customers with young children and the second included the customers with older children and the empty nesters. Table 3.1 details the participant profile. In all groups a mix of gender, socioeconomic grade, ethnicity and disability were recruited. In addition, customers were asked whether they were 'comfortable' with or 'struggled' to pay their bills at the moment. A minimum quota of two who were 'comfortable' and two who 'struggled' was set on each group.

Table 3.1: Focus group locations and participant profile (domestic customers)

LIFESTAGE	TOTAL	SEG			
		AB	C1	C2	DE
Empty Nesters	**11**	1	7	1	2
Older Children	**13**	2	5	5	1
Young Children	**20**	4	8	5	3
Pre Children	**11**	2	6	1	2
TOTAL	**55**	**9**	**26**	**12**	**8**

Notes: SEG = socio-economic group. Market Research Society definitions are: A = professionals, very senior managers, etc.; B = middle management in large organisations, top management or owners of small businesses, educational and service establishments; C = junior management, owners of small establishments, and all others in non-manual positions; D = skilled manual workers; E = semi-skilled and un-skilled manual workers.

The main role of the focus groups and in-depth interviews was to test and refine the descriptions of service attributes, particularly in terms of the show materials that would accompany the stated preference questionnaire. The set of attributes to test was developed in conjunction with input from South Staffs Water. Initial attribute definitions were informed by the Output Performance Measures Framework and the template provided by the UKWIR (2011) *Carrying Out Willingness to Pay Surveys* report. Discussion areas in the groups included:

- Perceptions of utility services in general within the local area;
- Knowledge of water industry and the provision of water services;
- Perceptions of current levels of service received, including problems encountered in respect to the service attributes of interest;

- Understanding of attributes and descriptions, the extent of their relevance and the acceptability of such measures as criteria for delivery of service;
- The relative importance of different attributes and priorities for improvement;
- The perceived value of improvements to services, in terms of willingness to pay for changes in service levels;
- The perceived value of deteriorations to service, in terms of willingness to accept for changes in service levels;
- The preference for the status quo, deterioration or improvement;
- The layout and content of the choice cards; and
- Wording referring to the bill impact and inflation in the questionnaire (known as cheap talk).

A summary of headline findings from the focus groups is provided by Opinion Leader (2013) *Willingness-to-pay qualitative research findings*. Key findings included:

- Participants' knowledge about water supply and water services was fairly low. Many, for example, did not realise that Severn Trent Water was responsible for waste water services in the area. There was also only a basic understanding of South Staffs Water's (SSW's) responsibilities as a water supply company. However, after some consideration customers could see that the company was responsible for providing and maintaining water pipes and infrastructure (such as reservoirs) across the region, as well as supplying clean, safe drinking water to their homes. This low level of understanding appeared to stem from the fact that very few participants had experienced problems with their water supply, which meant it was not a service that was top of mind.
- Some of the attributes were felt to be hygiene factors, and therefore something which SSW should be carrying out as a matter of course. For these attributes in particular, participants were unwilling to pay more to improve the service, despite thinking they were very important, since they felt this was part and parcel of what a water company should deliver as a minimum.
- Leaks were frequently cited as an issue customers felt that SSW should address. This was mainly driven by news reports about leaks in the area and by a pervasive concern about mismanagement and the 'wastage of clean water'.
- When asked about service and bill changes together the vast majority of participants thought that the current level of service was acceptable and therefore an additional charge to the bill for an improvement in the service was not seen as necessary or something they wanted. Respondents across the groups rejected a deterioration of service for a decrease bill.
- Some groups were able to quantify how much they would be willing to pay for improvement to service, and two groups said they would be willing to pay up to £20 a year for reduced hardness and improved quality of the water provided.

Overall the findings from the groups reinforced the importance of the 'content validity' of the study and ensuring that respondents are able to effectively engage with the survey and that their responses reflect their genuine perceptions of service levels and the benefits of changes in these. The collective feedback from the groups was used to modify individual attribute descriptions and showcards, as well as providing significant qualitative information on customers' perceptions of service levels. These updates were then incorporated into the subsequent cognitive testing phase of the study.

The focus groups also tested the content of choice cards and the accompanying wording relating to potential changes to income and expenses (known as cheap talk). We found that most (but not all) participants were thinking about income and household bill changes. The participants wanted us to mention inflation in the cheap talk and were content that the increases shown were uncertain and based on a forecast. However, when we showed wording with the bill impact converted to money from a percentage there was a strong feeling that we should either tailor the impact to their individual bills or not show this at all. This opinion relates to the wider range of bills observed and links to the fact that many of the customers did not distinguish between the South Staffs Water and Severn Trent Water bill.

Initial survey design

The structure for the domestic questionnaire is based around the typical format for a stated preference survey (see Bateman et al., 2002):

- Preliminary questions: Recruitment, screening and quota questions
- Section A: Introductory questions
- Section B: Service priorities - choice experiment blocks and contingent valuation package questions
- Section C: Follow-up questions
- Section D: Socio-economic characteristic and demographics

Key features of the initial design included the following:

- Extra questions on the customer's bill amount to understand awareness of the billing arrangement with Severn Trent Water and identify the SSW part of the bill.
- Including leakage in a block with attributes that can be caused by leakage. The description was adapted to ensure that the valuation did not include the impact on rivers and road disruptions. A potential overlap exists with hosepipe bans but this value is expected to be low.
- Including the status quo as one of the options in the choice experiments.
- Showing the inflation impact as a percentage only but providing interviewers with additional information to allow the impact to be tailored to a customer's bill amount.
- Following the final package CV question that asks about customers WTP for an improvement to all of the attributes with a further follow-up question on how changes in the STW bill would affect their answer.
- Including an additional question on interruptions to identify a set of relative weights for different durations of planned and unexpected interruptions.
- At the beginning of each block including a package CV question on the attributes considered in that block.

The initial survey has departed from UKWIR by offering the status quo as a choice. The reasoning behind this is that not including a status quo choice forces respondents to make a hypothetical choice. The status quo is also a real choice for respondents and the customers at the focus groups demonstrated a very strong preference for this option. For these reasons it would appear that the status quo is a viable option for many and it is valid to include it as a choice. It will also represent an opt-out option that is a real option and help reduce hypothetical bias. To avoid over emphasising the status quo this option has been included on the right hand side of the choice card.

The survey also excludes the UKWIR choice set D which presents three choice experiment cards containing all of the attributes. The reason for excluding this is cognitive burden which was evident when customers were considering 6 attributes in a card.

Cognitive interviews

Cognitive testing involves administering the draft stated preference questionnaire to a sample of respondents followed by a set of debriefing questions. The debriefing elicits qualitative feedback from respondents on questions and choice tasks in the main questionnaire. In general this permits the examination of a number of issues concerning the design of stated preference surveys, including respondent comprehension and retrieval of information (e.g. from attribute showcards), and respondent decision processes (e.g. mental effort, motivations behind choices, truth telling). Cognitive interviews are therefore highly useful in evaluating the validity of stated preference studies, especially when the topic area presented to respondents is complex.

In total ten cognitive testing interviews were undertaken in February 2013[6]. Key issues examined in the interviews included respondents':

- Understanding of attribute descriptions and showcards;
- Understanding of the choice tasks (choice experiment and contingent valuation) and the clarity with which these were presented;
- Motivations for the choices made in the choice exercises;
- Perceptions of the credibility of the choice exercises; and
- Attitudes towards the payment vehicle in the choice exercises (the water bill).

The main findings from the interviews were similar across both domestic and non-domestic customers. Overall, respondent understanding of the service attribute descriptions and showcards was good. While a number of specific refinements to the questionnaire material were identified as a result of feedback from the interviews, the findings provided assurance that respondents could effectively engage with the survey topic and readily perceive the service areas of interest.

In line with the focus groups findings it was evident that customers' experience of service failures is very limited, and as a result respondents were, on the most part, satisfied with the levels of service currently delivered by South Staffs Water. For domestic customers this appeared to lead to limited trading behaviour in the choice experiments and a strong preference to maintain current service levels. However, when customers were asked about the choices they felt that it was essential to include the status quo as a choice in the exercises. In contrast non-domestic respondents were more willing to engage in trading behaviour where they perceived a benefit to their organisation that represented 'value for money'.

Peer review

The draft survey was shared with the peer reviewer. The summary report is included in annex 6.

In summary the peer reviewer strongly agreed with including the status quo as an option in the choice experiments. Advice was sort on how to present the different attributes and the levels of service. Particularly in the presentation of risk where there was a small likelihood of a problem occurring. In this instance we decided to deviate from the UKWIR wording referring a chance of a problem occurring at a person property and instead presented the property information as the number of properties in 1000 that are affected each year. Formatting was used to minimise the cognitive burden.

[6] Note that a further set of cognitive interviews supported in piloting of the business version of the stated preference questionnaire in March 2013. These followed a similar format to the main set of interviews conducted in February 2013.

The peer reviewer also reviewed the wording used to explain bill impacts and suggested changes for a revised Contingent Valuation question that was adopted for the pilot.

3.3 Experimental design

The purpose of the choice experiment design is to ensure that the effects of interest, that is the effect of a given attribute on a respondent's choice behaviour, can be adequately and efficiently estimated given the intended survey sample size. The design specifies combinations of attribute blocks for each choice task faced by a respondent; i.e. it determines which levels of attributes will be presented on a given choice card in the choice exercise.

The typical practice in choice experiments of the type implemented in this study is to present two or three alternative options on each choice card. In this case three options were included with one specified as a fixed 'status quo' option where all attribute are specified at their current level with no change in the current bill level. This allows respondents to select a 'no improvement/deterioration at no extra cost' option in a given choice task. With this approach it is also possible to directly control for the preference customers may have maintaining current services levels, rather than 'forcing' them to opt for changes in service levels and bills. The two alternative options were specified on the basis of an experimental design that accorded to current 'good practice'[7].

Respondents were shown 6 choice cards for each block of service attributes. These were selected from a fractional factorial design that generated a total of 60 cards for each choice exercise.

As a result of the findings on the number of attributes in a choice card the questionnaire was altered to include a lower level contingent valuation question following each block of questions. The final overall package contingent valuation experiment recommended by UKWIR was retained.

3.4 Pilot survey

A pilot survey was undertaken during the last two weeks of February. The surveys covered 100 households using a Computer Aided Personal Interview approach (CAPI). The pilot survey permitted some preliminary testing of the design of the questionnaire to assess whether or not the choice experiments were eliciting reasonable responses, as well as further highlighting the priority service attributes.

Analysis of the survey data used three different models:

[7]The experimental design is an efficient D-optimal design, see Ferrini, S. and R. Scarpa (2007) for more information. One of the key features of choice experiments is the use of experimental design theory to optimise the amount of customer preference information that can be collected from a sample of a given size. In particular there are numerous ways in which service attribute levels can be combined into bundles of water services. In addition there are many more ways of combining these into sets from which respondents are asked to choose their preferred alternative. The purpose of the choice experiment design task is to ensure that the effects of interest – i.e. respondents' preferences for changes in attribute service levels - can be adequately and efficiently estimated from the available sample size.

- A conditional logit (CL) model with linear bill;
- A CL model with piecewise bill estimates to test for the difference between WTP and WTA; and
- A CL model with piecewise bill and error components that controls for additional variance associated with generically designed options (as opposed to the experienced status quo option) and negative-bill.

Pilot survey results

A further significant result is that the bill parameters have been found to be highly significant in the linear model and for block 1 in all of the models. Tests show that the nonlinear model outperforms the linear model, indicating that there are indeed differences between the bill parameters when these reflect bill decreases as opposed to bill increases[8].

- In most cases the attribute parameters have been found to be significant. The only parameter that is not significant in one or more of the models was the low flow parameter. The wording of this attribute was adjusted.
- In line with expectations outlined in Section 2.3, the pilot demonstrated some evidence of non-linear effects in choice models, with both diminishing marginal benefits and gains-loss asymmetry observed. This finding emphasised the requirement to test for these effects in the main survey analysis to counter the risk over-estimating unit values for service improvements.
- The results also indicated the need to revise the range of bill amounts specified for the water bill attribute in the choice tasks, in particular to increase the range covered by the amounts for bill reductions.
- Finally, results from both pilot indicated the need to review the questionnaire length for the main survey. The survey took longer to implement than the target timescale (25 minutes maximum). As a result the survey was changed so respondents only completed choice exercises on 2 out of the 3 blocks. Respondents were still introduced to the third block and the contingent valuation (package) exercise covered all 3 blocks.

The pilot demonstrated that a majority of customers did know their approximate total water and sewerage bill but there was a lack of awareness of the split between the water and sewerage services (the South Staffs Water and Severn Trent Water responsibilities). This led many customers to select the 'don't know' option when choosing their water services bill amount. As a result a calculation was added to the survey to provide customers with an approximation of their bill based on the information provided. This information was the answer to the question on metering and the average percentage split between the water and sewerage elements of the bills. This calculation was shown to customers when asking about their current South Staffs bill.

In addition to the above some minor changes were made to the survey wording to improve clarity and flow of the questionnaire.

The pilot results were shared with the peer reviewer who agreed with the changes that were adopted to revise the questionnaire.

[8] Z-tests reject the null hypothesis of equality of bill decrease and bill increase.

3.5 Final questionnaire: Structure

Annexes 1 and 2 provide the domestic and non-domestic versions of the final questionnaire and showcards. The structure for the domestic questionnaire is based around the typical format for a stated preference survey (see Bateman et al., 2002):

- Preliminary questions: Recruitment, screening and quota questions
- Section A: Introductory questions – perceptions of current service levels and bills
- Section B: Service priorities - choice experiment blocks and contingent valuation package questions
- Section C: Follow-up questions
- Section D: Socio-economic characteristic and demographics

The non-domestic version had a similar structure to the domestic questionnaire except for revised preliminary questions and the exclusion of the (non-relevant) Section D.

3.6 Final questionnaire: Attributes and levels

Table 3.2 presents the set of service attributes used in the questionnaire. The same list and description of attributes are used for both the household and business customers. The exception is where the domestic survey included hosepipe bans the non-domestic survey included non-essential use bans. The levels for non-essential use bans are shown separately in the table.

Table 3.2 presents the levels at which each service attribute could be delivered as used in the choice experiment part of the questionnaire.

- Level 2: the maximum improvement in service currently feasible for the period 2015-20
- Level 1: improved service from current level of service
- Level 0: the 'status quo'/current level of service, typically based on average performance levels over recent years or expected performance in 2014-15
- Level -1: deteriorated service from current service level
- Level -2: the maximum deterioration in service.

Note that 'Level +2' for each attribute represents a feasible 'aspirational level', seen as the highest service level that can be achieved within the current constraints of asset planning. In contrast, 'Level -2' represents the maximum deterioration in service. Following from the discussion in Section 2.3, the specification of attribute levels across improvements and deteriorations in services, along with two levels of improved service, implies that non-linear effects (gains-loss asymmetry and diminishing marginal benefits) should be tested for in the econometric analysis.

Table 3.1: Service attributes and descriptions

Name	Description
Boil water notice	• Notices last about 3 days. This is usually a precaution and may be issued if South Staffs Water thought there was a risk the water may make you ill. • When this occurs you will need to boil tap water before using it for drinking, cooking or preparing food. • It may affect your health if you do not boil the water before drinking. • The tap water can be used for: Washing; bathing; and flushing the toilet.
Discoloured tap water	• Water is discoloured for a week at a time without warning. Usually the tap water is brown in colour. • Although this is very unlikely to be harmful to your health, you may choose not to drink it. It can also stain clothes in washing machines. • Running the tap for several minutes will not remove the discolouration. • Discolouration occurs due to water mains pipes being repaired or because of rust occurring over time in some pipes that are made from iron.
Taste and smell of tap water	• Dissolved minerals in drinking water can affect taste and smell. This may be caused by the treatment of the water. • When this occurs water has a taste and smell that is not ideal for a week at a time, but it is **safe to drink**. • The problem is persistent, which means that it will occur regularly. • Running the tap for several minutes does not remove the taste or smell. • Different properties are affected each year
Hard water	• The water at your property is hard causing lime scale. • Hard water contains minerals and is caused by the natural minerals in the source of the water. • Lime scale may build up on appliances like kettles, washing machines and boilers and machines affecting businesses.

Hosepipe ban	• A ban on using the hose pipe that would typically last for 5 months beginning in May and ending in September
	• Under a hosepipe ban, customers are not allowed to use a hosepipe to:
	  • Water a garden
	  • Clean a car or van
	  • Fill or maintain a swimming or paddling pool or ornamental fountain
	  • Clean outdoor surfaces (e.g. paths or patios)
	• The last hosepipe ban in the South Staffs Water region occurred in 1976

Non-essential use ban	• This ban needs Government approval. It is introduced after a hosepipe ban for households.
	• Under a non-essential use ban, business customers are not allowed to use a hosepipe to:
	  • Water outdoor plants on commercial premises; Clean any vehicle, boat, aircraft or railway rolling stock; Clean the exterior of buildings, windows and industrial plant or use water to suppress dust.
	• Business customers are also not allowed to:
	  • Fill or maintain a swimming or paddling pool; Fill or maintain a pond that is for ornamental use; Operate a mechanical vehicle-washer; or Operate an automatic flushing cistern (WC or urinal) in any building that is unoccupied and closed.

Name	Description
Minor pollution incident	• Pollution incidents on rivers and streams in your area, caused by South Staffs Water. • Pollution incidents can happen from time to time due to accidents or equipment failures involving chemicals used to treat the water. • The impact is localised, minimal and temporary, allowing the rivers to return to their previous quality within days. • For example fewer than 10 fish will typically be killed and it will still be possible to use the river for recreation.
Low water levels and flow in rivers and streams	• The water environment is impacted by South Staffs Water as well as other sectors, including farming and industry. • Removal of water for drinking water supply can cause low water levels and flow in rivers and streams. • This can cause an adverse impact on visual amenity, recreational use of the river and habitats for plants and wildlife. • South Staffs Water can invest to reduce this impact, which can contribute to an overall improvement in the quality of the river environment.
Low water pressure	• Low water pressure affects the taps, showers and boilers at properties. This means water runs slower and is less forceful. • Some properties can be affected by persistent low pressure, which means that this occurs all the time or regularly. • Examples include this happening at weekday breakfast times or at some properties at the top of tall buildings or on hills.
Unexpected supply interruption lasting 3 to 6 hours	• If this occurs the affected properties will be without water for 3 to 6 hours. • This may happen without warning because of a burst pipe, a problem with a water treatment works or repairs are needed. • The interruption could happen at any time of day or night. • Different properties are affected each year.
Internal water flooding	• Flood water gets into people's properties due to failure of water company pipes and pumps. An example is burst water pipes. • This is not flooding from rivers or rain water. • The flood water may contain dirt and debris from the ground & carpets and furniture may need to be replaced. • Different properties are affected each year & this could happen anywhere.
Leakage	• Leaks occur due to cracks in pipes or corrosion as they age. • South Staffs Water can reduce leakage by investing to find the leaks faster and repairing them quicker. • South Staffs Water can minimise the disruption by using technology that avoids digging up roads. • Reducing leakage will have minimal impact on the environment.

Block	Service attributes
Your drinking water quality (DWQ)	Boil Water notice, discoloured tap water, taste and smell of tap water, hard water
Water availability and the environment (WAE)	Hosepipe ban/Non-essential use ban, pollution incident, Low water levels and flow in rivers and streams
Reliability of your water supply (RWS)	Low water pressure, Unexpected supply interruption lasting 3 to 6 hours,

Table 3.2: Service attributes and levels

Attribute	Unit/measure	Level -2	Level -1	Level 0	Level 1	Level 2
Boil water notice	The number of properties in any one year.	6,000 properties (10.5 in 1,000)	1,000 properties (1.8 in 1,000)	30 properties (0.1 in 1,000)	0 properties	N/a
Discoloured tap water	Number of properties affected each year.	5,000 properties (8.8 in 1,000)	3,500 properties (6.1 in 1,000)	2,500 properties (4.4 in 1,000)	2,000 properties (3.5 in 1,000)	1,500 properties (2.6 in 1,000)
Taste and smell of tap water	Number of properties affected each year.	1,500 properties (2.6 in 1,000)	1,250 properties (2.2 in 1,000)	1,000 properties (1.8 in 1,000)	750 properties (1.3 in 1,000)	500 properties (0.9 in 1,000)
Hard water	Number of properties affected each year.	N/a	N/a	12,000 properties have very hard water & 558,000 properties have moderately hard water	All properties experience moderately hard water	All properties experience soft water
Hosepipe ban	The chance that a hosepipe ban will be required in any one year.	5% chance (on average 1 in 20 years)	3.3% chance (on average 1 in 30 years)	2.5% chance (on average 1 in 40 years)	1.0% chance (on average 1 in 90 years)	0% chance (on average 1 in 1,000 years)
Non-essential use ban	The chances that a non-essential use ban will be required in any one year.	3.3% chance (1 in 30 years)	2.5% chance per year (1 in 40 years)	1.5% chance per year (1 in 60 years)	1% chance per year (1 in 90 years)	0% chance per year (1 in 1,000 years)
Minor pollution incident	The chance in any one year that South Staffs Water causes one minor pollution incident.	20% chance (on average 1 in 5 years)	14% chance (on average 1 in 7 years)	10% chance (on average 1 in 10 years)	7% chance (on average 1 in 15 years)	5% chance (on average 1 in 20 years)
Low water levels and flow in rivers and streams	The percentage of rivers out of 339 miles experiencing low flow in the South Staffs region.	N/a	N/a	9.1% (31 miles)	6% (20 miles)	0% (0 miles)
Low water pressure	Number of properties affected each year.	2,000 properties (3.5 in 1,000)	1000 properties (1.8 in 1,000)	0 properties	N/a	N/a
Unexpected supply interruption lasting 3 to 6 hrs	Number of properties affected each year.	4,700 properties (8.2 in 1,000)	3,700 properties (6.3 in 1,000)	2,660 properties (4.7 in 1,000)	2000 properties (3.5 in 1,000)	1,500 properties (2.6 in 1,000)
Internal water flooding	Number of properties affected each year.	250 properties (0.4 in 1,000)	100 properties (0.2 in 1,000)	50 properties (0.1 in 1,000)	25 properties (0.04 in 1,000)	5 properties (0.01 in 1,000)
Leakage	The amount of water lost through leaks each year. Based on the amount of water used by an average property. Equivalent to supply to:	N/a	N/a	69,000 properties (12% of all SSW properties)	64,000 properties (11% of all SSW properties)	59,000 properties (10% of all SSW properties)

Table 3.3 presents the levels tested in the additional interruptions question that examined preference for different durations and levels of notice.

Table 3.3: Service attributes and levels

Attribute	Duration	Properties affected
Planned interruptions	0-3 hours	10,900
	3-6 hours	3,000
Unexpected interruptions	0-3 hours	2,660
	3-6 hours	7,889
	6-12 hours	180
	12-24 hours	89
	24-48 hours	3

Table 3.4 presents the levels of the bill amount attribute used in the choice experiment. These are likely bill increases but are not directly linked to particular improvement or decline in services. The bill amounts are distributed to each choice option for each respondent based on the experimental design.

The bill attribute levels were defined in terms of the change in the current bill amount paid by the respondent. For domestic customers this was presented in terms of the annual water bill as a £ amount. For non-domestic customers the change was presented as a percentage amount (%) to accommodate the much greater variation in bill amounts paid. The bill levels were specified to be asymmetrical around a 'no change' amount, following results from the pilot survey.

Table 3.5 presents the levels of the bill amount attribute used in the final contingent valuation exercise. These were again randomly distributed across the respondents. As for service attributes, Level 2 values were used in the contingent valuation question which asked whether respondents were willing to pay the bill amounts presented.

Table 3.4: Bill levels

Attribute	Unit/measure	Level -4	Level -3	Level -2	Level -1	Level 0	Level 1	Level 2	Level 3	Level 4
Domestic	£	-75	-40	-20	-10	0	5	10	15	20
Non-domestic	Percentage	-25	-15	-10	-5	0	3	7	10	15

Table 3.5: Bill levels

Attribute	Unit/measure	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	Level 7
Domestic	£	5	10	15	20	30	40	50
Non-domestic	Percentage	3	5	10	15	20	25	35

3.7 Sampling and administration

The main survey was implemented with the following sampling approaches:

- **Domestic customers via CAPI**: This approach means that interviews are conducted in a person's home. The main survey for the household CAPI sample ran between the 25th March and the 21st April. The target sample was 500 respondents. Respondents were offered a £5 voucher for taking part.

- **Non-domestic customers via CATI to online:** The business customer survey was administered online with telephone recruitment. The main survey for the business sample ran between 27th March and the 26th April and targeted 300 businesses taken randomly from a database provided by SSW. Businesses were offered a £10 incentive for taking part. The survey included the option for businesses to donate this incentive to charity.

The key requirement for the sampling was to ensure that the samples were representative of the domestic and non-domestic customer bases. A set of target quotas were specified as a guide and the achieved samples are compared to these in Sections 4.1 and 5.1. For domestic customers the target quotas covered respondent gender, age and socio-economic group based on 2011 census data. For non-domestic customers the target quotas were specified on the basis of (aggregated) industry classification and bill amount (a proxy for water consumption). The industry classification was based on the Standard Industrial Code (SIC) information taken from 2012 ONS data on UK Business activity[9].

The fieldwork for the main survey was carried out in April 2013. Results are presented in Sections 4 and 5. Target sample sizes were achieved for the domestic and non-domestic samples with 506 household surveys taking place and 300 business responses.

CAPI Sampling points

To ensure a proportional allocation of interviews across the region customer postcode data provided by SSW were used to understand where customers live. A stratified approach was used to allocate the interviews across the region. This means that the number sampling points (and therefore interviews) within each postcode area is uneven and based on the actual property distribution.

Within each postcode area the sampling point locations were allocated based on a mixture of where people live, and to ensure coverage of the region. The locations shown in table 3.6 below are the central point for these interviews which were conducted in and around these locations. The list covers a mixture of rural, sub-urban and urban locations. This mix is not even across the postcode areas due to the fact that the south of the SSW region is more densely populated and urban whereas the north of the region is more rural.

[9] Table A1.1

Table 3.2: CAPI sampling points

Sampling point	No. of interviews
Aldridge	35
Brierley Hill	30
Brownhills	13
Burton-On-Trent	30
Cannock	3
DE13	15
Dudley	13
Great Barr	18
Great Wyrley	17
Kingswinford	2
Kinver	20
Lichfield	1
Rugeley	15
Stourbridge	16
Sutton Coldfield B72	11
Sutton Coldfield B73	32
Sutton Coldfield B74	23
Sutton Coldfield B75	28
Sutton Coldfield B76	7
Swadlingcote	15
Tamworth	30
Uttoxeter	15
Walsall WS1	26
Walsall WS2	4
Walsall WS3	12
Walsall WS4	9
Walsall WS5	30
Wednesbury	4
West Bromwich	32

4 ANALYSIS AND RESULTS – DOMESTIC CUSTOMERS

This section of the report presents the main results from the domestic customer survey. It covers the sample representativeness and respondent profile, and the econometric analysis of the choice experiment and contingent valuation components of the stated preference survey.

4.1 Sample representativeness

Random sampling was used and the resulting customer samples are compared against available population statistics, based on Census data for the South Staffs Water region based on the local authorities covered. In general the sample is in line with the population statistics and the results can be considered representative.

Table 4.1 details the gender split for the domestic sample. Slightly more females have been sampled than the population statistic.

Table 4.1: Gender

Gender	Sample	SSW region
Female	53	51
Male	47	49
Total	100	100

The breakdown of respondent age is provided in Table 4.2. Compared to the overall population it is observed that the 18-29 group is slightly under-sampled. Conversely, the 45-64 year old age group is slightly over-sampled.

Table 4.2: QL. Respondent Age

Age	Sample	SSW region
18-29	18	21
30-44	26	26
45-64	35	32
65+	21	21
Total	100	100

Turing to respondent socio-economic group (SEG) the sample shows some differences. This is partly due to the SSW regional population data being based on the Census 2011 results for Socio-Economic Classification, which at the time of the project has not been mapped to SEG. This is likely to overestimate groups AB and underestimate C1/C2. As a result the sample is more aligned than it would first appear.

Table 4.3: Socio Economic Grouping

Age	Sample	SSW region
AB	27	30
C1/C2	39	32
D	18	24
E	16	14
Total	100	100

4.2 Sample profile – demographics and household income

Table 4.4 reports the percentages of the number of people by age in the respondent households.

Table 4.4: Q17. Household demographics

Age	0 people	1 person	2 people	3 people	4 people	5 people or more
Up to 5 years	79	14	6	0	0	0
5 to 15 years	71	18	9	1	0	0
16 to 64 years	18	23	46	9	4	1
65+	78	13	10	0	0	0

Table 4.5 reports that the majority of survey respondents were either employed full-time (30+ hours), or are retired. Respondents covered all categories including some who were unable to work due to sickness or disability.

Table 4.5: Q15. Respondent employment

Occupation	Percentage
Employed full-time (30+ hrs)	41
Employed part-time (up to 30 hrs)	14
Looking after the home / children full-time	7
Self-employed	8
Retired	23
Student	1
Unable to work due to sickness or disability	1
Unemployed – other	2
Unemployed - seeking work	3
Other (please specify)	0
Refused	0
Total	100

Table 4.6 presents the highest level of qualification achieved by the respondent. The majority of respondents report that O levels/CSEs/GCSEs are the highest level of education achieved although all levels of qualification are covered. 17% reported not holding any qualifications. It is likely that the 5% that refused also hold no qualifications.

Table 4.6: Q16. Respondent education

Qualification	Percentage
Professional qualifications (teacher, doctor, dentist, architect, engineer, lawyer, etc.)	5
Higher degree (e.g. MA, PhD, PGCE, post graduate certificates and diplomas)	5
First degree (e.g. BA, BSc)	9
A levels / AS level / higher school certificate	9
NVQ (Level 1 and 2). Foundation / Intermediate / Advanced GNVQ / HNC / HND	10
Other qualifications (e.g. City and Guilds, RSA/OCR, BTEC/Edexcel)	11
O levels / CSEs / GCSEs (any grades)	27
No qualifications	17
Prefer not to say	5
Total	100

Table 4.7 reports the total household income prior to tax. Where income has been reported the highest proportions of respondents indicate total household income in the £15,500 to £39,999 range.

Table 4.7: Q18. Total household income before tax

Income	Percentage
£7500 and over per month (£90,000 and over per year)	1
£5000 - £7499 per month (£60,000 - £89,999 per year)	2
£3330 - £4999 per month (£40,000 - £59,999 per year)	6
£2080 - £3329 per month (£25,000 - £39,999 per year)	10
£1290 - £2079 per month (£15,500 - £24,999 per year)	9
£790 - £1289 per month (£9,500 - £15,499 per year)	6
£540 - £789 per month (£6,500 - £9,499 per year)	4
Up to £539 per month (Up to £6,499)	3
Don't know	11
Refused	48
Total	100

4.3 Service levels – perceptions and experience

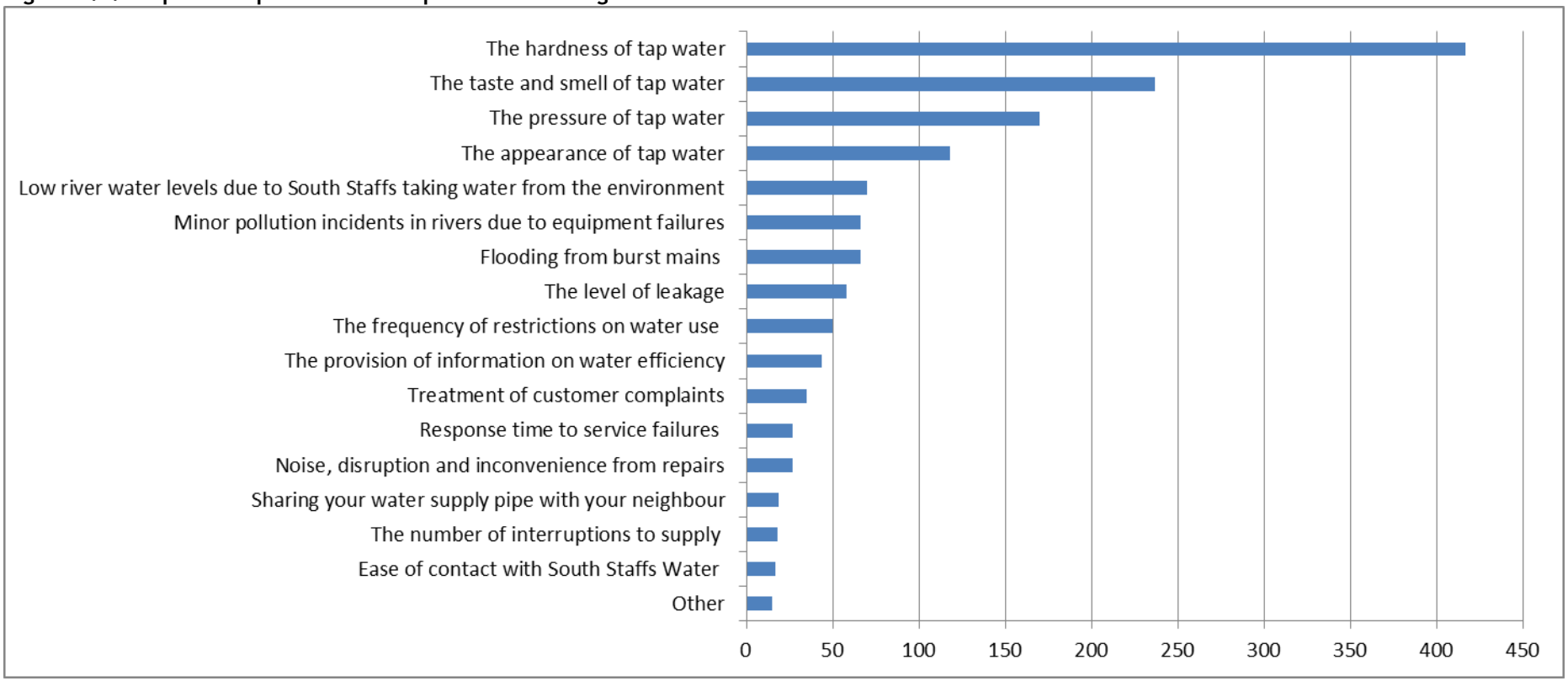
In line with findings from the qualitative testing (Section 3.2), respondents, in general reported, high levels of satisfaction with services received from South Staffs Water. Hardness was the area of service most likely to be reported as needing improvement. This was followed by the taste and smell of water, low pressure and the appearance of tap water.

Table 4.8: Respondent view of current service levels (percentage)

Service attribute	Happy with current level of service	Needs improvement	Don't know
The taste and smell of tap water	79	20	1
The number of interruptions to supply due to burst pipes	85	5	11
The frequency of restrictions on water use during periods of drought (e.g. hosepipe bans)	84	8	9
The pressure of tap water	80	18	2
The hardness of tap water (e.g. scaling of kettles and other appliances)	57	40	3
Noise, disruption and inconvenience from water company repairs (e.g. traffic, dust, etc.)	85	7	8
Response time to service failures (e.g. repair of burst pipes)	74	5	20
Ease of contact with South Staffs Water (e.g. telephone, email, letters)	76	5	19
Treatment of customer complaints	60	5	35
The appearance of tap water	85	14	1
Flooding from burst mains	74	8	18
The provision of information on water efficiency	74	9	17
The level of leakage	75	9	16
Sharing your water supply pipe with your neighbour	77	5	18
Low river water levels due to South Staffs taking water from the environment	63	9	27
Minor pollution incidents in rivers due to equipment failures	63	10	27
Other	3	2	9

In the survey respondents were asked to indicate the top three service priorities for improvement out of the list of those that they indicated as needing improvement. The results of this question are presented in figure 4.1. To simplify the presentation the results have been weighted based on the order of priority indicated by the respondent. The results show a similar result to table 4.8 in that hard water, taste and smell, pressure and appearance are ranked as top priorities.

Figure 4.1: Respondent priorities for improvement – weighted results



Note: Weighted results are calculated based on first priority = 3 points, second priority = 2 points and third priority = 3 points

Table 4.9 shows the customers reported experience of the service attributes. As expected hard water is the most commonly experienced attribute. The attributes most likely to have been experienced broadly correspond to those areas that customer have indicated needing improvement in figure 4.1. The one exception is hosepipe bans.

Table 4.9: Customer experience of attributes (percentage)

Attribute	Within the last year	1 - 3 years ago	3+ years ago	Total
Boil water notice	1	3	5	8
Discoloured tap water	10	11	12	33
Taste and smell of tap water	15	8	7	30
Hard water	51	3	2	56
Hosepipe ban	6	27	23	56
Minor pollution incident	2	6	5	13
Low water levels and flow in rivers and streams	4	8	4	16
Low water pressure	17	11	8	36
Unexpected supply interruption lasting 3 to 6 hours	4	10	10	24
Internal water flooding	1	2	2	5
Leakage	4	5	5	14

Table 4.10 presents respondents views on their current bill. This show that a majority of respondents believe their bill is about right. Only 12% think that their bill is far too much.

Table 4.10: Respondent views on current bill

	Percentage
Too little	1
About right	54
Slightly too much	33
Far too much	12
Total	100

The survey also included an initial question asking about future bills and service levels. The question gave respondents three scenarios and asked which they would prefer for the period 2015 to 2020 in addition an inflationary increase. The results are presented in table 4.11 below and show that given the three scenarios 71% of respondents would prefer that bills remain the same and service levels remain unchanged.

Table 4.11: Respondent views on future bills and service levels.

	Percentage
Bills increase by a small amount and services improve	25
Bills remain the same and service levels unchanged	71
Bills decrease by a small amount and services deteriorate	3
Total	100

4.4 Econometric estimation

Estimation strategy

Analysis of the choice experiment data centred on the three blocks of attributes specified in Section 3.3 (DWQ, WAE and RWS). The estimation strategy focused on identifying the model specification – from the MNL and set of MXL models described in Section 2.2 – that provided the best fit to the data; i.e. the model that provides the best account of customer preferences. A priori it is not possible to know whether the restrictive assumptions (outlined in Table 2.1) of the multinomial logit (MNL) model will hold. It is therefore sensible to try other models to see if they provide a better fit to the data.

The comparative performance of alternative models was primarily based on various measures of models fit. This included the 'information criteria', log-likelihood and pseudo r^2. This is partly because information criteria penalises more complex models for having a large number of parameters. In particular the estimated models are based on the maximum likelihood of the same sample, and in these circumstances a model with a greater number of parameters cannot return a goodness of fit that is worse than a model which is specified with a subset of the same parameters (i.e. including more model parameters improves model fit). The approach to the estimation tested the following model specifications:

- Standard MNL model with fixed parameters;
- Error component model (which controls for unobserved variation arising from respondents choosing between hypothetical alternatives to a status quo option); and
- Mixed Logit Random Parameter model.

Two utility specifications were tested for each model: (i) a version with a single cost coefficient for increases and decreases of bill amounts; and (ii) a version with in which two coefficients were estimated, one for increases in bills and one for decreases in bills. The second specification explicitly accounts for gains-loss asymmetry.

Further non-linear specifications were also estimated to test for diminishing marginal benefits. Overall differences in unit values are relatively minor in most cases and a linear approximation of marginal WTP for improvements in service over the range Level 0 to Level +2 is judged to be a reasonable assumption.

Expectations of results

Prior to the evaluation of econometric results, theoretical considerations and prior empirical results give rise to certain expectations for the parameter estimates in choice experiment models. In particular these relate to the 'sign' of coefficient estimates, which inform on the nature of the relationship between a parameter – i.e. a service attribute – and customer preferences. For variables coded in the levels, expectations for the signs of the coefficient estimates relate to the effect of increasing by one unit the unit of measurement of the variable.

Given the way the service attributes are presented the unit of measure (properties affected in most cases) decreases as the quality of service improves. Since models are consistent with random utility theory of choice, the expected sign of the coefficient from the models is negative. The one exception to this is hard water, here the level represent different situations. In the models each level has been effect coded, which means the coefficient represents the utility of moving from the current situation to that level and is expected to be positive. The bill coefficient is expected to be negative as a higher bill implies lower utility.

A summary of expected coefficient sign for each service attribute grouped by choice experiment block is provided in Table 4.11.

Table 4.12: Expected coefficient signs for service attributes

Block	Service attribute	Model coefficients
DWQ	Boil Water notice	Negative
	Discoloured tap water	Negative
	Taste and smell of tap water	Negative
	Hard Water	Positive
WAE	Hosepipe ban	Negative
	Minor pollution incident	
	Low water levels and flow in rivers and streams	
RWS	Low water pressure	Negative
	Unexpected supply interruptions lasting 3 to 6 hours	
	Internal water flooding	
	Leakage	
All blocks	Water bill	Negative

Expectations as to gains-loss asymmetry can also be specified. In particular in the piecewise model specifications, deteriorations from the baseline (the status quo and starting 'endowment' for respondents) may exhibit a greater value (WTA) than an improvement of the same magnitude (WTP). Thus linking the bill coefficients back to utility theory we expect to see a smaller magnitude coefficient for negative prices than positive prices.[10]

Estimating different cost coefficients for positive or negative prices, directly addresses this issue by establishing different rates of substitution between attributes and money spent or received. As noted in Section 2.3 this analysis is a fundamental requirement for choice experiment studies specifying both improvements and deteriorations in service, in order to ensure that marginal WTP values for improvements are not over-estimated due an assumption of linearity.

[10] The models are coded as a spline function that implies that the same sign should be observed for both bill parameters.

This section also presents the results for the additional interruptions question that was included in the study. As the question involved ranking the situations a set of odd ratios has been derived. Odds Ratios are a relative value expressed relative to a base level. In the estimation the unexpected interruption lasting between 3 to 6 hours has been used as a base in the modelling. This means that all other types of interruptions have been modelled relative to this. All coefficients are expected to be positive with longer durations showing a higher weight. The exact order of the categories between the different length planned and unexpected durations cannot be defined a priori, however, we can expect that, in general, unexpected interruptions will viewed as creating more disutility (worse) than planned interruptions.

Estimation results

For both the linear and non-linear models the mixed logit models (MXL) were preferred. This section presents both of these results for each block in turn before presenting the results for the additional question on interruptions to supply.

Table 4.13 reports the linear MXL model results for the Drinking Water Quality (DWQ) choice experiment block. All expectations of coefficient estimates are observed and all coefficient estimates are highly statistically significant. The exception to this is the first level for hard water which is not significant and represented removing very hard water from 12,000 properties. The second level is highly significant which show that customers are willing to pay for hard water to be removed.

The positive coefficient for hard water and the negative coefficient for all other service attributes indicates that improvements in service have a positive effect on customer utility. The 'ASC' parameter is an alternative specific constant. This is included to capture respondent preferences for the current level of service; i.e. the status quo option. The positive and statistically significant coefficient indicates, that all else equal, customers have a preference for maintaining current service levels. Note that this effect is observed across all estimated models for both domestic and non-domestic customers.

Drinking Water Quality (DWQ)

Table 4.13: MXL linear model – DWQ block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Boil Water Notice	-0.00028	4.03E-05	-7.07	0.00	-0.0004	-0.0002
Colour	-0.00035	4.85E-05	-7.29	0.00	-0.0005	-0.0003
Taste	-0.00046	0.0002	-3.04	0.00	-0.0008	-0.0002
Hard Water – +1 level	0.16676	0.1704	0.98	0.33	-0.1673	0.5008
Hard Water - +2 level	0.77318	0.1449	5.34	0 .00	0.4892	1.0571
ASC	1.545294	0.1447	10.68	0.00	1.2617	1.8289
Water bill	-0.01685	0.0019	-8.75	0.00	-0.0206	-0.0131
Log likelihood	-1607.85					
BIC	1653.34					
Pseudo r^2	0.25					
LR chi2(6)	1095.25					
Prob > chi2	0.00					
Observations	1962					

The non-linear results are presented in table 4.14 below. As with the linear model all coefficients show the expected signs. All of the attribute coefficients are significant at the 95% confidence level with many of the coefficients showing a similar level of significance to the linear model. A notable difference to the linear model is that the first level for hard water is now significant. The

results for the bill coefficients show that the improvement coefficient is highly significant but the deterioration coefficient is not significant. Despite this the bill coefficients do conform to expectations in that the bill deterioration coefficient is smaller than the bill improvement coefficient.

Table 4.14: MXL piecewise non-linear model – DWQ block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Boil Water Notice	-0.00029	3.86E-05	-7.63	0.00	-0.0004	-0.0002
Colour	-0.00031	4.90E-05	-6.25	0.00	-0.0004	-0.0002
Taste	-0.00031	0.0002	-2.1	0.04	-0.0006	-0.00002
Hard Water – +1 level	0.37405	0.1666	2.24	0.03	0.0475	0.7007
Hard Water - +2 level	0.77538	0.1540	5.03	0.00	0.4735	1.0772
ASC	0.92117	0.1583	5.82	0.00	0.6109	1.2315
Water bill (deterioration)	-0.00171	0.0024	-0.71	0.48	-0.0065	0.0030
Water bill (improvement)	-0.10657	0.0104	-10.24	0.00	-0.1270	-0.0862
BIC	1611.69					
Log likelihood	-1558.62					
Pseudo r^2	0.28					
LR chi2(14)	1193.71					
Prob > chi2	0.00					
Observations	1962					

Water availability and environment (WAE)

Table 4.15 reports the MXL linear model results for the Water availability and environment (WAE) choice experiment block. All expectations of coefficient estimates are observed and all coefficient estimates are highly statistically significant.

Table 4.15: MXL linear model – WAE block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Hosepipe ban	-0.10814	0.0283	-3.83	0.00	-0.1635	-0.0528
Pollution	-0.1256	0.0125	-10.03	0.00	-0.1501	-0.1010
Low flow	-0.03001	0.0134	-2.25	0.03	-0.0562	-0.0038
ASC	1.137995	0.1308	8.7	0.00	0.8817	1.3943
Water bill	-0.02365	0.0017	-14.28	0.00	-0.0269	-0.0204
BIC	1748.94					
Log likelihood	-1713.9369					
Pseudo r^2	.20					
LR chi2(4)	-869.90					
Prob > chi2	0.0000					
Observations	1956					

A similar result is observed for the non-linear piecewise model. These are shown in table 4.16 below. Again it can be observed that, in line with expectations, the bill deterioration coefficient is smaller in magnitude that the bill improvement coefficient. As both of these coefficients are significant this implies that a gains-loss relationship exists. This is examined further in section 6.1 that presents the marginal willingness to pay values.

Table 4.16: MXL Piecewise non-linear model – WAE block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Hosepipe ban	-0.14392	0.0300	-4.78	0.00	-0.2029	-0.0849
Pollution	-0.11816	0.0133	-8.9	0.00	-0.1442	-0.0921
Low flow	-0.05002	0.0145	-3.44	0.00	-0.0785	-0.0215
ASC	0.65277	0.1380	4.73	0.00	0.3823	0.9232
Water bill (deterioration)	-0.01013	0.0021	-4.86	0.00	-0.0142	-0.0060
Water bill (improvement)	-0.11697	0.0101	-11.57	0.00	-0.1368	-0.0972
BIC	1692.29					
Log likelihood	-1658.19					
Pseudo r^2	0.23					
LR chi2(10)	981.39					
Prob > chi2	0.00					
Observations	1956					

Reliability of water supply (RWS)

Table 4.17 reports the MXL linear model results for the reliability of water supply (RWS) choice experiment block. As with the water availability block all expectations of coefficient estimates are observed and all coefficient estimates are highly statistically significant.

Table 4.17: MXL linear model – RWS block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Low Pressure	-0.00067	9.37E-05	-7.2	0.00	-0.0009	-0.0005
Interruption	-0.00043	5.66E-05	-7.59	0.00	-0.0005	-0.0003
Internal flooding	-0.0082	0.0012	-6.8	0.00	-0.0106	-0.0058
Leakage	-7.9E-05	1.42E-05	-5.59	0.00	-0.0001	-5.1E-05
ASC	1.98550	0.1651	12.03	0.00	1.6619	2.3091
Water bill	-0.02051	0.0020	-10.43	0.00	-0.0244	-0.0167
BIC	1464.61					
Log likelihood	-1422.5824					
Pseudo r^2	.38					
LR chi2(5)	1729.47					
Prob > chi2	0.0000					
Observations	2082					

The piecewise non-linear results for the RWS choice experiment block are shown in table 4.18. The results are similar to the linear model. The deterioration bill coefficient is marginally significant at the 88% confidence level. Despite this the bill coefficients do conform to expectations in that the bill deterioration coefficient is smaller than the bill improvement coefficient.

Table 4.18: MXL piecewise non-linear model – RWS block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Low Pressure	-0.00069	9.630E-05	-7.16	0.00	-0.0009	-0.0005
Interruption	-0.00039	6.239E-05	-6.21	0.00	-0.0005	-0.0003
Internal flooding	-0.00761	0.00115	-6.61	0.00	-0.0099	-0.0054
Leakage	-5.82E-05	1.551E-05	-3.75	0.00	-8.86E-05	-2.78E-05
ASC	1.15657	0.18514	6.25	0.00	0.7937	1.5195
Water bill (deterioration)	-0.00389	0.00252	-1.54	0.12	-0.0088	0.0011
Water bill (improvement)	-0.12406	0.01203	-10.32	0.00	-0.1476	-0.1005
BIC	1417.84					
Log likelihood	-1375.82					
Pseudo r^2	0.40					
LR chi2(12)	1822.97					
Prob > chi2	0.00					
Observations	3036					

Table 4.19 below presents the results for the interruptions question. The results resented are odd ratios which can be interpreted as weights based on relative probabilities. The unexpected interruption lasting between 3 to 6 hours has been used as a base in the modelling and this severity takes the base value of one. This means that all other types of interruptions have been modelled relative to this: <1 indicates a lower weight relative to the base level, > 1 indicates a higher weight. All results are highly significant and the results show that customers find longer durations to be worse than shorter durations as expected. The results also show that both of the planned interruption categories are viewed as less of an inconvenience than any unexpected interruption. Although it was expected that some warning would be perceived as better than no warning it was not clear a priori whether customers would view a short 0 to 3 hour unexpected interruption as worse than a slightly longer 3 to 6 hour planned interruption.

Supply Interruption severities

Table 4.19: Interruptions weights

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Planned 0-3 hours	0.10814	0.0136	7.95	0.00	0 .0815	0.1348
Planned 3-6 hours	0.34445	0.0340	10.14	0.00	0.2779	0.4110
Unexpected 0-3 hours	0.55391	0.0498	11.12	0.00	0.4563	0.6516
Unexpected 3-6 hours	1	-	-	-	-	-
Unexpected 6-12 hours	1.43578	0.1248	11.51	0.00	1.1912	1.6804
Unexpected 12-24 hours	1.77751	0.1644	10.81	0.00	1.4553	2.0997
Unexpected 24-48 hours	1.82033	0.1800	10.11	0.00	1.4675	2.1732

Validity testing – respondent feedback

As well as the design and testing phrase of the project the validity testing of the domestic survey results was supported by the inclusion of a series of 'diagnostic' questions in the stated preference questionnaire. These asked respondents for direct feedback on the survey and their motivations for choice responses, which provide a useful gauge for understanding of the survey, its credibility, the perceived difficultly of choice tasks, and attention paid to overall responses. Overall findings are encouraging and indicate high engagement with the survey and understanding of the choice tasks.

Feedback from respondents in Table 4.20 indicates that the majority chose options in the choice tasks that offered the most improvement relative to cost. Other 'private' value motivations are also notable, with respondents selecting options with least cost (33%) or likely to directly affect the respondent's household (33%). Very few respondents (2%) felt they were provided with too little information to make choices.

Table 4.20: Q7. Respondent motivations for choices

Motivation	Percentage
I chose the options with least cost to my household	33
I chose the options which offered most improvement relative to cost	21
I was interested in improvements irrespective of cost	3
I chose the options that affect or are most likely to affect my household directly	33
I chose the options that I thought would benefit people I know	3
I chose the options that I thought would benefit other customers the most	2
I chose improvement that I feel other customers should experience	2
The information provided was not clear enough for me to make a choice	2
Other/None of these	2
Total	100

Table 4.21 shows respondents views on the difficulty of the choice exercises. The majority of respondents found the exercise to be fairly easy (46%) or neither easy nor difficult (20%). Only 2% found the questions to be very difficult.

Table 4.21: Q8. Difficulty of the choice cards

	Frequency	Percentage
Very easy	81	16
Fairly easy	234	46
Neither easy nor difficult	102	20
Fairly difficult	76	15
Very difficult	12	2
Don't know	1	0
Total	506	100

Respondents were generally positive about the questionnaire as a whole, as shown in Table 4.22, which reports the perception of the overall questionnaire. The majority of respondents indicated it was interesting (47%). Overall around 16% of respondents indicated it was difficult to understand.

Table 4.22: Q19. Views on the questionnaire

Response	Percentage
Interesting	47
Too long	26
Difficult to understand	16
Educational	12
Unrealistic/not credible	6
Other:	7
Positive	2
Negative	5
None of these	0

As the domestic questionnaire was administered by an interviewer, feedback was also sought from the interviewer to gauge respondent understanding of the survey and the consideration they gave to their answers to the choice questions. Results are reported in Tables 4.23 and 4.24, respectively. Overall these indicate a high level of respondent understanding and engagement with the survey.

Table 4.23: QY. How well did the respondent understand what he or she was asked to do when making the choices? [Interviewer opinion]

	Percentage
Understood completely	35
Understood a great deal	34
Understood somewhat	21
Understood a little	6
Did not understand very much	3
Did not understand at all	0
Total	100

Table 4.24: QZ. How serious was the consideration given by the respondent to the questions? [Interviewer opinion]

	Percentage
Extremely serious	21
Very serious	49
Somewhat serious	24
Slightly serious	5
Not at all serious	2
Total	100

Contingent valuation package estimates

Recalling the discussion in Section 2.3, it is reasonable to expect that a package effect will be observed when comparing independently estimated WTP values from choice experiments with a

valuation for a multiple and simultaneous improvement in services estimated from a contingent valuation (CV) question. This section presents the contingent valuation results and compares these to the results from the choice experiment exercises.

The set of contingent valuation questions asked customers about their willingness to pay for an improvement to the 2nd improvement level from the status quo with no bill change. To limit the cognitive burden the improvements were presented as changes in to one or more blocks. Respondents answered three questions in total and all respondents were asked about an improvement to all three choice blocks as a final question.[11]

The results of this exercises is presented in table 4.25 below. Two sets of results are shown for the CV questions. The overall CV question produces a WTP of £9.80 for all blocks to move to the 2nd improvement level. The analysis of all the package cards produces values for improvements to the individual blocks that sum to £15.64. We use these results to directly estimate relative weights between the three choice experiment blocks. These weights are used to allocate the overall CV value of £9.80 between the blocks.

Table 4.25: Comparison of domestic choice experiment and contingent valuation package valuations (£/hh/yr)

CE block	CE WTP (£)	CV WTP (£) Upper Based on all CV questions	CV WTP (£) Lower Based on final CV question	CV upper: CE ratio	CV lower: CE ratio
DWQ	11.70	10.06	6.30	0.86	0.54
WAE	12.02	4.24	2.66	0.35	0.22
RWS	11.08	1.34	0.84	0.12	0.08
Total/average	**34.80**	**15.64**	**9.80**	0.44	0.28

Notes: CE WTP calculated from non-linear WTP estimates aggregated across the SQ to maximum (+2 level) service improvement for each service attribute in the combined blocks.

Table 4.25 provides strong evidence of a package effect. The results from the non-linear choice exercises show that the total WTP for improvements to the 2nd improvement level is £34.80 per household. The upper CV estimate is 44% of this and the overall package CV question produces a result that is 28% of this.

The overall package WTP estimate of £9.80 can be viewed as a range for the maximum household respondents would pay on average to receive a maximum improvement across all aspects of service. Thus, it can be viewed as a limit or ceiling to household customer WTP in the sense that it is unlikely that benefits will exceed costs for a programme of maximum improvements across all services. In the survey an additional question was included on the impact of an increase in the Severn Trent Water part of the bill for sewerage services. The results show that this would reduce this value further. In the domestic exercise 28% of those choosing to pay for improvements indicated that they would revise the WTP amount stated.

In a planning context, the information provided by this overall WTP constraint could be used in a number of ways. As suggested in the UKWIR (2011) it could be used to scale the individual attribute WTP benefit values that are used in CBA. An alternative and arguably more correct approach would use the overall average WTP as a constraint on an overall investment optimisation that compares (unscaled) benefit values with costs. This would ensure that levels of service are determined in a way that is consistent with both the individual service valuations and the valuation of overall

[11] The final CV question was presented as a dichotomous choice exercise.

programmes of investment (rather than being driven by the latter as would be implied by the use of scaled benefit valuations).

Tables 4.26 and 4.27 present the motivations for respondents when answering the CV questions. Table 4.25 shows the motivations for not choosing to see improvements and a bill increase. The main reasons include objections to paying higher water bills (25%) and the view that the current level of service is already good enough (22%). Only 5% of people wished to see more information before making a decision.

Table 4.26: Q9c. Motivations for not choosing an increase in the CV questions

	Percentage
I do not believe these improvements would actually happen	4
I object to paying higher water bills	25
I object to the proposed improvements	0
I object to water companies being privatised	1
I think the current services are already good enough	22
I would like the improvements, but I cannot afford to pay	7
I would like the improvements, but the bill increase was more than I would be prepared to pay	7
I'd like to have more information before making a decision	5
Improvement in only one or two of these services is important to me, not all of them	2
The government or council should pay for this	4
The improvements of these services are not important to me	2
The water company is inefficient	1
The water company should pay for this	10
Water companies make enough profits as it is	8
Other	2
Total	100

N=286

Table 4.27 shows that those choosing to pay had a mix of private and altruistic motivations with 48% indicating that the reason was to avoid a negative impact on their household and 22% indicating that the choice related to both theirs and other households.

Table 4.27: Q9f. Motivations for paying for service increases in the CV questions

	Percentage
It is a good cause	6
To prevent / avoid damage to rivers	1
To prevent / avoid damage to the environment or wildlife generally	5
To prevent / avoid negative impact on my household	48
To prevent / avoid negative impact on future generations	5
To prevent / avoid negative impact on my household and others in the area	22
To prevent / avoid negative impact to businesses in the area	1
Other	10
Total	100

N=220

5 ANALYSIS AND RESULTS – NON-DOMESTIC CUSTOMERS

This section of the report presents the main results from the non-domestic customer survey. It covers the sample representativeness and respondent profile, and the econometric analysis of the choice experiment and contingent valuation components of the stated preference survey.

5.1 Sample representativeness

As with the domestic survey, random sampling was used for the non-domestic customer survey. The resulting sample is compared against available population statistics for the South Staffs Water customer base.

Table 5.1 details the proportion of respondents by industry type and table 5.2 shows these results summarised and compared to the regional statistic.

Table 5.1: QD. Main activity of organisations

Activity	Percentage
Accommodation and food service activities	3
Activities of extraterritorial organizations and bodies	0
Administrative and support services	1
Agriculture, forestry or fishing	5
Arts, entertainment and recreation	2
Construction	3
Education	4
Electricity, gas, steam and air	1
Finance and insurance services	3
Human health and social work services	2
Manufacturing	8
Other (please specify)	41
Other service activities	5
Professional, scientific and technical services	2
Public administration and defence; social security	1
Real estate services	3
Repair of motor vehicles and motorcycles	4
Transport and storage	2
Water supply, sewerage, waste management and remediation activities	0
Wholesale and retail trade	11
Total	100

Compared to the SSW region data, each aggregated industry sector is under-represented, although this is largely due to the large proportion of 'others' that are evident for the sample. It is likely that many of these respondents were mis-coded as 'other' in the CATI recruitment interview from the full list of standard industrial classification codes that were provided. As information on the businesses was available the results coded as 'other' have been reallocated to the relevant summary classification using information on the detailed SIC codes for each business.

Table 5.2: Summary of the main activity of organisations (percentage)

Grouped activities	Survey	Revised allocation	SSW Region
Agriculture, forestry and fishing	5	7	6
Construction	3	5	11
Manufacturing/Production	8	14	8
Other activities	63	31	26
Professional, scientific, technical and business administration/support	3	10	18
Public organisations, education, health and social work activities	7	11	10
Wholesale and retail trade	11	22	21
Total	100	100	100

SSW Region data source: Office of National Statistics - UK Business activity, size and location, 2012 Table A1.1

Table 5.3 shows the respondents annual bill amount. The recruiters were provided with information on the current bill amounts for businesses. The initial response from the respondent is shown in the survey column. The bill information from a database provided by SSW was subsequently suggested to the respondent to assist with the survey. The table shows that the respondent recruitment is broadly in line with the profile for the whole database.

Table 5.3: QG. Respondent SSW bill

	Survey	Respondent bill in SSW database	SSW Region
Less than £499 per year	36	81	80
£500 to £999 per year	8	9	9
£1,000 to £4,999 per year	8	8	10
£5,000 to £9,999 per year	2	1	1
£10,000 to £24,999 per year	1	0	0
Above £25,000	2	1	0
Don't know	44	0	0
Total	100	100	100

SSW Region based on all entries in the SSW Bill database

Table 5.4: Q10. Organisation size

Number of	Percentage
0 - 4	31
5 - 9	25
10 - 19	15
100 - 249	4
20 - 49	15
250 - 499	2
50 - 99	3
500 - 999	1
1,000 +	2
Don't know / not stated	1
Total	100

5.2 Service levels – perceptions and experience

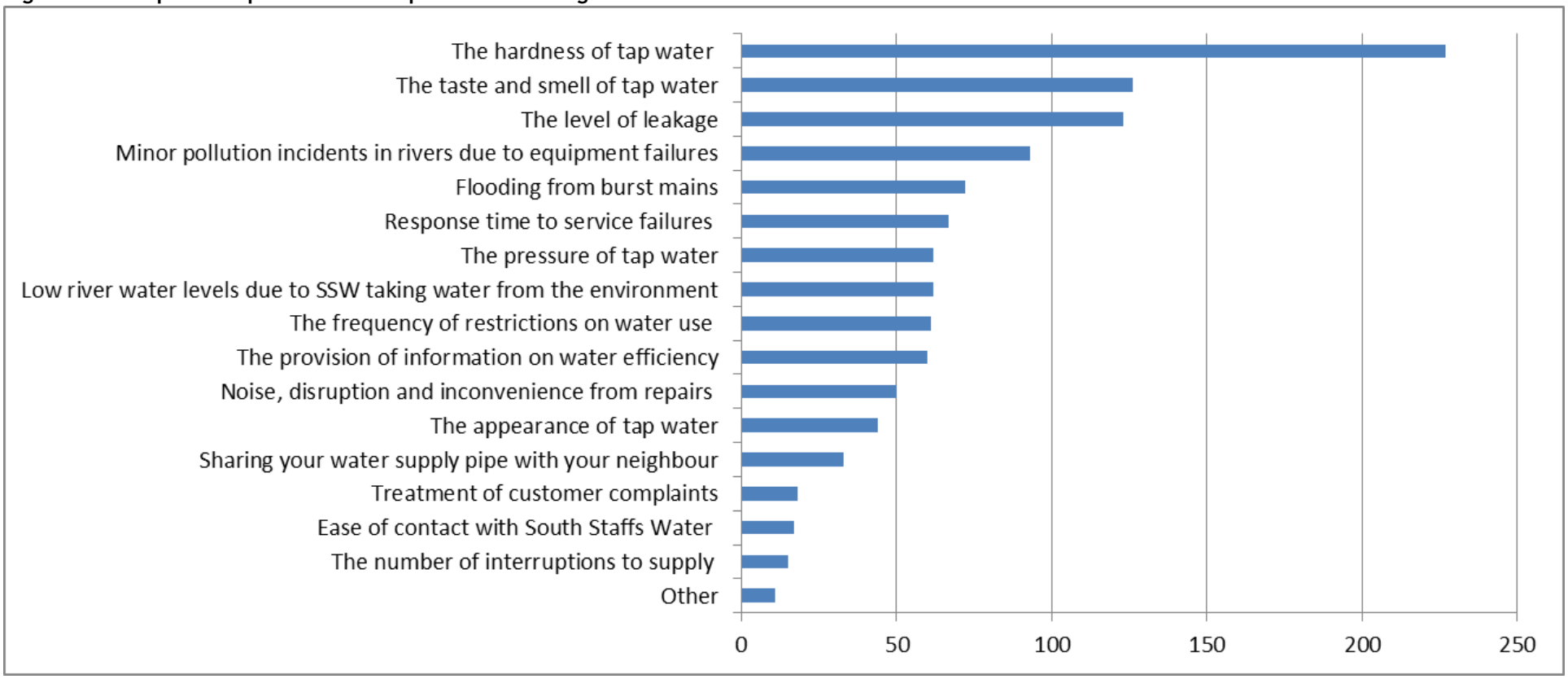
As with domestic customers, the majority of non-domestic customers reported they were satisfied with the current level of service received from South Staffs Water. Table 5.5 reports that the hardness of tap water – similarly to domestic customers - is issue that respondents were least happy with.

Table 5.5: Q1. Respondent view of current service levels (percentage)

Service issue	Happy with current level of service	Needs improvement	Don't know
The taste and smell of tap water	73	24	4
The number of interruptions to supply due to burst pipes	80	5	16
The frequency of restrictions on water use during periods of drought (e.g. hosepipe bans)	75	16	9
The pressure of tap water	85	13	2
The hardness of tap water (e.g. scaling of kettles and other appliances)	47	48	5
Noise, disruption and inconvenience from water company repairs (e.g. traffic, dust, etc.)	70	14	17
Response time to service failures (e.g. repair of burst pipes)	44	13	43
Ease of contact with South Staffs Water (e.g. telephone, email, letters)	78	8	14
Treatment of customer complaints	45	7	48
The appearance of tap water	84	13	3
Flooding from burst mains	43	18	39
The provision of information on water efficiency	50	20	31
The level of leakage	38	26	36
Sharing your water supply pipe with your neighbour	51	8	41
Low river water levels due to South Staffs taking water from the environment	32	20	48
Minor pollution incidents in rivers due to equipment failures	29	24	48
Other	34	16	49

In the survey respondents were asked to indicate the top three service priorities for improvement out of the list of those that they indicated as needing improvement. The results of this question are presented in figure 5.1. To simplify the presentation the results have been weighted based on the order of priority indicated by the respondent.

Figure 5.1: Respondent priorities for improvement - weighted results



Note: Weighted results are calculated based on first priority = 3 points, second priority = 2 points and third priority = 3 points

Table 5.6: Customer experience of attributes (percentage)

Attribute	Within the last year	1 - 3 years ago	3+ years ago	Total
Boil water notice	3	3	3	9
Discoloured tap water	13	17	13	43
Taste and smell of tap water	20	10	10	40
Hard water	43	6	4	53
Non-essential use ban	7	13	10	30
Minor pollution incident	2	6	4	12
Low water levels and flow in rivers and streams	11	21	7	39
Low water pressure	16	13	7	36
Unexpected supply interruption lasting 3 to 6 hours	6	16	5	27
Internal water flooding	4	2	5	11
Leakage	8	11	3	22

Table 5.7 presents respondents views on their current bill. This show that 49% of respondents believe their bill is about right. Only 13% think that their bill is far too much.

Table 5.7: Respondent views on current bill

	Percentage
Too little	0
About right	49
Slightly too much	38
Far too much	13
Total	100

When asked about future service levels and bills in addition to inflation for the period 2015 to 2020 57% of respondents would prefer that bills remain the same and service levels remain unchanged. A further 41% indicated that they would prefer bills to increase slightly and service levels improve.

Table 5.8: Respondent views on future bills and service levels.

	Percentage
Bills increase by a small amount and services improve	41
Bills remain the same and service levels unchanged	57
Bills decrease by a small amount and services deteriorate	2
Total	100

5.3 Econometric estimation

Reporting for the non-domestic choice experiment analysis follows the same structure as domestic customer results in Section 4.3. Details for the estimation strategy and expectations of results are identical and these report sections are not repeated. The difference between the domestic and non-domestic cases is the specification of the bill attribute. As detailed in Section 3.3 the bill change was presented as a percentage amount (%).

Estimation results

Drinking Water Quality (DWQ)

Table 5.6 reports the linear MXL model results for the DWQ choice experiment block. All expectations of coefficient estimates are observed and all coefficient estimates with the exception of hard water are highly statistically significant.

Table 5.9: MXL linear model – DWQ block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Boil Water Notice	-0.00020	4.08E-05	-5.03	0.00	-0.00028	-0.00013
Colour	-0.00036	6.28E-05	-5.78	0.00	-0.00049	-0.00024
Taste	-0.00050	0.00017	-2.88	0.00	-0.00084	-0.00016
Hard Water – +1 level	0.33047	0.20573	1.61	0.11	-0.07275	-0.73369
Hard Water - +2 level	0.31088	0.19869	1.56	0.12	-0.07855	-0.70030
ASC	1.45002	0.21067	6.88	0.00	1.03711	1.86293
Water bill	-0.03555	0.00592	-6.01	0.00	-0.04714	-0.02395
Log likelihood	-962.41					
BIC	1008.55					
Pseudo r^2	0.28					
LR chi2(13)	736.02					
Prob > chi2	0.00					
Observations	1211					

The non-linear results are presented in table 5.10 below. As with the linear model all coefficients show the expected signs. All of the attribute coefficients with the exception of hard water are significant at the 95% confidence level. The results for the bill coefficients show that the improvement coefficient is highly significant but the deterioration coefficient is not significant. Despite this the bill coefficients do conform to expectations in that the bill deterioration coefficient is smaller than the bill improvement coefficient.

Table 5.10: MXL piecewise non-linear model – DWQ block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Boil Water Notice	-0.00020	3.88E-05	-5.13	0.00	-0.00028	-0.00012
Colour	-0.00034	6.40E-05	-5.38	0.00	-0.00047	-0.00022
Taste	-0.00038	0.00018	-2.15	0.03	-0.00073	-0.00003
Hard Water – +1 level	0.32195	0.20217	1.59	0.11	-0.0743	0.7182
Hard Water - +2 level	0.26204	0.20673	1.27	0.20	-0.14313	0.66722
ASC	1.03536	0.23141	4.47	0.00	0.5818	1.48892
Water bill (deterioration)	-0.00607	0.00875	-0.69	0.49	-0.02322	0.01107
Water bill (improvement)	-0.10205	0.01686	-6.05	0.00	-0.13509	-0.069
BIC	1001.84					
Log likelihood	-952.15					
Pseudo r^2	0.28					

LR chi2(14)	756.53
Prob > chi2	0.00
Observations	1211

Water availability and environment

Table 5.11 reports the MXL linear model results for the Water availability and environment (WAE) choice experiment block. All expectations of coefficient estimates are observed and all coefficient estimates are highly statistically significant.

Table 5.11: MXL linear model – WAE block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Non-essential use ban	-0.25042	0.058561	-4.28	0.00	-0.3652	-0.13565
Pollution	-0.15739	0.018912	-8.32	0.00	-0.19446	-0.12033
Low flow	-0.0491	0.018861	-2.6	0.01	-0.08607	-0.01214
ASC	1.598613	0.24134	6.62	0.00	1.125595	2.071631
Water bill	-0.05175	0.00605	-8.55	0.00	-0.06361	-0.03989
BIC	870.77					
Log likelihood	-839.28					
Pseudo r^2	0.30					
LR chi2(9)	720.80					
Prob > chi2	0.00					
Observations	1092					

A similar result is observed for the non-linear piecewise model shown in table 5.12 below. Again it can be observed that, in line with expectations, the bill deterioration coefficient is smaller in magnitude that the bill improvement coefficient. As with domestic respondents both of these coefficients are significant implying that a gains-loss relationship exists. This is examined further in section 6.1 that presents the marginal willingness to pay values.

Table 5.12: MXL Piecewise non-linear model – WAE block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Hosepipe ban	-0.27277	0.05992	-4.55	0.00	-0.3902	-0.15533
Pollution	-0.14910	0.01939	-7.69	0.00	-0.1871	-0.11109
Low flow	-0.05776	0.01991	-2.9	0.00	-0.0968	-0.01873
ASC	1.20253	0.25121	4.79	0.00	0.7102	1.6949
Water bill (deterioration)	-0.01957	0.00913	-2.14	0.03	-0.0375	-0.00167
Water bill (improvement)	-0.13281	0.01955	-6.79	0.00	-0.1711	-0.0945
BIC	863.10					
Log likelihood	-828.13					
Pseudo r^2	0.31					
LR chi2(10)	743.12					
Prob > chi2	0.00					
Observations	1092					

Reliability of water supply

Table 5.13 reports the MXL linear model results for the reliability of water supply (RWS) choice experiment block. As with the water availability block all expectations of coefficient estimates are observed and all coefficient estimates are highly statistically significant.

Table 5.13: MXL linear model – RWS block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Low Pressure	-0.00048	9.88E-05	-4.85	0.00	-0.0007	-0.0003
Interruption	-0.00047	8.17E-05	-5.81	0.00	-0.0006	-0.0003
Internal flooding	-0.00649	0.0014	-4.57	0.00	-0.0093	-0.0037
Leakage	-7.9E-05	1.98E-05	-3.98	0.00	-0.0001	-4.0E-05
ASC	1.821278	0.2182	8.35	0.00	1.3937	2.2488
Water bill	-0.04014	0.0062	-6.53	0.00	-0.0522	-0.0281
BIC						
Log likelihood	-837.34					
Pseudo r^2	0.33					
LR chi2(11)	827.96					
Prob > chi2	0.00					
Observations	1139					

The piecewise non-linear results for the RWS choice experiment block are shown in table 5.14. The results are similar to the linear model. The deterioration bill coefficient is not significant. Despite this the bill coefficients do conform to expectations in that the bill deterioration coefficient is smaller than the bill improvement coefficient.

Table 5.14: MXL piecewise non-linear model – RWS block

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Low Pressure	-0.00054	0.0001	-5.18	0.00	-0.00074	-0.00033
Interruption	-0.00045	8.24E-05	-5.46	0.00	-0.00061	-0.00029
Internal flooding	-0.00694	0.0014	-4.96	0.00	-0.00968	-0.00419
Leakage	-7.23E-05	1.89E-05	-3.82	0.00	-1.09E-04	-0.35E-05
ASC	1.17409	0.24822	4.73	0.00	0.68759	1.66059
Water bill (deterioration)	0.00024	0.01023	0.02	0.98	-0.01982	0.02029
Water bill (improvement)	-0.12978	0.02001	-6.49	0.00	-0.16899	-0.09057
BIC	867.49					
Log likelihood	-825.26					
Pseudo r^2	0.34					
LR chi2(12)	852.12					
Prob > chi2	0.00					
Observations	1139					

Supply interruption severities

Table 5.15 below presents the results for the interruptions question. The results have been estimated in the same way as the domestic results and the unexpected interruption lasting between 3 to 6 hours has been used as a base in the modelling. This means that all other types of interruptions have been modelled relative to this. Similar to the domestic results all coefficients are highly significant and the results show that customers find longer durations to be worse than shorter durations as expected. The results also show the same pattern for planned interruption categories. It is worth noting that when compared to domestic customers the non-domestic customer place a higher relative weight on longer duration incidents.

Table 5.15: Interruptions weights

	Coeff.	Std. Err	z	P>|z|	95% Conf. Int.	
Planned 0-3 hours	0.08062	0.0144	5.58	0.00	0.0523	0.1089
Planned 3-6 hours	0.33072	0.0449	7.36	0.00	0.2427	0.4188
Unexpected 0-3 hours	0.46095	0.0596	7.74	0.00	0.3442	0.5777
Unexpected 3-6 hours	1	-	-	-	-	-
Unexpected 6-12 hours	2.11809	0.2640	8.02	0.00	1.6007	2.6355
Unexpected 12-24 hours	3.33348	0.4465	7.47	0.00	2.4584	4.2086
Unexpected 24-48 hours	3.57695	0.5120	6.99	0.00	2.5734	4.5805

Validity testing – respondent feedback

The non-domestic questionnaire also included 'diagnostic' questions to gauge respondent understanding of the choice tasks, their credibility, and perceived difficultly. Again the results are encouraging and indicate high engagement with the survey and understanding of the choice tasks. Table 5.16 reports the main motivation for responses to the choice tasks. Across all samples the majority of respondents indicated that they choose options that either offered most improvement relative to cost (32%) or chose the options that affect or are most likely to affect their business directly (28%). As with the domestic sample very few respondents stated that too little information was provided to make a choice (2.0%).

Table 5.16: Q7. Respondent motivations for choices (percentage)

	Most relevant
I chose improvements that I feel other customers should experience, irrespective of what they think is best	5
I chose the options that affect or are most likely to affect my business directly	28
I chose the options that I thought would benefit other customers the most	5
I chose the options that I thought would benefit people I know	3
I chose the options which offered most improvement relative to cost	32
I chose the options with least cost to my business	21
I was interested in improvements irrespective of cost	3
The information provided was not clear enough for me to make a choice	2
Other / None of these	2
Total	100

Table 5.17 shows the perceived difficulty of the choice cards. Overall the choice cards were considered reasonable with only 5% finding them very difficult.

Table 5.17: Q8. Difficulty of the choice cards

	Percentage
Very easy	6
Fairly easy	36
Neither easy nor difficult	27
Fairly difficult	25
Very difficult	5
Don't know	0
Total	100

With regards to the overall perception of the questionnaire in contrast with domestic customers there is a lower percentage of customers that found the survey interesting and a higher percentage that found the survey too long or difficult.

Table 5.18: Q15 Overall views on the questionnaire

	Percentage
Interesting	29
Too long	51
Difficult to understand	18
Educational	6
Unrealistic/not credible	4
Other	6

Contingent valuation package estimates

The tests of package effects for the non-domestic survey applied the same format as presented for the domestic sample in Section 4.3):

- Two package cards showing one or two of the blocks improving; and
- One final package card showing all of the choice blocks improving.

Both tests provide valuations for the shift from the current level of service (status quo) to the maximum improvement level (Level +2) for the attributes included in the specified package, with WTP estimates presented in terms of the percentage change in customer bill.

The results of this exercises is presented in table 5.19 below. As with the domestic respondent results two sets of results are shown for the CV questions. The overall CV question produces a WTP of 5.13% for all blocks to move to the 2nd improvement level. The analysis of all the package cards produces values for improvements to the individual blocks that sum to 9.99%. We use these results to directly estimate relative weights between the three choice experiment blocks. These weights are then used to allocate the overall CV value of 5.13% between the blocks.

Table 5.19: Comparison of non-domestic choice experiment and contingent valuation package valuations (£/hh/yr)

CE block	CE WTP (%)	CV WTP (%) Upper Based on all CV questions	CV WTP (%) Lower Based on final CV question	CV Upper: CE ratio	CV Lower: CE ratio
DWQ	7.87	2.21	1.13	0.28	0.14
WAE	12.65	4.45	2.29	0.35	0.18
RWS	12.02	3.33	1.71	0.28	0.14
Total/average	**32.54**	**9.99**	**5.13**	0.29	0.16

Notes: CE WTP calculated from non-linear WTP estimates aggregated across the SQ to maximum (+2 level) service improvement for each service attribute in the combined blocks.

As with domestic customers Table 5.19 provides strong evidence of package effect. The results from the non-linear choice exercises show that the total WTP for improvements to the 2nd

improvement level is 32.54% per business. The upper CV estimate is 29% of this and the overall package CV question produces a result that is 16% of this. The non-domestic package CV results can be used in the same way as the domestic results and the overall package WTP estimate of 5.13% can be viewed as a range for the maximum businesses respondents would pay on average to receive a maximum improvement across all aspects of service.

The additional question on the impact of an increase in the Severn Trent Water part of the bill for sewerage services shows that this value is sensitive. 19% of those choosing to pay for improvements indicated that they would revise the WTP amount stated.

Tables 5.20 and 5.21 present the motivations for respondents when answering the CV questions. Table 5.20 shows the motivations for not choosing to see improvements and a bill increase. The main reason stated is the view that the current level of service is already good enough (31%).

Table 5.20: Q9c. Motivations for not choosing an increase in the CV questions

	Percentage
I do not believe these improvements would actually happen	3
I object to paying higher water bills	6
I object to the proposed improvements	1
I object to water companies being privatised	2
I think the current services are already good enough	31
I would like the improvements, but I cannot afford to pay	7
I would like the improvements, but the bill increase was more than I would be prepared to pay	13
I'd like to have more information before making a decision	7
Improvement in only one or two of these services is important to me, not all of them	2
The government or council should pay for this	1
The improvements of these services are not important to me	2
The water company is inefficient	4
The water company should pay for this	8
Water companies make enough profits as it is	12
Other (specify)	2
Total	100

N=188

Table 5.21 shows that the reasons for choosing to pay were mixed and covered a wide range of areas. The most commonly cited reason was to avoid impacts on future generations. This was closely followed by avoiding the impact on businesses in their area.

Table 5.21: Q9f. Motivations for paying for service increases in the CV questions

	Percentage
To prevent / avoid damage to rivers	2
To prevent / avoid damage to the environment or wildlife generally	13
To prevent / avoid negative impact on future generations	22
To prevent / avoid negative impact on my business	16
To prevent / avoid negative impact on my business and others in the area	20
To prevent / avoid negative impact to businesses in the area	9
To prevent / avoid negative impact to households in the area	11
It is a good cause	4
Other (specify)	4
Total	100

N=112

6 SUMMARY OF BENEFIT VALUES

This section presents the benefit estimates for use in CBA by South Staffs Water. It draws together the significant findings from the econometric analysis with respect to estimation of customer WTP.

6.1 Marginal WTP estimates

The domestic and non-domestic survey data has been subject to a comprehensive econometric testing procedure, as documented in Sections 4.3 and 5.3 respectively. These sections present both the preferred linear and non-linear models. In most cases the coefficients are highly statistically significant and the measures of model performance indicate a very good fit to the data. The coefficients that have not been found to be significant are the hard water values for businesses and the bill deterioration coefficients in non-linear models for two of the choice blocks. For the business hard water results this suggests that there are a wide range of views with some businesses concerned about the hard water but others essentially ignoring it in their decision making.

The results for the bill deterioration coefficient indicate that there is a variety of trading behaviours with a mixed reaction to a negative bill being shown. Some of these results may be linked to the desire to avoid a service reduction that is shown in tables 4.11 and 5.8. As a result it is recommended that the WTP estimates for improvements are based on the non-linear models used and the linear models are used for deteriorations.

Overall marginal WTP estimates derived from the preferred models are regarded as robust and 'fit for use' by South Staffs Water in the development of the PR14 business plan.

Table 6.1 and 6.2 draws together the marginal WTP estimates for domestic and non-domestic customers respectively in accordance with the results in Section 4.4 and 5.3.

Table 6.1 Domestic marginal willingness to pay results

Attribute	Unit of measurement	WTA (£/household/annum)	WTP (£/household/annum)
Boil water notice	Per property per year	0.0169	0.0028
Discoloured tap water	Per property per year	0.0210	0.0029
Taste and smell of tap water	Per property per year	0.0270	0.0029
Hard water level 1	Remove very hard water	N/a	3.5098
Hard water level 2	Remove moderately hard water	N/a	7.2756
Hosepipe ban	% change per year	4.5725	1.2304
Minor pollution incident	% change per year	5.3107	1.0102
Low water levels and flow in rivers and streams	% change per year	N/a	0.4276
Low water pressure	Per property per year	0.0329	N/a
Unexpected supply interruption lasting 3 to 6 hours	Per property per year	0.0210	0.0031
Internal water flooding	Per property per year	0.4001	0.0614
Leakage	Per property supplied	N/a	0.0005

Table 6.2 Non-domestic marginal willingness to pay results

Attribute	Unit of measurement	WTA (%/business/annum)	WTP (£/business/annum)
Boil water notice	Per property per year	0.0058	0.0020
Discoloured tap water	Per property per year	0.0102	0.0034
Taste and smell of tap water	Per property per year	0.0141	0.0037
Hard water level 1	Remove very hard water	N/a	3.1549*
Hard water level 2	Remove moderately hard water	N/a	2.5679*
Non-essential use ban	% change per year	4.8389	2.0539
Minor pollution incident	% change per year	3.0413	1.1227
Low water levels and flow in rivers and streams	% change per year	N/a	0.4349
Low water pressure	Per property per year	0.0119	N/a
Unexpected supply interruption lasting 3 to 6 hours	Per property per year	0.0118	0.0035
Internal water flooding	Per property per year	0.1618	0.0535
Leakage	Per property supplied	N/a	0.0006

*Not significant

The findings show that where the results are expressed in comparable units, such as per property, internal water flooding is a priority for both domestic and non-domestic customers. Non-domestics customers also have a relatively strong preference to avoid discolouration, interruptions to supply and taste and odour. The domestic customer's results also indicate that removing hard water is a priority whilst the non-domestic customer's views were not found to be significant.

In addition to this the non-linear models for the WAE choice exercise block indicate a significant relationship for domestic customers. This has been tested using the Z-statistic based on the following equation:

$$Z = \frac{X - \mu}{\sigma} = \frac{\overline{WTA} - \overline{WTP}}{\sqrt{\sigma^2_{WTA} + \sigma^2_{WTP}}}$$

The Z-statistic is based on the ratio of the difference between an estimated parameter and some hypothesised value relative to the estimated standard error of the parameter. Under the hypothesis $Z = 0$ if $WTA = WTP$. For hosepipe bans and pollution the resulting Z-statistics is 4.17 and 4.31 for domestic customers indicating a highly significant relationship. The corresponding values for business customers are 1.73 and 1.88 indicating a marginally significant relationship. These results suggest that a higher WTA value could be used for these attributes and could be applied in sensitivity testing. The values are £14.21/household per annum for hosepipe bans, and 13.94% per business per annum for non-essential use bans and £11.66/household per annum and 7.62% per business per annum for pollution.

6.2 Individual customer WTP estimates for step changes

The results shown in table 6.2 can be multiplied by the improvements in service shown in table 3.2 to shown the total WTP per household and per business for those step changes in service.

These domestic results are displayed graphically in figures 6.2 to 6.4 below.

Figure 6.2 Drinking Water Quality

		Change in Service Level			
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Boil Water Notice	*Properties affected*	*5,970*	*970*	*-30*	*N/a*
	Annual £ WTP per household	**-101**	**-16**	**0.08**	
Discoloured water	*Properties affected*	*2,500*	*1,000*	*-500*	*-1,000*
	Annual £ WTP per household	**-52**	**-21**	**1.44**	**2.87**
Taste and smell	*Properties affected*	*500*	*250*	*-250*	*-500*
	Annual £ WTP per household	**-14**	**-7**	**0.74**	**1.47**
Hard water		*N/a*	*N/a*	*All moderately hard*	*All soft*
	Annual £ WTP per household			**3.51**	**7.28**

Figure 6.3 Water availability and the Environment

		Change in Service Level			
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Hosepipe Ban	*% change in likelihood*	*2.5*	*0.8*	*-1.5*	*-2.5*
	Annual £ WTP per household	**-11**	**-4**	**1.85**	**3.08**
Pollution incident	*% change in likelihood*	*10.0*	*4.0*	*-3.0*	*-5.0*
	Annual £ WTP per household	**-53**	**-21**	**3.03**	**5.05**
Low levels/flow in rivers	*% change in length affected*	*N/a*	*N/a*	*-3.1*	*-9.1*
	Annual £ WTP per household			**1.33**	**3.89**

Figure 6.4 Reliability of Water Supply

		Change in Service Level			
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Low pressure	*Properties affected*	*2,000*	*1,000*	*N/a*	*N/a*
	Annual £ WTP per household	**-66**	**-33**		
3 to 6 hour interruptions	*Properties affected*	*2,040*	*1,040*	*-660*	*-1,160*
	Annual £ WTP per household	**-43**	**-22**	**2.06**	**3.62**
Internal Water flooding	*Properties affected*	*200*	*50*	*-25*	*-45*
	Annual £ WTP per household	**-80**	**-20**	**1.53**	**2.76**
Leakage	*Properties supplied*	*N/a*	*N/a*	*-5,000*	*-10,000*
	Annual £ WTP per household			**2.35**	**4.70**

The results show that the highest value for a move to the +2 level is for hard water. Households also value pollution and leakage. However, it is important to note that comparison of these results is not straight forward as the value depends on the change in service level presented.

When comparing reductions to service household value avoiding deterioration to the level of service for boil water notices the most. This is followed by internal water flooding and low tap water pressure.

The results for the non-domestic customers are shown in figures 6.5 to 6.7.

Figure 6.5 Drinking Water Quality

		Change in Service Level			
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Boil Water Notice	*Properties affected*	*5,970*	*970*	*-30*	*N/a*
	Annual % WTP per business	**-34**	**-6**	**0.06**	
Discoloured water	*Properties affected*	*2,500*	*1,000*	*-500*	*-1,000*
	Annual % WTP per business	**-26**	**-10**	**1.69**	**3.38**
Taste and smell	*Properties affected*	*500*	*250*	*-250*	*-500*
	Annual % WTP per business	**-7**	**-4**	**0.93**	**1.86**
Hard water		*N/a*	*N/a*	*All moderately hard*	*All soft*
	Annual % WTP per business			**3.15**	**2.57**

Figure 6.6 Water availability and the Environment

				Change in Service Level	
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Non-essential use ban	*% change in likelihood*	*1.8*	*1.0*	*-0.5*	*-1.5*
	Annual % WTP per business	**-9**	**-5**	**1.03**	**3.08**
Pollution incident	*% change in likelihood*	*10.0*	*4.0*	*-3.0*	*-5.0*
	Annual % WTP per business	**-30**	**-12**	**3.37**	**5.61**
Low levels/flow in rivers	*% change in length affected*	*N/a*	*N/a*	*-3.1*	*-9.1*
	Annual % WTP per business			**1.35**	**3.96**

Figure 6.7 Reliability of Water Supply

				Change in Service Level	
Service Attribute	**Units**	**Reduction -2**	**Reduction -1**	**Improvement +1**	**Improvement +2**
Low pressure	*Properties affected*	*2,000*	*1,000*	*N/a*	*N/a*
	Annual % WTP per business	**-24**	**-12**		
3 to 6 hour interruptions	*Properties affected*	*2,040*	*1,040*	*-660*	*-1,160*
	Annual % WTP per business	**-24**	**-12**	**2.28**	**4.01**
Internal Water flooding	*Properties affected*	*200*	*50*	*-25*	*-45*
	Annual % WTP per business	**-32**	**-8**	**1.34**	**2.41**
Leakage	*Properties supplied*	*N/a*	*N/a*	*-5,000*	*-10,000*
	Annual % WTP per business			**2.80**	**5.60**

The results show that the highest value for a move to the +2 level is for leakage and pollution. Households also value interruptions highly. When comparing reductions to service household value avoiding deterioration to the level of service for boil water notices the most. This is followed by internal water flooding and pollution.

6.3 Aggregated benefit estimates

South Staffs Water intends to use the data presented in sections 4 and 5 in cost benefit analysis to understand which investments customers' value. This requires some adjustments to the data to convert it to a useable format.

The reported WTP values presented in tables 6.1 and 6.2 can be aggregated over the South Staffs Water customer base to produce the 'total' value for a unit change in service for each service attribute. Table 6.3 presents information on the SSW customer base. In addition a non-domestic bill value of £658.06 has been used to convert the non-domestic results into monetary values.

Table 6.3 Number of customers in the South Staffs Water Region

	Domestic	Non-domestic
Number of customers	535,243	33,666

Based on information provided by South Staffs Water

Tables 6.4 and 6.5 present the WTP values by service attribute. These values represent the estimated monetary benefit to customers for a unit change in each service measure. Cost benefit analysis is then based on comparing these benefits with the costs of delivering a unit change for each service measure. The WTP values should be used for improvements to service and the WTA values should be used when assessing investment to avoid deterioration to service.

The estimates represent mean or average values and like any statistical estimate have an associated confidence range. This range is provided in brackets. To produce this range for sensitivity testing we have been guided by the 95% confidence level to produce a conservative (lower) estimate and an upper range. The mean values shown are the statistically correct values to use in investment planning, though we recommend that the sensitivity of the cost benefit analysis is tested against the conservative and upper ranges.

These ranges have been calculated using the standard errors for each set of estimates. Where the 95% confidence interval implies a negative lower end for the range (the business hard water value), we have truncated at the value zero.

Table 6.4 Total Regional WTP Values for Cost Benefit Analysis (£/year)

Attribute	Unit of measurement	Domestic	Non-domestic	Total
Boil water notice	Per property per year	1,480 (1,050 - 1,910)	430 (230 - 640)	1,920 (1,280 - 2,550)
Discoloured tap water	Per property per year	1,540 (980 - 2,090)	750 (380 - 1,110)	2,290 (1,360 - 3,210)
Taste and smell of tap water	Per property per year	1,570 (60 - 3,080)	820 (0 - 1,650)	2,400 (70 - 4,730)
Hard water level 1	Remove very hard water	1,879k (232k - 3,525k)	699k (0 - 1,470k)	2,578k (232k - 5,107k)
Hard water level 2	Remove moderately hard water	3,894k (2,259k - 5,529k)	569k (0 - 1,471k)	4,463k (2,259k - 7,000k)
Hosepipe ban	% change per year	659k (385k - 932k)	N/a	659k (385k - 932k)
Non-essential use ban	% change per year	N/a	455k (241k - 669k)	455k (241k - 669k)
Minor pollution incident	% change per year	541k (396k - 685k)	249k (156k - 341k)	789k (552k - 1,027k)
Low water levels and flow in rivers and streams	% change per year	229k (98k - 360k)	96k (30k - 163k)	325k (128k - 522k)
Low water pressure	Per property per year	N/a	N/a	N/a
Unexpected supply interruption lasting 3 to 6 hrs	Per property per year	1,670 (1,080 - 2,260)	770 (420 - 1,110)	2,440 (1,510 - 3,370)
)Internal water flooding	Per property per year	32,840 (21,720 - 43,960)	11,840 (6,350 - 17,330)	44,680 (28,070 - 61,290)
Leakage	Per property supplied	250 (110 - 400)	120 (50 - 200)	380 (160 - 600)

Values are rounded to the nearest £10 or £1000 as appropriate.

Table 6.5 Total Regional WTA Values for Cost Benefit Analysis (£/year)

Attribute	Unit of measurement	Domestic	Non-domestic	Total
Boil water notice	Per property per year	9,050 (6,270 - 11,820)	1,280 (710 - 1,840)	10,320 (710 – 1,840)
Discoloured tap water	Per property per year	11,230 (7,670 - 14,790)	2,260 (1,260 - 3,270)	13,490 (8,930 – 18,050)
Taste and smell of tap water	Per property per year	14,480 (5,080 - 23,880)	3,130 (890 - 5,360)	17,610 (5,970 – 29,240)
Hard water level 1	Remove very hard water	N/a	N/a	N/a
Hard water level 2	Remove moderately hard water	N/a	N/a	N/a
Hosepipe ban	% change per year	2,447k (1,212k - 3,683k)	N/a	2,447k (1,212k – 3,683k)
Non-essential use ban	% change per year	N/a	1,072k (591k - 1,553k)	1,072k (591k – 1,553k)
Minor pollution incident	% change per year	2,843k (2,267k - 3,420k)	674k (492k - 855k)	3,516k (2,760k – 4,270k)
Low water levels and flow in rivers and streams	% change per year	N/a	N/a	N/a
Low water pressure	Per property per year	17,610 (12,310 - 22,920)	2,650 (1,460 - 3,830)	20,260 (13,770 – 26,750)
Unexpected supply interruption lasting 3 to 6 hrs	Per property per year	11,210 (8,020 - 14,410)	2,620 (1,530 - 3,710)	13,830 (9,550 – 18,120)
Internal water flooding	Per property per year	214k (145k - 283k)	35,840 (17,510 - 54,170)	249,970 (163k – 337k)
Leakage	Per property supplied	N/a	N/a	N/a

The central estimates of the values are also shown graphically in Figure 6.1 below.

Figure 6.8 Summary of the regional value for a unit change (£/year)

		Change in Service Level	
Service Attribute	**Units**	**Reduction £**	**Improvement £**
Boil Water Notice	*1 property affected*	10,320	1,915
Discoloured water	*1 property affected*	13,490	2,290
Taste and smell	*1 property affected*	17,610	2,400
Hard water	*1 property affected*	N/a	8
Low Pressure	*1 property affected*	20,260	N/a
Interruption	*1 property affected*	13,830	2,440
Flooding	*1 property affected*	249,970	44,680
		Reduction £k	**Improvement £k**
Hosepipe ban	*1% change in likelihood*	2,447	659
Non-essential use ba	*1% change in likelihood*	1,072	455
Pollution incident	*1% change in likelihood*	3,516	789
Low levels and flow i	*1% change*	N/a	325
Leakage	*1000 properties supplied*	N/a	376

Notes: Values are rounded to nearest £10 or £1000. Values are aggregated over 535,243 domestic properties and 33,666 non-domestic properties based on average non-domestic bill (£658). Leakage is shown as 1000 properties as this is equivalent to 1.01Ml/d.

The results of the extra question on interruptions can also be linked to the data from tables 6.4 and 6.5 by applying the weights calculated in section 4.3 and 5.3 to the results for an unexpected interruption lasting between 3 to 6 hours. These results are shown in Tables 6.6 and 6.7 below for the WTP and WTA respectively.

Table 6.6 Total Regional WTP Values interruptions (£/year)

Interruption type	Domestic	Non-domestic	Total
Planned 0-3	180	60	240
Planned 3-6	580	250	830
Unexpected 0-3	930	350	1,280
Unexpected 3-6	**1,670**	**770**	**2,440**
Unexpected 6-12	2,400	1,620	4,020
Unexpected 12-24	2,970	2,560	5,520
Unexpected 24-48	3,040	2,740	5,780

Table 6.7 Total Regional WTA Values interruptions (£/year)

Interruption type	Domestic	Non-domestic	Total
Planned 0-3	1,210	210	1,420
Planned 3-6	3,860	870	4,730
Unexpected 0-3	6,210	1,210	7,420
Unexpected 3-6	**11,210**	**2,620**	**13,830**
Unexpected 6-12	16,100	5,550	21,650
Unexpected 12-24	19,930	8,730	28,660
Unexpected 24-48	20,410	9,370	29,780

Table 6.8 presents the scaled WTP values resulting from the CV package questions. These values are calculated using the data in table 6.4 and the relevant scaling factors presented in tables 4.25 and 5.19. The lower end of the range compares to the range shows the difference between the lower and upper scaled values.

These values should be used for large improvements. The scaled values relate to a package where the respondents would receive the maximum improvement across all aspects of service. The upper range is more applicable where large improvements are made in a smaller number of areas.

The use of scaled values can be used in sensitivity testing and will depend on the size of the programme indicated by the application of CBA. If a large programme is considered simply summing the unscaled marginal WTP values for service improvements will over-estimate overall benefits since they do not account for substitution effects between attributes valued in a different choice experiment blocks. However the use of scaled values is likely to under-estimate the benefits of service improvements for individual attributes, especially if these are 'small' in total.

Table 6.8 Total Regional scaled WTP Values for Cost Benefit Analysis (£/year)

Attribute	Unit of measurement	Domestic	Non-domestic	Total
Boil water notice	Per property per year	800 – 1,280	60 – 120	860 – 1,400
Discoloured tap water	Per property per year	830 – 1,320	108 – 210	940 – 1,530
Taste and smell of tap water	Per property per year	850 – 1,350	120 - 230	970 – 1,580
Hard water level 1	Remove very hard water	1,012k – 1,615k	101k – 200k	1,113k – 1,811k
Hard water level 2	Remove moderately hard water	2,098k – 3,348k	82k – 160k	2,180k – 3,507k
Hosepipe ban	% change per year	146k – 232k	N/a	146k – 232k
Non-essential use ban	% change per year	N/a	82k -160k	82k -160k
Minor pollution incident	% change per year	120k – 191k	45k – 87k	164k – 278k
Low water levels and flow in rivers and streams	% change per year	51k – 81k	17k – 34k	68k – 115k
Low water pressure	Per property per year	N/a	N/a	N/a
Unexpected supply interruption lasting 3 to 6 hours	Per property per year	130 – 200	110 – 210	236 – 420
Internal water flooding	Per property per year	2,500 – 3,980	1,690 – 3,280	4,180 – 7,270
Leakage	Per property supplied	20 - 30	20 - 30	40 – 70

6.4 Observations and findings

Comparison to PR09

Criterion validity tests of stated preference results examine how these results compare to actual market outcomes. Tests of this type could, for example, look at the difference between WTP values estimated in a stated preference study versus actual market purchases made at a later time. While the benefits of such a test are obvious, it is often difficult to perform such tests if the good or service valued in the stated preference exercise has no parallel in actual goods and services for which market data are available. This is particularly true when the subject of the stated preference exercise is a 'public good' that is not actually traded in markets, and thus does not have any associated prices.

A more limited criterion validity test is to compare with the current estimates with a previous stated preference study. We have sought to undertake this more limited test by comparing the current estimates with the PR09 study undertaken for South Staffs Water where the attribute was assessed.

Table 6.9 Comparison to SSW PR09 values

Attribute	PR14 unit £/year	PR14 scaled value*	PR09 Unit	PR09 value** £/year
Low water pressure	Per affected property	£20,260 (WTA)	Per affected property	£52.39
Supply interruptions	Per affected property 3 to 6 hours	£127	Per affected property 0 to 6 hours	£6.55
Hosepipe ban	Per 1% change in frequency	£145,570	Per property per 1% change in frequency	£66,497
Leakage***	per Ml/d change	£18,927	per Ml/d change	£6,143

*Only domestic results are shown to be comparable
**Value are indexed by RPI to March 2013
***The leakage value is adjusted by assuming that water required to supply a property is 1.01 m3/day

Table 6.9 includes the scaled values for PR14 as these are the most comparable to the PR09 results presented. This is because the PR09 study assessed the total WTP for a large change in service and the results presented were derived from this assessment. It should be noted that the pressure values are not directly comparable as the PR14 study only assessed WTA for pressure whereas the PR09 value is equivalent a scaled domestic WTP value. For the remaining three attributes Table 6.9 shows that the WTP is higher for all of the attributes. It is worth noting that all of the PR09 values were converted to produce marginal values.

Aspects likely to affect valuation include the methodology, description, current level of service, bill level, the range of the levels presented in the choice cards and whether any significant incidents or media coverage has occurred on an issue. The latter two points may have significantly contributed to the difference for water restrictions. Also the interruption values presented cover a different range. The scaled value for a planned interruption of 0 to 3 hours is £14. The PR09 study also included other attributes on the replacement to water pipes and promptness of response that is likely to have reduced the value of leakage, pressure and interruptions.

We would suggest that with a large number of uncontrolled for differences between the studies, any weight on these differences would be risky. A preferable approach would be to use the current WTP estimates as the basis for validating future valuations in later phases of work.

Comparison to other studies

The numbers presented in Tables 6.4 and 6.8 are in general in line with expectations, when compared to published data from companies in PR09 and the Yorkshire Water published figures from PR04:

Domestic

- It has not been possible to compare values for boil water notices, hard water and river flow.
- Where values can be compared there is a mixed view on the ranges found at PR09.
    - Leakage, taste and smell, interruptions to supply and hosepipe bans are within the ranges observed.
    - When converted to a per incident value the pollution value is significantly higher. The value form the study can therefore be considered equivalent to customers indicating that they do not wish to observe pollution incidents and an alternative value should be used, such as the Environment Agency value for cleaning up pollution incidents which provides a lower bound value for avoiding pollution incidents.
    - Internal water flooding is not directly comparable but is within the range of sewer flooding values observed.
    - The PR14 low water pressure value is a WTA value and is not directly comparable to a majority of the published values, however, when the scale of the difference between the WTA and WTP values is taken into account the result appears to be within the range observed.
    - The discoloured water value appears to be slightly higher than the range observed.

Business Values

- Comparing the business values has been more difficult than comparing the household values due to few companies surveying business customers at PR09. There is also greater difficulty in comparing the values as it is more common to present the percentage change in bill.
- As with the domestic results it has not been possible to compare boil water notices, hard water and river flow. It has also not been possible to compare discolouration.
- The results are similar to the domestic results.

7 CONCLUSIONS

In drawing together the outcomes from the study, this concluding section focuses on the key features of survey design, customer preferences for water service levels, and recommendations for the use of results in investment planning.

7.1 Summary

The overall objective of *the PR14 Willingness to Pay study* was to provide benefit estimates that input to the cost-benefit analysis that will support the development of South Staffs Water's Business Plan. The study featured a comprehensive design and testing phase of work, which was used to iteratively refine the stated preference survey. The design built on good practice recommendations from recent UKWIR studies. The analysis and results of the study are based on a large scale sampling of domestic and non-domestic customers. Comprehensive econometric modelling has been undertaken to examine customer preferences for water services. Overall the study provides robust benefits estimates that are 'fit for use' in PR14 investment planning.

The one exception to this is the value for pollution where the results show that the value is much higher than expected suggesting that customers are indicating that they do not wish to observe pollution incidents. As a result it is recommended that an alternative value is used, such as the Environment Agency value for cleaning up pollution incidents, which provides a lower bound value for avoiding pollution incidents.

7.2 Key features of study design

At the core of the survey design, testing and analysis were a series of key considerations concerning the application of stated preference techniques, which are fundamental to validity of the study and robustness of WTP estimates. They have been explicitly addressed by the study:

- **Respondent understanding of choice tasks**: a rigorous assessment of the cognitive burden of the stated preference questionnaire was undertaken via the qualitative testing and pilot survey stages of the study. Here the aim was to ensure that the choice tasks presented to respondents were manageable, and hence the observed choices can be interpreted as genuine preferences for changes in service levels, and not influenced by potential bias arising from the complexity of the survey.

- **Non-linear effects:** the design of the study, which includes both improvements and deteriorations in service, and multiple improved levels of service, implies that the analysis of the choice data must account for potential non-linear effects. These include gains-loss asymmetry, where it is commonly observed that unit losses are valued greater, in absolute terms, than unit gains of the same magnitude. Not accounting for gains-loss asymmetry can potentially lead to over-estimation of WTP for service improvements. The study also examined the potential for diminishing marginal benefits, where successive units of service improvement are valued at a decreasing rate, due to a satiation effect. Again, not accounting for diminishing marginal benefits can lead to the over-estimation of WTP for service improvements.

- **Package effects:** the study included a number of consistency tests to control for potential 'package effects'. This refers to the case where summing independently valued WTP estimates from choice experiments can over-estimate the value of large and multiple improvements in service levels in CBA. The contingent valuation component of the survey therefore provided a

set of 'package values' to compare to the choice experiment values from which 'scaling' factors can be estimated for use in CBA.

- **Interruptions:** the study included an additional question to explore the relative value of different length interruptions and the impact on a customer of being informed about an interruption prior to the event.

7.3 Customer preferences for water service levels

Representativeness of results

Random sampling was used and the resulting customer samples are compared against available population statistics.

The domestic sample was compared to 2011 Census data for the South Staffs Water region based on the local authorities covered. Gender and ages were in line with the population statistics and the results can be considered representative. The socio-economic group (SEG) the sample shows some differences. However, this is expected to be partly due to the SSW regional population data being based on the Census 2011 results for Socio-Economic Classification, which at the time of the project has not been mapped to SEG. As a result it is expected that the sample is more aligned than it would first appear. This difference will not affect the results significantly.

For non-domestic customers the sample was compared to the regional 2012 Office of National Statistics data for business activity. The CATI sample provides a good spread across industry type. The results classified as 'other' have been reallocated based on the information available on the businesses. The resulting reallocation does not raise any obvious cause for concern. The non-domestic annual bill value stated showed that many business respondents were not aware of their SSW bill. However, the SSW database shows that the businesses sampled were representative.

Overall, whilst some limitations are recognised in the survey sampling, it is judged that the survey is representative and any of the deviations noted will not have any effect on the results.

The value of improvements in service

The study results present a consistent view of customer preferences. For a large number of service attributes, the majority of domestic and non-domestic customers indicated that they were satisfied with the current level of service experienced. This finding was prevalent in the qualitative testing, pilot survey and main survey results. A notable exception is dissatisfaction with water hardness across both domestic and non-domestic customers.

Customer satisfaction with current services levels is also borne out by analysis of the choice experiment data. As documented in Section 4.4 (domestic customers) and Section 5.3 (non-domestic customers) a significant 'status quo' effect is observed. This provides further empirical evidence that customers have a preference for maintaining the current level of service. It should though be noted however, that this does not imply that improvements in services are not valued by customers. The econometric modelling consistently identifies positive and statistically significant WTP for improved levels of service. The interpretation instead is that in the choice tasks respondents were prepared to select improved service levels if they were judged to offer 'value for money' or if they thought that the service area would affect them directly. This is also supported by feedback provided by respondents. For both domestic and non-domestic customers a large proportion of respondents stated that they chose the options which 'offered the most improvement relative to cost' and 'affect or are most likely to affect my household/business directly'.

The findings show that where the results are expressed in comparable units, such as per property, internal water flooding is a priority for both domestic and non-domestic customers. Non-domestics customers also have a relatively strong preference to avoid discolouration, interruptions to supply and taste and odour. The domestic customer's results also indicate that removing hard water is a priority whilst the non-domestic customer's views appear to be mixed.

Non-linear effects

The willingness to pay results presented control for non-linear effects to avoid over estimating the value of service improvements. Diminishing marginal benefit is not directly controlled for – as this was not evident across all service attributes. It is recommended that the 'scaled' values (see below) are used for larger service improvements to ensure that this is not a factor in the application of WTP results.

Package effect

As expected significant package effects are observed when large improvements to multiple water services are valued. The results from the package tests included in the survey design have produced a range for the scaling factors. At a high level this range is 28% to 44% for domestic customers and 15% to 29% for non-domestic customers. Whilst the non-domestic results appear to be consistent across service areas (choice experiment blocks) the domestic results are notably different. The domestic customers have indicated that they value the drinking water quality service areas the most.

The use of scaled values may be more appropriate where the application of CBA may result in 'large' improvements across multiple service attributes and thus exceeds the maximum package of improvements customers have indicated they are willing to pay as measured in terms of the impact on the bill[12]. Here it is likely that simply summing the unscaled marginal WTP values for service improvements will over-estimate overall benefits since they do not account for substitution effects between attributes valued in a different choice experiment blocks. However the use of scaled values is likely to under-estimate the benefits of service improvements for individual attributes, especially if these are 'small' in total. The use of unscaled values (with constraints around the maximum increase in bills) will allow the maximum scope of investment to be identified. Depending on the scale of this improvement it is recommended that the scaled results are applied to test the effect on CBA results.

[12] The findings from the survey suggest the maximum package suggests a maximum of £9.80 limit on domestic bill increases for all service improvements, with a corresponding 5.13% for businesses.

8 GLOSSARY

Akaike Information Criterion (AIC)	Measures the goodness of fit in a statistical model, used in model selection. It measures the trade-off between model complexity and accuracy; i.e. how parsimonious the model is.
Attribute Non-Attendance	A cognitive bias observed in choice experiments where respondents systematically ignore one or more of the attributes of the alternatives when making choices.
Bayes Information Criterion (BIC)	Measures the goodness of fit in a statistical model, used in model selection. Similar to the AIC it measures the trade-off between model complexity and accuracy; i.e. how parsimonious the model is, but has a larger penalty for models that include more parameters.
Choice Experiment	A stated preference method and form of choice modelling in which respondents are presented with a series of alternatives and asked to choose their most preferred.
Conditional Logit Model (CL)	The discrete choice model, which relates the likelihood of a choice being chosen by a respondent to the attributes of the good.
Contingent Valuation	A stated preference method where respondents are asked what they are willing to pay (or accept) for a discrete change in the provision of a non-market good.
Covariance	Measures how two variables move together. If the covariance of two variables is positive, they have a positive relationship. Likewise, if the covariance of two variables is negative, they have a negative relationship.
Econometric	Quantitative/empirical analysis of economic data via statistical methods.
Error Corrected (EC) Model	This model specification relaxes the MNL assumptions on the error term in relation to how a decrease in the likelihood of choosing an option is correlated to the chance of selecting an alternative option.
Halton Draw	A method of generating random numbers.
Latent Class Model	A model that accounts for heterogeneity in preferences by modelling different groups ('classes') so that coefficient estimates are different between groups.
Log-likelihood	A likelihood ratio details how likely data are under one model rather than another; the log-likelihood ratio is the logarithm of this ratio.
Log-Normal Distribution	Describes a continuous probability distribution of a random variable; the random variable's logarithm is normally distributed.

Mixed Logit Models (MXL)	These are an advance on the multinomial logit model (MNL) model that address its limitation via a set of alternative models, such as the random parameter logit (RPL) model, the random parameter logit correlated model, and the error corrected (EC) model.
Multinomial Logit Model (MNL)	The 'basic' choice experiment model, which relates the likelihood of a choice being chosen by a respondent to the attributes of the good and the characteristics of the respondent. The MNL model is identical to the conditional logit model (CL) model if it does not include the characteristics of the respondent.
Normal Distribution	Describes a continuous probability distribution, which has a bell shaped probability density function.
Random Parameter Logit (RPL)	The multinomial logit model (MNL) model assumes that the coefficients of the independent variables are the same over all respondents (i.e. homogeneity in preferences). The RPL model allows for the coefficients to vary over individuals (i.e. heterogeneous preferences).
RPL Correlated Model	This model specification allows unobserved factors to continue to affect individuals' decisions over multiple choices (i.e. different choice cards).
Variance	Measures how far a set of numbers is spread out from each other (i.e., how far a set of numbers lie from the mean).
Willingness to Accept (WTA)	The monetary measure of the value of compensation needed to accept the loss or avoid a gain in the provision of good or service.
Willingness to Pay (WTP)	The monetary measure of the value of a gain or avoided loss in the provision of a good or service.

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