# A303 Stonehenge

## Amesbury to Berwick Down

# Valuing Heritage Impacts

**HE551506-AA-GEN-SWI-RP-JX-000025**

**P01, S2**

**06/02/2017**

# Table of contents

**Table of Tables**

# 1 Executive Summary

1.1.1 Stonehenge in Wiltshire is one of the best-known and most important archaeological sites in the world. The Stonehenge part of the Stonehenge and Avebury World Heritage Site (WHS) covers around 26km. The site currently suffers considerable intrusion in the form of the A303 road, which passes within 165 metres of the famous stone circle and cuts through some other features of the WHS such as The Avenue.[1] The Government has committed to improving the A303 between Amesbury and Berwick Down and, in doing so, reducing the impact of the road on the WHS.

1.1.2 Highways England is currently progressing through the options identification and selection stage of the project. Options considered involve diverting the A303 away from the Stonehenge monument, either through a tunnel or via a bypass. Diverting the road away from Stonehenge would have a number of beneficial effects on the cultural and heritage value of the Stonehenge WHS, including reduced noise, increased tranquillity, reduced visual intrusion and reduced landscape severance resulting from the existing route.

1.1.3 According to Government guidance, every large spending proposal such as this requires a five case business case.[2] Such a business case aims to set out the full benefits and costs of a spending project to enable the decision makers to take full account of the impact of a project. This study is part of a wider business case for a proposed change in the road layout of the A303. In particular, this study considers the impact of the proposed change on the heritage experience and non-use heritage values. Other impacts (such as economic and environmental) are considered in the overall business case and use the methods described in the Department for Transport's transport appraisal guidance (WebTAG). This study is carefully designed to exclude those other impacts to avoid double counting. This study focuses exclusively on the cultural heritage impacts of removing the A303 from its current location within the WHS in terms of noise reduction, increased tranquillity, visual amenity and reduced landscape severance.

1.1.4 The HM Treasury Green Book (2011) recommends the use of stated preference methods for the valuation of goods which do not have actual or revealed market prices, such as cultural heritage or biodiversity. The **contingent valuation method (CV)** is a stated preference survey-based methodology that seeks to elicit monetary values for non-market goods by directly asking individuals about their willingness to pay or willingness to accept compensation for a particular change (Bateman et al. 2002). Respondents are presented with a hypothetical market that describes in detail the proposed change, using baseline conditions as a reference point. The hypothetical scenario should be understandable, plausible, and meaningful to respondents so that they can give valid and reliable values despite possible lack of

[1] More detail can be found on http://www.english-heritage.org.uk/visit/places/stonehenge/?gclid=CPTh-amOqdACFUHGGwodrCEBpQ&gclsrc=aw.ds

[2] For more detail on the business case process see: Public sector business cases using the five case model (HM Treasury 2013).

experience with one or more aspects of the scenario (Mitchell and Carson 1989).

1.1.5 We applied CV surveys to elicit monetary values for a hypothetical change in noise, tranquillity, visual amenity and landscape severance within the Stonehenge WHS, by directly asking individuals about their willingness to pay (WTP) or willingness to accept (WTA) compensation for a hypothetical change in the layout of the A303 road through the Stonehenge WHS. The CV survey instrument design was informed by an extensive review of the valuation literature on heritage and cultural goods and services. The study has been peer reviewed by an academic expert and quality assured by Department for Transport (DfT) and Highways England (HE) economists.

1.1.6 The key methodological advantage of CV over other non-market valuation approaches is that it can measure use and non-use values and benefits that would not be revealed under market conditions. In this case **use values** stem from those visiting the site, those travelling on the A303 and viewing the site from the road, and those who experience Stonehenge remotely via other media such as the internet, film, books, photographs or social media. Use values can include an option value for those deriving value from the possibility of using Stonehenge in the future. **Non-use values** are made up of: *altruistic values* – welfare increases from knowing that others living will benefit; *bequest values* – welfare increases from knowing that future generations will benefit; and *existence values* – welfare changes from knowing that the road layout within the Stonehenge WHS has been changed (even if an individual does not experience the changed road layout now or in the future). It is likely that some people who have not visited and will not ever visit Stonehenge, or even engage with it remotely (e.g. through media), will nonetheless value the positive effects of the road layout scenarios if this improves experiences for visitors and others who care about Stonehenge. By the same token, non-users may value the positive effects for road users of maintaining the current road layout within the WHS.

1.1.7 This study was designed to assess both use values and non-use values associated with the removal of the A303 from its current location within the Stonehenge WHS, covering both positive and negative aspects of the hypothetical road scenario for users and non-users.

a) For those who positively valued the road option change, we estimate the willingness to pay, via an annual tax at the individual level, for the changes to noise, tranquillity, visual amenity and landscape severance associated with the removal of the A303 from its current location in the Stonehenge WHS and its redirection through a tunnel of approximately 2.9km.[3]
b) For those that negatively valued the road option change, and that therefore indicated they would not be willing to pay for the tunnel, we estimate the willingness to accept, via a one-off cash compensation, to put up with the

[3] The current A303 would likely be replaced with a narrower footpath or other access way covered with a different material than the current tarmac.

removal of the A303 from its current location in the Stonehenge WHS and its redirection through a tunnel of approximately 2.9km.

1.1.8 We conducted three surveys on three sets of stakeholders who may be anticipated to hold different types of values for the hypothetical removal of the A303 from within part of the Stonehenge WHS:

a) Visitors to the Stonehenge WHS (n=432): On-site face-to-face interviews (UK resident, aged 16+) estimating the following possible values associated with the removal of the road from the Stonehenge WHS:
    i. Direct use value
    ii. Non-use value (associated with effects on other cultural heritage within the Stonehenge WHS)
    iii. Use and option value for changes in the view of Stonehenge from the A303 between Amesbury and Berwick Down.

b) Road users (Local residents as proxy) (n=1,001): Online survey of people living within a 50-mile radius of Stonehenge with quotas on gender and age, estimating the following possible values associated with the removal of the road from the Stonehenge WHS:
    i. Direct use value
    ii. Non-use value (associated with effects on other cultural heritage within the Stonehenge WHS)
    iii. Use and option value for changes in the view of Stonehenge from the A303 between Amesbury and Berwick Down.

c) General population (n=2,102): On-line survey of people living in the UK (UK residents aged 16+, with quotas on age, gender, and region) estimating the following possible values associated with the removal of the road from the Stonehenge WHS:
    i. Non-use value;
    ii. Use values for those who have visited the site recently or have photos of it;
    iii. Option value for changes in the view of Stonehenge from the A303 between Amesbury and Berwick Down.

1.1.9 The three surveys used the same basic structure and were divided into three sections. Respondents were provided with information about the route of the tunnel and the expected impact of the scheme on the World Heritage Site (both positive and negative).

1.1.10 In total, we received 3,535 completed survey responses composed of visitors N=432, Local Population N=1,001, General Population N=2,102. Following the surveys, the respondents were redistributed into three study groups of visitors, road users, and the general population. This was because some of the general population sample were regular road users, whilst some of the local resident survey (local residents as a proxy) were not. To ensure that the study groups maintained representativeness of their respective populations, the visitor group was weighted by age, and the general population group weighted by region,

gender, age group and income group to ensure representativeness of real-world populations. Road users were revealed through their responses to survey questions on past usage of the A303 between Amesbury and Berwick Down, and in this case we did not have relevant real-world population demographic data with which to make comparisons of representativeness.

1.1.11 We elicited WTP and WTA values across all three study groups for the following hypothetical scenario (from hereon, 'the road scheme'):

*The construction of a dual carriageway between Amesbury and Berwick Down, including a 2.9km tunnel underneath the WHS with both portals located within the WHS but out of sight from the stone circle. By removing the road from the central portion of the World Heritage Site, those using the road will no longer be able to see Stonehenge while driving and those visiting the site will no longer be affected by the road. To either side of the tunnel itself, widening the road and constructing tunnel portals will have adverse impacts on other monuments (e.g. burial sites) within the WHS.*

1.1.12 Respondents were presented with this hypothetical scenario including maps and photos (see Appendix A for the full survey and information material) and told that the project would be funded through national taxes. Respondents were first asked if they would, in principle, be willing to pay an increase in annual taxes over a three-year period to support the alternative road scheme. Those respondents that stated they would be willing to pay something for the alternative road option were then directed to the WTP valuation question.

1.1.13 Those who indicated that they would not be willing to pay anything for the alternative road scheme were asked a willingness to accept (WTA) compensation question for the removal of the current A303 using a hybrid wellbeing-contingent valuation WTA question developed in previous cultural valuation studies (Bakhshi et al. 2015). The WTA question involved asking respondents if the proposed road scheme would reduce their life satisfaction. Those who indicated that the road scheme would reduce their life satisfaction were asked about the minimum they would be willing to accept in compensation, using the same payment card range as the WTP question.

1.1.14 In designing the CV survey instrument we implemented best practice related to question wording and ordering, payment format, payment vehicle, prompts, use of images, entreaty scripts (reminders of budget constraints and requests to answer the WTP or WTA question realistically) to reduce the impact of hypothetical bias, and follow-up questions on motivations for WTP and WTA (Bateman et al. 2002; Bakhshi et al. 2015).

1.1.15 We apply validity testing to assess the WTP findings and provide supporting evidence that the WTP results reflect the welfare changes associated with the road scheme. The credibility of estimated values from CV studies is most commonly assessed by examining their theoretical validity (Bateman et al. 2002). Theoretical validity examines whether the relationship between WTP and other indicators are in accordance with prior expectations. Some of these indicators are predictors from economic theory, such as the positive association between income and WTP predicted by microeconomic theory

(Bateman and Willis 2001), or the higher values held by those with positive attitudes towards heritage conservation. The validation tests confirmed that WTP is associated with the key drivers of WTP (such as income and frequency of visits to Stonehenge), and in the expected direction (e.g. those with higher incomes report higher mean WTP).

1.1.16 We provide summary results of the contingent valuation of the hypothetical reduction in noise, increased tranquillity, increased visual amenity and reduced landscape severance associated with the removal of the A303 from part of the Stonehenge WHS. The main result is a total net benefit of £1.3bn resulting from the road scheme. The total net benefit aggregates those willing to pay for the road scheme, net of those requiring compensation for it. The aggregated net benefit sits within a 95% confidence interval of £1.1bn and £1.4bn. The values elicited comprise two drivers of welfare; (i) the use value derived from changes to the heritage experience; and (ii) the non-use value which people place on the existence of the altered WHS including bequest value to future generations. It is not possible to separate these values into use and non-use values.

**Table: Aggregate net value of road scheme**

| | Lower bound of 95% confidence interval | Mean | Upper bound of 95% confidence interval |
|---|---|---|---|
| Visitors | £20million | £25million | £29million |
| Road Users | £42million | £49million | £56million |
| General Population | £1.1billion | £1.2billion | £1.3billion |
| Total | £1.1billion | £1.3billion | £1.4billion |

1.1.17 To conclude, the study applies best practice stated preference methods (contingent valuation) to elicit the total net benefits associated with the hypothetical reduction in noise, increased tranquillity, increased visual amenity and reduced landscape severance associated with the removal of the A303 from part of the Stonehenge WHS for three population groups: Stonehenge visitors, road users, and the UK resident general population (aged 16 and over). Individual mean WTP and WTA values, as well as the number of zero responses, are in line with comparable results from heritage studies in the UK and international studies of World Heritage Sites. Validity tests show that WTP values are consistent with theoretically consistent drivers of value (Bateman et al. 2002), with additional sensitivity analyses performed on respondent certainty levels. Surveys were carefully designed following best practice to reduce known biases in CV surveys (Bakhshi et al. 2015).

1.1.18 While the values elicited in this study cannot be directly translated into cashable benefits, they represent the value that the improvements achieved by the road scheme will have for users and non-users of the WHS. They therefore

form a key component of the overall cost-benefit analysis of this scheme. They have been conducted in strict adherence to the Green Book guidance on appraisal and evaluation.

1.1.19 The comparison of these aggregate values with the earlier CV study that valued the benefits of removing the A303 and placing it in a tunnel in the Stonehenge WHS, by Maddison and Mourato (2001), shows comparable values once inflation, growth and factors specific to the studies such as survey mode are accounted for. This adds to the validity of the values in this CV study.

# 2 Introduction

## 2.1 Background

2.1.1 Stonehenge in Wiltshire is one of the best-known and most important archaeological sites in the world. The Stonehenge part of the Stonehenge and Avebury World Heritage Site (WHS) covers around 26km$^2$. Stonehenge is the most recognised monument, but the wider landscape contains features of similar archaeological importance. The site currently suffers considerable intrusion in the form of the A303 road, which passes within 165 metres of the famous stone circle and cuts through some other features of the WHS such as The Avenue.[4] The Government has committed to improving the A303 between Amesbury and Berwick Down and, in doing so, reducing the impact of the road on the WHS. However, the current road layout also provides the public with a view of the stone circle from the road. As a result, a full CBA of the proposed policy is required.

2.1.2 Highways England is currently progressing through the options identification and selection stage of the road scheme. Options considered included the diversion of the A303 away from the Stonehenge monument, either through a tunnel or via a bypass. In January 2017, Highways England commenced a consultation on their plans for the Scheme. Highways England's proposed solution is to build a 1.8 mile (2.9 kilometre) tunnel under the World Heritage Site (WHS). Diverting the road away from Stonehenge would reduce the noise, visual intrusion and the landscape severance that results from the existing route, whilst increasing tranquillity.

## 2.2 Objectives

2.2.1 The unique nature of the A303 Stonehenge project, creates a significant challenge to appraisers when considering the value for money of the scheme. Impacts on the WHS are clearly central to the development and identification of a preferred scenario for the scheme. The objective of enhancing and protecting the WHS is likely to result in higher construction costs than for a 'typical' highway improvement project. Whilst it is reasonably easy to quantify construction costs, it is much more challenging to quantify some of the key potential benefits of the scheme. In this context, there is a possibility, therefore, that the cost-benefit analysis of the scheme provides a skewed picture of value for money with the potential benefits being under-represented.

2.2.2 According to Government guidance every large spending proposal such as this requires a full business case.[5] Such a business case aims to set out the full benefits and costs of a spending project to enable the decision makers to take full account of the impact of a project. This study is part of a wider business case for a proposed change in the road layout of the A303. In particular, this study considers the impact of the proposed change on the heritage experience

[4] More detail can be found on http://www.english-heritage.org.uk/visit/places/stonehenge/?gclid=CPTh-amOqdACFUHGGwodrCEBpQ&gclsrc=aw.ds

[5] For more detail on the business case process see: Public sector business cases using the five case model (HM Treasury 2013).

and non-use heritage values. Other impacts (such as economic and environmental) are considered in the overall business case and use the methods described in the DfT's transport appraisal guidance (WebTAG). This study is carefully designed to exclude those other impacts to avoid double counting. For example, if respondents include the reduction in the journey time along the A303, once it has been moved into a tunnel, into their WTP value, this would be counted twice because time benefits are picked up in the WebTAG assessment as part of the wider cost-benefit analysis. Figure 1 illustrates how these considerations fit together. This study attempts to focus exclusively on the cultural heritage impacts of removing the A303 from its current location within the WHS in terms of noise reduction, increased tranquillity, visual amenity and reduced landscape severance.[6] Impacts of a project such as this are complex. At the time of this study comprehensive information on the routing of the tunnel and its portals was not available. The construction of a tunnel is likely to have impacts on other elements of the WHS, most of which may not even be visible in the current state. While the removal of the A303 will increase the tranquillity and visual amenity around the WHS its further impacts may become apparent while exploratory work is conducted. These archaeological impacts are outside of the scope of this study but will be addressed in the consultation process.

2.2.3 The aim of this research is to produce a set of robust and defensible estimates for non-market benefits associated with the removal of the A303 from its current location within the Stonehenge WHS (hereon, 'the road scheme'). Simetrica was commissioned by AAJV (Arup Atkins Joint Venture) on behalf of Highways England to conduct this study. The Simetrica project team consisted of [redacted] Director, [redacted] (London School of Economics and Simetrica), [redacted], [redacted], [redacted], [redacted], [redacted] and [redacted] The study builds on Susana Mourato's previous study in 1998 published in 2001 . All survey materials were reviewed and approved by a project steering group, including members of Highways England, DfT, Defra, English Heritage, Natural England, and Historic England.

2.2.4 HM Treasury's Green Book is founded on the economic concept of cost-benefit analysis (CBA). What distinguishes economic approaches to appraisal and evaluation is that the outcomes of an action are what matter, and these outcomes are measured ultimately in terms of their welfare implications.

2.2.5 There are two ways of converting an impact on welfare into a monetary figure, which enables different policies to be appraised and evaluated on a consistent basis: **Compensating surplus (CS)** is the amount of money, paid or received, that will leave the agent in their initial welfare position following a change in the good; and **Equivalent surplus (ES)** is the amount of money, to be paid or received, that will leave the agent in their subsequent welfare position in absence of a change in the good. CS can be interpreted in terms of people's **willingness to pay (WTP)** for welfare-enhancing outcomes and **willingness to accept (WTA)** welfare-decreasing outcomes. In contrast, ES can be

[6] Willingness to pay studies can be subject to biases, including strategic bias. See section 4.2 for details on potential biases and how they have been addressed in this study.

interpreted as peoples' **WTA to forego** a welfare enhancing outcome and **WTP to avoid welfare-decreasing** outcomes.

2.2.6 Where market prices do not exist for goods and services (termed 'non-market' goods) economists have traditionally turned to direct elicitation of WTP and WTA through non-market valuation methods such as survey-based **stated preference** valuation methods (HM Treasury 2011). The **contingent valuation method (CV)** is a stated preference survey-based methodology that seeks to elicit monetary values for non-market goods by directly asking individuals about their willingness to pay or willingness to accept compensation for a particular change (Bateman et al. 2002). Respondents are presented with a hypothetical market that describes in detail the proposed change under valuation, using baseline conditions as a reference point. The hypothetical scenario must be understandable, plausible, and meaningful to respondents so that they can give valid and reliable values despite possible lack of experience with one or more aspects of the scenario (Mitchell and Carson, 1989). Respondents are then asked how much they would be prepared to pay or accept for the change described.

2.2.7 The methods used for this study were subject to a review process by analysts from Highways England and the DfT and were discussed with an independent peer reviewer, Professor Danny Campbell from Stirling University.

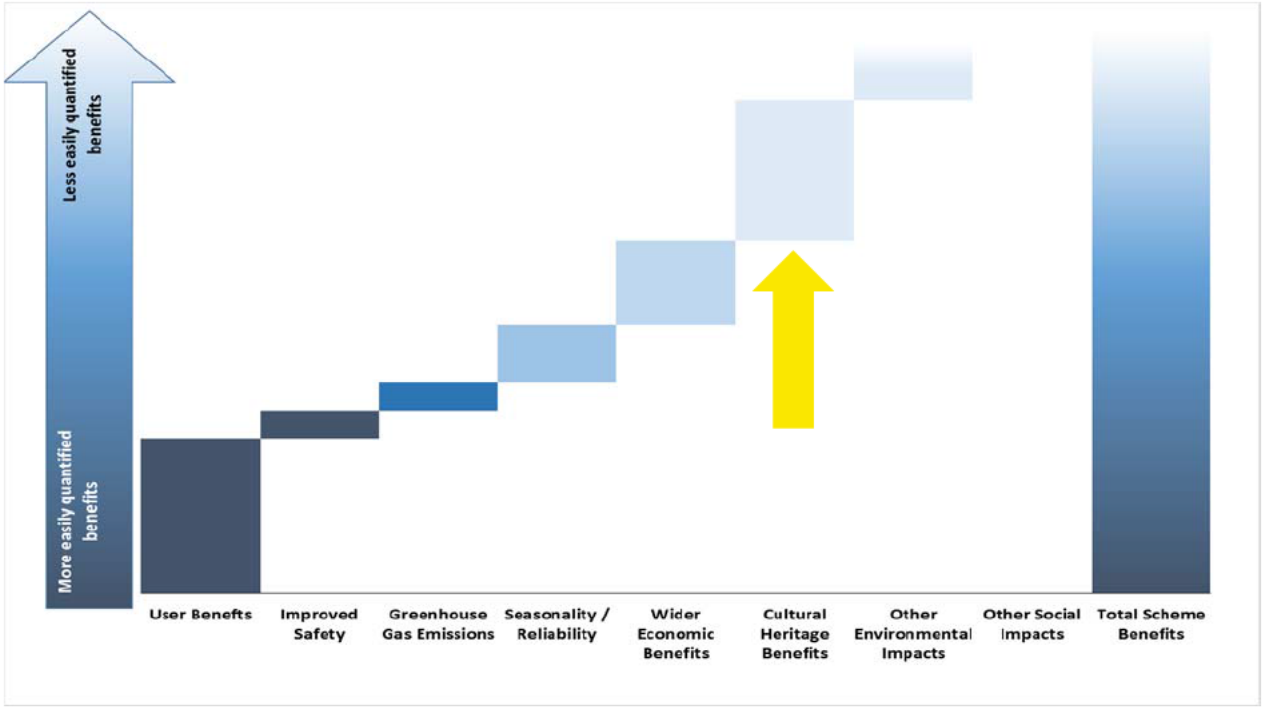


**Figure 1 Benefits assessed in the A303 business case**

*Note: the size of the bars in this figure are examples of the size of the impact and are not based on data. The yellow arrow indicates the specific benefits considered by the study.*

# 3 Literature review

## 3.1 Contingent valuation studies of road schemes

3.1.1 The key piece of research which guides this study is a contingent valuation study which assessed the heritage value of the removal of two roads – the A344 and the A303 – within the Stonehenge WHS, conducted by Maddison and Mourato (2001b). The data was collected in 1998 on a face-to-face basis, both on site and in households across the country.[7] Respondents were asked to consider their WTP for the change or WTP to retain the status quo situation, in terms of a household tax. The net weighted average value was then aggregated using the total number of households in the UK. The majority of respondents (by a narrow margin) in 1998 would prefer to retain the existing scenario, but of these the majority did not express a positive WTP to retain it. Those who preferred the construction of the tunnel had higher levels of positive WTP. This study design was partly used as a benchmark for the current study. The net aggregate WTP for replacing the A303 with the construction of a tunnel was £149m. Appendix B explains the difference in the total valuation to our study. The main reasons for this difference are subsequent levels of inflation and that aggregation occurred on the household rather than individual level.[8] In addition, the CV method has been developed further and the use of online panels via the internet allows for significantly larger surveys making studies more robust.

3.1.2 Sieber and Melichar (2014) used the CV method in their valuation of a road improvement in the Czech Republic. They focussed on one particular aspect of the road improvement – reduction of noise – and had to ensure that the information provided to survey respondents ensured this focus. The validity tests conducted showed that variability of WTP accorded with theoretically consistent drivers, such as demographic characteristics and where people lived. Mean WTP was estimated at 98 Koruna, which converts to £2.98 at 2015 prices.

## 3.2 Contingent valuation studies of cultural heritage

3.2.1 This project is not just concerned with the valuation of a road scheme in general but the impact of a road on cultural heritage. The A303 Stonehenge scheme is unique in that it seeks, as a key objective, to enhance a heritage assets. To assess these multifaceted effects, we also reviewed the literature on cultural heritage. Contingent valuation studies have been applied to a wide range of heritage sites within the UK (Willis 1994; Eftec 2005), Europe (Mourato et al. 2014; Mourato et al. 2002; Del Saz Salazar and Montagud Marques 2005; Ruijgrok 2006), and beyond (Kim et al. 2007; Lee 2014; Báez-Montenegro et al. 2012),

[7] The A344 was removed in 2013. Part of the old road is now used as a footpath, the rest has been completely removed and grassed over.
[8] The literature on aggregating contingent valuation upon review, points in the direction of aggregating on an individual level.

3.2.2 In 2003, Noonan (2003) provided a review of the state-of-the-art CV methods in the cultural and heritage sector. Noonan considered 116 studies which used CV or Dichotomous Choice Experiments (DCE) and assessed the differences in methods with respect to their impact on WTP. Of 53 CV studies of cultural sites published at the time, five were related to heritage sites (Boxall et al. 2003; Mourato et al. 2002; Creigh-Tyte 2000; Eftec 2005; Lockwood 1996) and 19 to historical sites (Noonan, 2003). The most common form of payment mechanism used across all studies were payment card and dichotomous choice methods.[9] Noonan showed that, in 2003, the UK was one of the leaders in applying CV studies to assess the value of cultural goods, just behind the US.

3.2.3 In 2014 Bakhshi, Fujiwara, Mourato, Lawton and Dolan conducted a CV study of cultural heritage in the UK focussing on museums and galleries (Bakhshi et al. 2015). This report also updated Noonan's literature review related to museums and galleries. The authors undertook an explicit comparison between two methods of economic valuation: contingent valuation (CV) and subjective wellbeing valuation (SWV). The study found that CV performed well in measuring use and non-use/option values for cultural institutions, when undertaken using best-practice techniques for addressing well-known biases and implementation challenges. It demonstrated once more that CV can be a useful tool in assessing the value that cultural heritage creates, in the absence of markets, producing very realistic values. It should be noted that, in the current study, subjective well-being valuation would not have been suitable because it is based on experienced utility, requiring participants to experience both the current road and the tunnel options and compare their well-being. This is clearly not feasible in this case.

3.2.4 A persistent problem in CV studies is that estimates of WTA typically exceed that of WTP, which violates the underlying theory of economic preference satisfaction (Hausman 2012). Bakhshi et al. (2015) elicit the value of avoiding the closure of a cultural institution (with case studies of London's Natural History Museum and the Tate Liverpool gallery) for one year using a WTA approach, via a one-off cash compensation. The authors define this mostly as a use value and an option value, as closure would prevent access and future access to the institution but not, say, on-going research and conservation. The study addresses the well-known WTP-WTA disparity (Horowitz and McConnell 2002; Shogren et al. 1994), often described as an endowment effect, whereby people ascribe more value to things merely because they own them (Daniel Kahneman and Tversky 1979; Loewenstein and Adler 1995). The study addresses this by assessing whether constraining the WTA scenario by setting it explicitly in the context of changes in life satisfaction produces reasonable WTA values relative to WTP. The hypothesized mechanism for this is that respondents are asked explicitly to think about the WTA question within the framework of economic theory, i.e. they are compensated directly for changes in their welfare, in this case life satisfaction. Importantly, compensation is only offered for those that say their life satisfaction would be negatively affected in the first place, from the institutional closure. The study finds that the hybrid

[9] More detail on the reasons for choosing CV compared to Dichotomous Choice Experiments in section 6.

wellbeing-contingent valuation WTA approach, based on life satisfaction and combining elements of both CV and SWV, delivers plausible values.

3.2.5 The Stonehenge WHS is listed in the UNESCO's list of World Heritage Sites. Sites included in this list must be of outstanding universal value.[10] We reviewed some of the literature which considered other WHS. Tuan and Navrud (2007) conduct a study valuing the My Son WHS in Vietnam (a large complex of religious temples). They focus on the international relevance of this WHS to residents and foreign visitors in order to estimate benefits for visitors and assess optimal entrance fees to maximize revenues for the site. They are able to demonstrate the applicability of the CV method to value these sites by comparing CV results with the results of choice modelling, which reflects the same underlying preference structures. The mean WTP for preserving the My Son WHS in Vietnam (a large complex of religious temples) was about US$7 per adult foreign visitor, as a one-time increase in entrance fee, and about US$2 per household in the region, as a one-time local tax.

3.2.6 Kim et al. (2007) estimate use value of a WHS in Korea using a dichotomous choice CV. The study explicitly stated that the WHS status of the site recognised it as a representative heritage resource "indicating excellence of Korean national tradition and culture". The results from this study revealed the economic value of the World Heritage Site to domestic users or tourists in levels exceeding its financial benefits. The mean WTP values were 5706 Won ($5.70) in a log-linear model, and 6005 Won ($6.00) in a log-logit model. Taking into account only domestic visitors, the aggregate use value from the log-linear model was estimated to be approximately US$1.93 million (at 2007 prices), while the aggregate use value from the log-logit model was estimated as US$2.01 million.

3.2.7 More recently, Mourato et al. (2014) elicited visitor (UK resident and foreign) and general population WTP to support conservation and maintenance of built heritage interiors from climate change damage in the UK. Visitors to three heritage sites (Ham House, Knole House, and St Joseph and the English Martyrs Roman Catholic Church) were surveyed using a payment card mechanism, as part of a wider benefits transfer study of ten heritage sites in the European Union (EU). A top-up entry fee mechanism was used in the case of visitors to Ham and Knole, and an annual donation was adopted in the case of the parishioners visiting St Joseph's Church. The general population surveys focused on the protection of all built heritage interiors in the UK and used and annual tax payment mechanism. Mean WTP a top-up entry fee for Ham House and Knole was £2.46 and £2.47, respectively. Mean WTP for St. Joseph's Church was £24.12, as a yearly donation. Mean WTP annual taxes for the protection of all built heritage interiors in the UK was £33.40 for the general population.

3.2.8 A further challenge to valuing the heritage impact of a road is the size of the site. As outlined in the introduction, it is not just the stone circle's value that might be affected by the road options but also the value of the site surrounding

[10] Selection criteria for UNESCO WHS are listed on the UNESCO's website: http://whc.unesco.org/en/criteria/

it which includes ‘the Avenue’, currently severed by the A303, and a number of other monuments and burial sites. One relevant study is the valuation of the setting of the ancient city of Valdivia in Chile (Báez and Herrero 2012). The authors use a CV approach with a clear description of the whole site. Baez and Herrero include foreign tourists in the valuation. The mean WTP for each tourist is 6,558 Chilean pesos (£7.93). This value reflects each tourist’s mean willingness to pay for the guided walking tour, and is taken as an estimation of the direct use value of Valdivia’s historical heritage, rather than the heritage impacts of a road. However, their study is of interest because it values an existing man-made structure, over a considerable area of land and combines the results of the CV study with a wider cost-benefit-analysis.

## 3.3 Summary

3.3.1 The studies we reviewed support the choice of the CV method in the case of a complex valuation project such as the heritage impact of the removal of the A303 from the WHS of Stonehenge and Avebury. We see that previous CV studies on UNESCO WHS in developing countries have focussed on the international relevance to both resident and foreign visitors. However, the focus in these studies was on maximising potential revenue for the sites. In the overwhelming majority of studies of cultural heritage, measures of WTP have been elicited; Bakhshi et al. (2015) is a notable exception, with their estimation of WTA, using the hybrid CV-SWV method.

3.3.2 The key piece of research which guides this study is Maddison and Mourato’s (2001) CV study of the heritage value of the removal of two roads - the A344 and the A303 - within the Stonehenge WHS. We note that Maddison and Mourato considered the removal of two roads at the time but the A344 has since been removed. The study assumed a two-year period of payments, did not include a road user sample, and included foreign visitors within the survey. Given the long time period since the Maddison and Mourato study, it is not possible to simply ‘uprate’ these values to 2016 prices. Significant changes have since occurred in the Stonehenge site (with the removal of the A344 road and the construction of the new visitor centre); there have been changes in the tunnel project (which is no longer 2km as in 1998, but almost 3km); and, more generally, there have been many societal changes that might affect preferences and values (e.g. financial crisis, Brexit).

3.3.3 The most recent UK heritage valuation studies are contained in the Mourato et al. (2014) benefits transfer study. WTP ranges from £2.46 to £33.40. We note that this study used top-up entry fees, donations and taxes, and elicited values for sites of regional or local importance, in contrast to the broader international relevance of a WHS. This study also valued a very different good (changes to case study interiors) compared to removal of a main road from within a WHS.

3.3.4 The studies presented here outline the complexities for the contingent valuation of cultural heritage, but also highlight the flexibility of the CV method to isolate a particular aspect of a road programme or site to assess. The most relevant study for the present valuation study is the Maddison and Mourato (2001) study which elicited WTP in form of a tax to support the removal of the A303 and A344 roads from the Stonehenge WHS.

3.3.5 The Bakhshi et al. (2015) study provides the most relevant methodological structure to guide the current survey design. This study has been recommended as best practice for CV valuation in the cultural sector by the Department for Culture Media and Sport (DCMS) and the Arts and Humanities Research Council (AHRC).[11] In addition, the Bakhshi et al. study provides a novel hybrid wellbeing-contingent valuation WTA question that has been found to reduce the well-known disparity between WTA and WTP.

[11] http://www.ahrc.ac.uk/newsevents/news/the-individual-experience-at-the-heart-of-cultural-value/

# 4 Valuation Method

## 4.1 Stated preference methods

4.1.1 Stated preference methods such as contingent valuation (CV) and discrete choice experiments (DCE) are recommended methods in the HM Treasury Green Book. DCE is applied by economists in situations that are multi-dimensional in nature and where it is important to find the value attached to the various dimensions of interest. Respondents are presented with a series of policy scenarios, grouped into 'choice sets' that describe the alternatives on offer. Respondents are then asked to identify their most preferred scenario, amongst the scenarios contained in a choice set. Willingness to pay (or to accept) is therefore inferred indirectly by analysing the choices and trade-offs made between the various attributes.

4.1.2 Contingent valuation (CV) surveys elicit the monetary value of non-market goods and services (measured as CS or ES, recall section 2.2) by directly asking people what value they attach to them (Bateman et al. 2002).[12] By means of an appropriately designed questionnaire, a hypothetical market is described where the good or service in question can be traded. A sample of people (representative of the population of interest) are then directly asked about their WTP or WTA for a change in the level of provision of the good or service. CV is used to value full policy changes rather than changes in specific attributes of a policy or good (e.g. full change (removal) of the A303 from part of the WHS) rather than questions about attributes of the road scheme (e.g. width of the road or where the portals of the tunnel should be situated). For a review of the advantages and disadvantages of DCE vis-à-vis CV see Hanley, Mourato and Wright (2001).

4.1.3 In sum, we do not apply DCE in the current study for two main reasons. First, DCE is aimed at valuing attributes rather than complete policy changes and in the current study we are interested in the overall value of the road scheme rather than the values of their constituent parts and CV, rather than DCE, is designed to pick up overall value. Second, in the case of the A303 the hypothetical road scheme (and attributes associated with it) are fixed and it would not make sense to vary the level of the attributes (many of the attribute combinations would not be possible). Therefore, DCE is not a suitable valuation method for the removal of the A303 into a tunnel and CV presents itself as the best available method for this study.

4.1.4 In line with standard economic theory, WTP and WTA when correctly elicited from CV (i.e. they are unbiased estimates) map onto the technically correct CS and ES measures of welfare change as follows:

[12] Bateman, I. J., Carson, R. T., Day, B., Hanemann, M., Hanley, N., Hett, T., et al. (2002). Economic Valuation with Stated Preference Techniques: A Manual. Cheltenham, UK: Edward Elgar.

| | Compensating surplus | Equivalent surplus |
|---|---|---|
| Welfare gain | *WTP for the positive change* | *WTA to forego the positive change* |
| Welfare loss | *WTA the negative change* | *WTP to avoid the negative change* |

4.1.5 In the context of this study people who value the removal of the road will have a positive WTP value, whilst people who value the road as it currently is will have a non-positive WTA value.

4.1.6 We measure welfare changes (both losses and gains) as compensating surplus (CS) measures. There is some debate as to what measure of welfare change is appropriate to use in CBA and CV since a given welfare gain or loss can be framed both in terms of CS and ES and the results will not always be the same. Due to issues related to budget constraints, substitution effects and the endowment effect, CS for a welfare loss can be much higher than the ES for the same welfare loss (Ericson and Fuster 2014; Brown and Gregory 1999). This is known as the WTP-WTA disparity and WTA has been found to be up to seven times larger than WTP (to avoid) for the same outcome (Horowitz and McConnell 2002). It is fairly typical to use CS for both welfare losses and gains in CBA (US EPA 2000) but the WTP-WTA disparity must be dealt with. One possible method for dealing with this is to downward calibrate WTA figures by WTA-WTP ratios identified in the literature (see Horowitz and McConnell 2002). As noted above, we use a different approach here whereby we employ a hybrid wellbeing-contingent valuation WTA question developed by our research team for the Arts and Humanities Research Council (AHRC) economic valuation of the Natural History Museum and Tate Liverpool to elicit WTA compensation for removal of the A303 via a one-off cash compensation (Bakhshi et al. 2015).

4.1.7 The hybrid method asks respondents to think explicitly about compensation in terms of compensating for their welfare losses (in terms of changes in their wellbeing). The hybrid contingent-wellbeing valuation WTA has been shown to reduce the well-known disparity between WTP and WTA for two studies of cultural institutions (Bakhshi et al. 2015). In sum, the hybrid WTA method is employed here for welfare losses (those that value maintaining the A303 road in its current location) so that CS measures for welfare gains and losses can be measured and aggregated consistently.

4.1.8 Finally, CV questionnaires also contain a wealth of additional questions to gain information on a respondent's socio-demographic characteristics, their attitudes towards the good, and the reasons behind their stated valuations. The responses to these questions are typically used to model the determinants of WTP (or WTA). In particular, the importance of income as a driver of WTP relates to: (i) the marginal utility of income, such that each additional pound has greater value for those on a lower income, meaning that higher income groups are willing (able) to pay more for the same welfare gain, and; (ii) the capping effect of income, which constrains budgets and reduces the amount that a low income respondent is able to pay. For extensive discussion of income effects see Horowitz and McConnell (2002).

## 4.2 Contingent Valuation: Methodology

4.2.1 We outline below the main elements of our CV design, in terms of elicitation method (the type of question used to elicit monetary values), measurement of use and non-use values, choice of payment vehicle (the hypothetical means by which payments will be made, such as taxes, donations, and entry fees), and bias reduction strategies.

**Elicitation method**

4.2.2 The valuation questions can be presented in a number of different ways, including open-ended, bidding game, payment card, and dichotomous choice elicitation formats.

4.2.3 **Open-ended questions** represent the simplest direct elicitation technique where respondents simply state the amount they would be willing to pay. However, a number of problems have been associated with this technique, including large non-response rates, protest bids, and outliers that skew the data (Bateman et al. 2002; Mitchell and Carson 1989). At the opposite end of the spectrum, **single-bounded dichotomous choice questions** allow the researcher to randomly present a monetary figure to the respondent (Arrow and Solow 1993). This simplifies the cognitive task and is thought to provide incentives for truthful revelation of WTP (if their WTP is higher, say, than the amount offered, it is in their interest to accept this value). However, this approach may also encourage a larger number of protest bids than open-ended mechanisms. It also provides data only in a range above or below which we can be certain the respondent is willing to pay. **Double-bounded dichotomous choice** improves on this method by asking a follow-up question: if the respondent indicates that they would pay the initial amount (e.g., £2), would they pay the next amount up (i.e. £3)? Alternatively, if the respondent indicated that they would not pay the initial amount of £2, would they be willing to pay the next amount down (i.e., £1)? Although this improves on the single-bounded dichotomous choice approach, both mechanisms introduce so-called anchoring bias, by suggesting to the respondent the appropriate range of values to be elicited (Arrow and Solow 1993). **Payment card** approaches present respondents with a range of monetary amounts from which they are asked to pick their willingness to pay. This eliminates anchoring (and starting point) bias and provides a visual aid to the cognitive process of valuing the good (Bateman et al. 2002; Maddison and Foster 2003; Maddison and Mourato 2001b). However, this approach is in turn vulnerable to range bias, whereby respondents may scale their responses to the range of numbers they are presented with (Whynes, Wolstenholme, and Frew 2004). To reduce the effect of range bias we tested the value ranges in the payment card in the pilot surveys (see below) and also included an open-ended ‘other amount’ option.

4.2.4 Dichotomous choice (DC) elicitation methods are more consistent with welfare economic theory, in terms of mimicking consumer experience and incentivising truth telling. However, DC requires a large enough sample size to provide at least 100 respondents per bid level. For a sample of n=400 this would provide only 4 bid levels. Moreover, if we have a high proportion of respondents with a zero WTP (as in the Bakhshi et al. 2015 cultural valuation study), this will

further reduce the subsample answering the dichotomous choice question, which is problematic.

4.2.5 Given the particular characteristics of this study we decided to use a **payment card method** for both the tunnel and status quo valuations. The payment card method provides a balance the theoretical ideal with the practical constraints of the project (specifically, the small sample size, limited piloting time, and potentially high zero response) (Bateman et al., 2002).

**Use and non-use values**

4.2.6 The key methodological advantage of CV over other non-market valuation approaches such as revealed preference methods is that it can measure values and benefits that would not be revealed under market conditions, such as *non-use* values. Importantly, it also offers the opportunity to measure benefits associated with changes that have not yet happened, that is, *future* changes.

4.2.7 In this case **use values** stem from those visiting the site, those travelling on the A303 and viewing the site from the road, and those who experience Stonehenge remotely via other media (internet, film, books, photographs, social media, etc.) Use values can include an option value for those deriving value from the possibility of using Stonehenge in the future. **Non-use values** are made up of: *altruistic values* – welfare increases from knowing that others living will benefit; *bequest values* – welfare increases from knowing that future generations will benefit; and *existence values* – welfare changes from knowing that the road layout within the Stonehenge WHS has been changed (even if an individual does not experience the changed road lay out now or in the future). It is likely that some people who have not visited and will not ever visit Stonehenge, or even engage with it remotely (e.g. through media), will nonetheless value the positive effects of the road layout scenarios if this improves experiences for visitors and others who care about Stonehenge. By the same token, non-users may value the positive effects for road users of maintaining the current road lay out within the WHS.

4.2.8 We note that although valuation distinctions (between use and non-use) exist, it is very difficult to disentangle the different components of value from people's stated WTP and WTA values. This is because whilst non-use value can be ascertained from non-users (alongside possible option values for future use), users will typically hold both use and non-use value for the non-market good, and both of these contribute to their overall WTP/WTA responses. Therefore, it is not possible to distinguish between use and non-use value in the responses of visitors to Stonehenge or users of the A303.

**Elicitation of values**

4.2.9 A range of hypothetical scenarios and payment vehicles that have been applied in previous studies were considered for the Stonehenge WHS WTP question. We outline below the advantages and disadvantages of each:

a) Increased **entrance charge** to Stonehenge: **Advantages**: Compulsory, incentive compatible payment mechanism.

**Disadvantages**: Misleading because a national road scheme is not just paid for by visitors to Stonehenge.

b) **Voluntary donation**: **Advantages**: Applicable to all survey populations. **Disadvantages**: Donations and other voluntary payment vehicles can lead to 'free-riding', as people are aware that they do not have to pay a donation to gain the benefit so long as others are willing to pay.
c) **Annual tax**: **Advantage**: Compulsory, incentive compatible, and applicable to all survey samples. **Disadvantage**: Taxable period has to be constrained, for example, to apply only over the period of tunnel construction.
d) **One-off tax**: **Advantages**: Compulsory, incentive compatible, and applicable to all survey samples. **Disadvantages**: One-off tax is unrealistic, because the costs occur over a number of years while the tunnel is constructed and the public do not realistically ever pay a one-off tax.
e) **Road tax**: **Advantages**: Compulsory, incentive compatible. **Disadvantages**: Open to protest responses, because those who drive may feel they should not bear all of the cost, while those who do not are able to free-ride.
f) **Road toll.** As above for Road tax.

4.2.10 The final payment vehicle used in the scenario of WTP for the construction of a tunnel to replace the A303 is a hypothetical increase in an individual's **annual national tax**. The project team and external peer reviewer were in agreement that a **non-voluntary national tax increase over three years** is the most realistic payment vehicle option for this survey, and the least likely to be subject to free-rider and hypothetical bias. The payment of the tax over three years reflects the expected construction time of the alternative tunnel option and hence realistically links increased tax payment with the costs of the road works. It is also a time horizon that respondents are arguably used to considering in their own private planning, without being unrealistically short, as a one-off payment would have been, or too long, as an unlimited tax would have been.

4.2.11 For those respondents who value the current status quo of keeping the road in its current location we employ a hybrid subjective wellbeing-contingent valuation WTA question, framed as a hypothetical one-off cash compensation payment. Given that the change (removal of the road) happens at one point in time, it is assumed that the compensation demanded to restore the individual to their initial welfare position (compensating surplus) is evaluated across the life course, and not as a continuous payment. This also accounts for adaptation effects, whereby individuals adapt for losses in their life and return to close to their original welfare position over a certain period of time, depending on the magnitude of the loss (Frederick and Loewenstein 1999).

**Bias reduction**

4.2.12 There are a number of well-known potential biases in CV that can be problematic if not adequately addressed in the survey instrument and analysis (Bateman et al. 2002; Pearce, Atkinson, and Mourato 2006). These include:

**hypothetical bias**, where respondents overstate the amount they are willing to pay in the hypothetical situation, in relation to what they would pay in reality; **insensitivity to scope**, where WTP is insensitive to the scope of the proposed change; **focusing bias** where the survey focuses respondents attention on the scenario in a way that does not reflect how people would actually experience these conditions or states in real life; **protest values**, where respondents have a principled objection to providing a monetary value; **framing and information bias** when people react to information in different ways depending on how it is presented and on the level of detail provided in the information; and **strategic bias**, where respondents seek to 'game' the study by providing values that they think will influence an actual resource allocation recommendation. Finally, **differences between WTP and WTA** can also occur, which violates the underlying theory of economic preference satisfaction (Hausman 2012). We outline below the main types bias that we expect might affect the current study, and the best-practice measures taken to deal with them.

4.2.13 **Strategic bias** refers to the act of when someone wishes to preserve a status quo or to achieve a specific change and purposefully influences the survey results (e.g. by stating an extremely high or low WTP/WTA value) in order to help achieve their wish. Strategic bias can, therefore, lead to over or under statement of WTP or WTA (Throsby and Withers 1986). The results in this study could have been affected by a number of different strategic biases, some of them balancing each other out. For example, respondents who want to preserve the status quo might have been tempted to exaggerate the necessary compensation and those who feel strongly about the need to remove the road may give an exaggerated WTP. The payment cards were capped at £200 and open-end responses above £250 were removed as unrealistically high and indicators of strategic bidding (see section 6.1 for discussion of rationale for excluding respondents from the study samples).

4.2.14 Strategic bias can also manifest in the self-selection into the survey of types of individuals seeking to influence the results. Ipsos Mori interviewers addressed this through measures to reduce the risk of self-selection by individuals aiming to influence the survey (choosing every third person exiting the site and avoiding those who directly approached them (this did not occur)).

4.2.15 For online surveys, we removed respondents who completed the survey quickly ('speedsters', see section 6.1). Speedsters are removed on the assumption that they are completing the survey for strategic purposes (for example monetary or political incentives), or a lack of understanding/ interest encouraging quick completion and are not giving fully considered and truthful answers.

4.2.16 **Framing and information bias** refer to the issue of when people react to information in different ways depending on how it is presented and on the level of detail provided in the information. The way the information is provided in a CV survey, therefore, has the potential to impact on WTP/WTA results. With this in mind, the information provided in our surveys was clearly set out in a neutral manner, describing both the positive and negative effects of the different road options.

4.2.17 The information provided in the surveys was tested within all three surveys during the pilots to ensure it was sufficiently clear to allow respondents to answer the questions (Ajzen, Brown, and Rosenthal 1996). During the pilot, we asked whether respondents felt the information was easy to understand and which benefits would arise from the road. This question tested whether they had understood the information at hand and whether they had been able to isolate the heritage effect within the survey (i.e., whether they were stating WTP for heritage effects or for aspects of road use, safety, travel time).

4.2.18 A bias caused by **insensitivity to scope** means that respondents are not responsive to the characteristics of the good valued (Carson 1997). Some degree of insensitivity to scope might have occurred when using CV to value different designs of the tunnel, with different lengths, different types of entrances and so on. However, here we just focus on a single generic 2.9 km tunnel, without providing a detailed description of its particular features. Insensitivity of scope should therefore be less of an issue.

4.2.19 We also asked respondents about their motivations for not being willing to pay/accept. This allows us to identify potential **protest** bids associated with the information or tax payment vehicle presented, which provides us with more confidence that respondents' stated values reflect the values they place in the heritage aspects of the road scheme.

4.2.20 **Focusing bias** occurs in CV studies when at the time of preference elicitation people are focusing only on the salient aspects of the condition or issue at hand (i.e. the road options) and this may not reflect in any way how people would actually experience these conditions or states in real life (Kahneman et al. 2006; Schkade and Kahneman 1998). This can lead to an overstatement of their WTP or WTA values.

4.2.21 We addressed the potential for focusing bias in our surveys through use of reminder statements and information about other service providers to ensure that respondents give full consideration to *substitutes*; and highlight other possible uses of an individual's time and money so that the value of the presence/absence of the A303 within the Stonehenge WHS is conceived of in the wider context of people's lives, experiences, and available budget, helping to avoid focussing biases.

4.2.22 The criticism of CV that has perhaps received greatest attention is **hypothetical bias** (Arrow and Solow 1993; Champ and Bishop 2001; Hausman 2012), where individuals' stated WTP may be significantly larger than actual WTP due to the hypothetical nature of the survey. This arises mostly when a *voluntary payment mechanism* is used. In the case of this study respondents had to compare the real situation of the existing road with a hypothetical situation of a tunnel with limited information on its position. The information provided to respondents included photoshopped images of the site without the road, but not of the potential tunnel portals.

4.2.23 To address this we included a certainty question in the surveys (e.g. "How certain are you that you would really pay the amount indicated if asked?") (Champ and Bishop 2001). This allows us to provide sensitivity analysis on

alternative levels of WTP associated with certainty of response, which is recommended when CV results are used in CBA (Haab et al. 2013). We aimed to use a payment vehicle which was as realistic as possible, a national tax over three years. We also use *cheap talk entreaties* (i.e. a script that explicitly describes this bias and asks respondents to avoid it) and *oath scripts* (i.e. asking respondents to agree to promise that they will respond to questions honestly), which were used effectively in our recent study for the AHRC (Bakhshi et al. 2015).

# 5 Contingent valuation methodology: design and implementation

## 5.1 Survey instrument

5.1.1 We applied best-practice methods for contingent valuation, developed from our review of the literature and our own prior work. We designed one on-site visitor survey and two online surveys of local road users and the UK general population. While international visitors and non-residents will also be affected by the changes, these are excluded from the valuation study in line with HM Treasury Green Book guidance.[13]

5.1.2 The Stonehenge visitor face-to-face survey was run in the field between 15th September and 7th October 2016. The road user survey was run online between 17th September and 3rd October 2016. The general population survey was run online between 22nd September and 5th October 2016. Each survey took about 15 to 20 minutes to complete. The initial number of respondents across all three surveys was 3,535. Survey instruments are provided in Appendix A.

5.1.3 We conducted three surveys on three sets of stakeholders who may be anticipated to hold different types of values for the hypothetical removal of the A303 from within part of the Stonehenge WHS (Figure 2). For instance, visitors and the general population may hold different use and non-use values for the Stonehenge WHS. Stonehenge is of national importance and well known and recognised across the UK. People who have never visited or seen Stonehenge are likely to have either learnt about it at school, seen it on national media or heard about it in another context. A WHS is a site of international significance and its maintenance is therefore of interest to the whole population. In addition, infrastructure investment such as the proposed tunnel will be funded from general taxation and is of interest to all taxpayers. People living in the area around Stonehenge may have different preferences for the road scheme associated with their higher frequency of using the A303 on a regular basis.

a) Visitors to the Stonehenge WHS (n=432): On-site face-to-face interviews (UK resident, aged 16+) estimating the following possible values associated with the removal of the road from the Stonehenge WHS:
   i. Direct use value
   ii. Non-use value (associated with effects on other cultural heritage within the Stonehenge WHS)
   iii. Use and option value for changes in the view of Stonehenge from the A303 between Amesbury and Berwick Down.

Road users (Local residents as proxy) (n=1,001): Online survey of people living within a 50-mile radius of Stonehenge with quotas on gender and age,

[13] The Green Book (page 21) recommends to assess impacts on foreign nationals separately where reasonable and if they affect the result of the appraisal overall. In this case conducting a survey of foreign visitors in potentially multiple languages would not have been reasonable given the time constraint. In addition, the payment method (see below) would have to be refined for foreign visitors who don't pay income tax in the UK. Impacts on local businesses affected by tourism should be addressed in a different part of the appraisal.

estimating the following possible values associated with the removal of the road from the Stonehenge WHS:

iv. Direct use value
v. Non-use value (associated with effects on other cultural heritage within the Stonehenge WHS)
vi. Use and option value for changes in the view of Stonehenge from the A303 between Amesbury and Berwick Down.

General population (n=2,102): On-line survey of people living in the UK (UK residents aged 16+, with quotas on age, gender, and region) estimating the following possible values associated with the removal of the road from the Stonehenge WHS:

vii. Non-use value;
viii. Use values for those who have visited the site recently or have photos of it;
ix. Option value for changes in the view of Stonehenge from the A303 between Amesbury and Berwick Down.

5.1.4 The three surveys used the same basic structure and were divided into three sections. Respondents were provided with information about the route of the tunnel and the expected impact of the scheme on the World Heritage Site (both positive and negative).

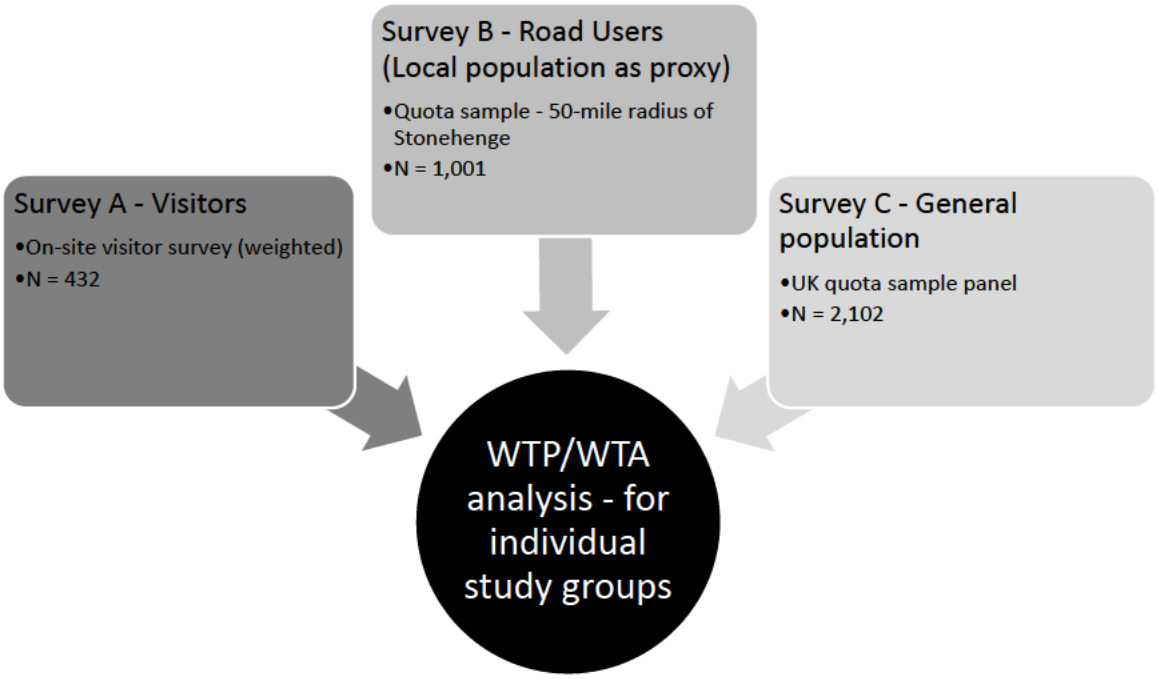


**Figure 2 WTP/WTA Surveys**

### Survey structures

5.1.5 Sample sizes are in line with existing UK Government guidance on stated preference surveys.[14] Following DfT guidance we set a target sample size of 400[15] for the visitor survey. This is within the lower range of sample size that is required for analysis of factors associated with WTP (socio-demographic factors, experience, visit behaviour etc.), but above the minimum n=300 sample size suggested in the literature for visitor samples of this size (given our estimate of 0.55m annual UK resident visitors to Stonehenge)[16].

5.1.6 For the face-to-face visitor surveys Ipsos Mori were chosen as the fieldwork provider because they have extensive experience in delivering complex fieldwork surveys to time and addressing issues such as non-response bias. Ipsos Mori applied loose quotas on gender and age based on other heritage sites.[17] Interviewer protocols were designed to avoid self-selection by strategic respondents (1 in every 3 were approached). We sought to reduce attrition during the survey by stating up front the length of the survey and offering shelter during the survey as well as an incentive of £5 for completion of the survey.

5.1.7 Online surveys were designed by Simetrica and delivered by the online panel provider Toluna. Toluna provide a representative online panel of the UK population, allowing quotas for age, gender, and region to be set at the local and national level. Sample selection is made randomly using the specified profile criteria. Panelists are awarded a small monetary incentive for each survey completed, and are restricted from taking the same survey more than once. Toluna takes account of predicted response rates by target demographic and country to avoid over-contacting panellists and to ensure that they do not introduce awareness bias in responses.[18]

5.1.8 The three surveys used the same basic structure and were divided into three sections (the questions in the valuation sections differed between the different surveys):

a) **Section A. Background questions on:** respondents' visit to Stonehenge (survey A only); travel; attitudes towards the existing

[14] Pearce and özdemiroglu (2002) provide guidance for the UK Government on estimating sample sizes for stated preference surveys (p45). Given that approximately 0.55million people visited Stonehenge in 2014, Assuming that 0.2 of the population is present in the true sample, a minimum sample size of around n=300 is required at the 5% confidence level. Pearce, D., & özdemiroglu, E. (2002). *Economic valuation with stated preference techniques*. London, UK: Department for Transport, Local Government and the Regions.
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191522/Economic_valuation_with_stated_preference_techniques.pdf

[15] The target sample size for the visitor survey was 400. Ipsos achieved 432 within the time available.

[16] English Heritage estimate annual visitor numbers to the Stonehenge site in 2015 of 1.3 million of which 540,000 are UK residents. Personal correspondence with English Heritage.

[17] A loose quota in the context of a face to face survey is a request to the interviewers to ensure they reflect some of the diversity of the audience, i.e. in this case the visitors to the site within the sample they are selecting. They are not required to exactly adhere to a specific percentage, but for example to make sure that they have about 50% men and 50% women in their sample.

[18] From (Toluna 2016)

road; experience of other heritage sites; and attitudes towards Stonehenge and heritage conservation.

b) **Section B. Contingent valuation**: Questions on willingness to pay for a road scheme to remove the A303 from its current location within the WHS; and the willingness to accept compensation for the removal of the road (see section 5.2 for full discussion of contingent valuation scenarios).
c) **Section C. Demographics:** Theoretical drivers of WTP/WTA developed from the literature, including income, education level, and labour force status (Bateman et al. 2002).

5.1.9 The information presented to respondents in CV surveys is important for the quality of the study (Boyle 2002). The layout, order in which information is presented and the quality of the information can affect the answers (For more information on bias reduction please see paragraphs under the Bias Reduction sub-section of section 4.2).

5.1.10 In this study, we also had to bear in mind that the design of the road was at a relatively early stage. For example, at the time of undertaking the research, the precise design and location of tunnel portals was yet to be determined. The survey therefore focused on the removal of the A303 and provided only limited information on precise alignment and design aspects of the tunnel. Due to the early stage of development of the scheme, respondents were shown the approximate position of the new tunnel portals and road leading up to the tunnel. The map provided and the description of the tunnel scenario in the questionnaire stated clearly that the tunnel portals and the new dual carriageway leading up to the tunnel would be within the WHS and would affect some elements within the site some of them not known. Whilst the precise location of the proposed scheme was not presented, the information was judged as being sufficient for respondents to consider the primary impacts of the scheme given the current state of information. This was confirmed by the results of the pilot study, in which the majority of respondents said that they felt that they had sufficient information to answer the questions.[19]

5.1.11 There was a degree of uncertainty as to the precise alignment and design of the road at the time the study was undertaken. This lack of information did not allow us to provide full information on the design and location of the portals to the survey respondents. The steering group discussed and agreed that further information would have been misleading because the heritage and archaeological impacts of the tunnel and its portals are not yet known. In practice, the impacts of the scheme on heritage and archaeology are highly complex and aspects of this require expert interpretation. As such, there are also practical barriers to the level of detail that can be provided to respondents. While this introduces additional elements of hypothetical bias, this was considered proportionate to the focus of the study on the visual amenity, noise reduction and reconnection of the landscape around Stonehenge.[20] Therefore, it should not be interpreted that this study captures or seeks to capture every aspect of the scheme's impacts on heritage and archaeology. As discussed in

[19] See Appendix C.
[20] See also section 2.2

section 2.2 the wider assessment of the scheme includes detailed archaeological investigation and expert heritage assessment.

5.1.12 The following information was provided as part of the survey material:

a) Current route and impacts of the A303 road (including impact of noise on ranquillity, visual amenity and landscape severance), including a very brief description of the history and archaeology of Stonehenge and the WHS.
b) Overhead map of A303 in relation to heritage sites within the WHS and photographs of the site as it currently is.
c) Diagrams and descriptive text for an alternative scenario: a 2.9 km tunnel through which the A303 road would pass.
d) Information on the impact of the removal of the road into a tunnel on tranquillity, visual amenity and landscape severance.
e) A clear statement that no policy scenario has been chosen yet.

5.1.13 The survey included follow-up questions on familiarity with the information provided and on the opinion of the respondents of the effect of the road on Stonehenge.

5.1.14 The material presented also included a clear statement that this study is not a public consultation, but that the information collected via the study would feed into a public consultation currently planned for January 2017. All survey materials were agreed by the steering group. The survey itself was agreed with DfT and HE analysts and the academic peer reviewer. The information material is in Appendix A.

5.1.15 In all surveys, we used payment card mechanisms to elicit WTP in terms of an increase in annual taxes over a three-year period. WTP values were elicited using a payment card with 35 values ranging from £0 to £200, including an open-end ‘other’ amount option to reduce anchoring bias set by the payment range (I. J. Bateman et al. 2002).

5.1.16 Those who indicate that the removal of the A303 road from within part of the Stonehenge WHS would reduce their life satisfaction are shown a payment card and asked the minimum they would be willing to accept in compensation, using the same payment card range as the WTP question.

5.1.17 In all surveys, respondents were asked a certainty question on the WTP amount which they had stated (Bedate et al., 2009; Champ and Bishop 2001). The last section of the survey included follow-up questions that asked the reasons for their willingness, or not, to pay - allowing us to identify protest responses in ex-post analysis – as well as standard sociodemographic questions (Bateman et al. 2002). In designing the contingent valuation scenarios we implemented best practice related to question wording and ordering, payment format, payment vehicle, prompts and use of images (Bateman et al. 2002; Bakhshi et al. 2015). Survey instruments are provided in Appendix A.

## 5.2 Valuation scenarios

5.2.1 The CV study has been carefully designed to value the impact of the A303 road between on Stonehenge and the WHS. This assessment focuses exclusively on the cultural heritage impacts of removing the A303 from its current location within the WHS, in terms of noise reduction, increased tranquillity, visual amenity and reduced landscape severance, which cannot be assessed through standard market-based economic valuation techniques.

5.2.2 This study was designed to assess both use values and non-use values associated with the removal of the A303 from its current location within the Stonehenge WHS, covering both positive and negative aspects of the hypothetical road scenario for users and non-users.

a. For those who positively valued the road option change, we estimate the willingness to pay, via an annual tax at the individual level, for the changes to noise, tranquillity, visual amenity and landscape severance associated with the removal of the A303 from its current location in the Stonehenge WHS and its redirection through a tunnel of approximately 2.9km.[21]
b. For those that negatively valued the road option change, and that therefore indicated they would not be willing to pay for the tunnel, we estimate the willingness to accept, via a one-off cash compensation, to put up with the removal of the A303 from its current location in the Stonehenge WHS and its redirection through a tunnel of approximately 2.9km.

5.2.3 It is appropriate to apply different welfare measures to a policy change depending on whether they lead to gains or losses to the individual (Kim et al. 2015; Bateman et al. 2002). Where a change from the status quo leads to welfare improvements for the individual, resulting from noise reduction, increased tranquillity, visual amenity and reduced landscape severance, we elicit WTP to measure the compensating surplus for obtaining the improvement produced by the removal of the A303 from within part of the Stonehenge WHS. Where a change from the status quo leads to a loss of welfare, in terms of the ability to view Stonehenge from the road, we elicit WTA to measure compensating surplus to restore their welfare to the state it was in before the removal of the road. This ensures that we are capturing both positive and negative values associated with the alternative road scenario. We use life satisfaction here as the measure of welfare change for the purposes of CS and ES (following Bakhshi et al. 2015). This is in line with guidelines in the Green Book and in the OECD guidelines (2013) on measuring wellbeing. For a full discussion and rationale for using life satisfaction as a measure of welfare see Fujiwara and Dolan (2015). This part of the CV survey is important because users and non-users may value the ability/opportunity to see the stone circle

[21] The current A303 would be replaced with a narrower footpath covered with a different material than the current tarmac.

from the road and the loss of this opportunity may be perceived as a negative aspect of the scheme for them.[22]

5.2.4 As explained in section 2 all other impacts (such as economic and environmental) are considered in the overall business case and use the methods described in the DfT's transport appraisal guidance (WebTAG). It is, therefore, important to this study to exclude those other impacts to avoid double counting with the other elements in the business case (see Figure 1 above). We exclude these elements as far as possible through clear definition of the heritage good being valued, in terms of noise reduction, increased tranquillity, visual amenity and reduced landscape severance. The information provided on the status quo and the alternative road option focuses only on those aspects which we aim to measure, such as the impact of the road on the experience at the site. We exclude all reference to congestion and other traffic outcomes (except briefly in the introduction to the policy content)[23].

5.2.5 Respondents were provided with information about the route of the tunnel and the expected impact of the scheme on the World Heritage Site (both positive and negative).[24] We were unable to give very detailed information to respondents because at the time of the study, the precise route alignment and tunnel portal positions were yet to be determined (we set out the information provided to respondents and the full survey instruments in the Appendix A). The following scenarios were presented to respondents:

a) the status quo (the current A303 road and route within the Stonehenge WHS)
b) the construction of a dual carriageway between Amesbury and Berwick Down, including a 2.9km tunnel underneath the WHS with both portals located within the WHS but out of sight from the stone circle. By removing the road from the central portion of the World Heritage Site, those using the road will no longer be able to see Stonehenge while driving and those visiting the site will no longer be affected by the road. To either side of the tunnel itself, widening the road and constructing tunnel portals will have adverse impacts on other monuments (e.g. burial sites) within the World Heritage Site.

5.2.6 Respondents were first asked if they would in principle be willing to pay an increase in annual taxes over a three-year period to support the alternative scheme using the following text.

*"For the next set of questions, please imagine a situation where the tunnel scenario was selected and was paid for by an increase in national taxes, for three years. Please think for a moment about how much the proposed scenario to remove the A303 from the World Heritage Site would be worth to you and your*

[22] Vehicles here refer to any form of transport that can legally view Stonehenge from the A303
[23] The survey material which was provided to the participants includes a clear statement that the heritage site itself is not in any danger to ensure people are not valuing Stonehenge as such.
[24] More detail on the role of information provided to participants in a CV study in Burgess et al (Burgess, Clark, and Harrison 2000)

*household, if anything. Would you be prepared to pay something, even if only a very small amount, to support the construction of a tunnel route?"*

5.2.7 Those people that state they would be willing to pay something for the alternative road option are then directed to the WTP questions. In order to reduce the risk of strategic bias[25] and hypothetical bias[26], before the payment card questions we used the following entreaty (cheap talk) script, which has been shown to be effective in previous studies (Chakraborty and Harbaugh 2010; Cummings and Taylor 1999) as well as our own studies (Bakhshi et al. 2015; D. Fujiwara, Lawton, and Mourato 2015). The entreaty script reminds individuals of their budget constraints and existence of alternatives:

*"Studies have shown that many people answering surveys such as this one, say they are willing to pay more than they would actually pay in reality. So please think about this question as if it were a real decision and you were actually making a payment for real. Please do not agree to pay an amount if you think you cannot afford it, if you feel you have paid enough already, or have other things to spend your money on. Also, this question is just about the proposed road scheme. We are not asking you about how much you value the Stonehenge site. Remember, Stonehenge is not in danger, this is a change to the lay out of the road around it."*

5.2.8 In addition, the questionnaire includes follow up certainty and motivation questions to understand how certain a respondent is about their willingness to pay and the reasons why they state they are willing to pay.

5.2.9 For those who indicated that they would not be willing to pay anything for the alternative road scheme, we ask a willingness to accept (WTA) compensation question for the removal of the current A303 using the following hybrid wellbeing-contingent valuation WTA question.

*"You indicated that you would not be willing to pay any additional taxes to fund the rerouting of the A303. In a hypothetical situation, imagine that the government chose to proceed and remove the A303 from its current location. The A303 would be redirected and you would no longer be able to view Stonehenge from the road. We would like you to think about how this decision would affect you, if at all. How would it affect your overall level of life satisfaction if the A303 was removed from its current location?"*

5.2.10 For those who indicate that the removal of the A303 from its current location would reduce their life satisfaction, we present the following question:

*"Assuming nothing else in your life would change, imagine that in order to compensate you for not being able to use the A303 in its current location you were given a publicly funded cash compensation. How much money would you have to receive, as a one-off payment, to give you the same life satisfaction that you have now (not better or worse but just the same) once the A303 is removed from its current location. Note that whatever compensation amount you receive will mean that money cannot be used on other public services."*

[25] For detail on the potential biases see also section 4.2. Strategic bias: The wish to preserve a status quo or to achieve a specific change can lead to overstatement of WTP or WTA. (Throsby and Withers 1986)
[26] Hypothetical bias: When judging a hypothetical situation, people are often overestimating the impact. People often have not considered in detail how they would value unfamiliar goods. See section 4.2.

# 6 Analysis

## 6.1 Data cleaning

6.1.1 This section sets out the data cleaning steps we took to generate a robust and reliable data set and ensure sample representativeness to allow aggregation of WTP/WTA to the relevant national populations.

**a)** 'Speedsters' who answered the online surveys in less than 4 minutes were excluded from the data.[27] This is because a proportion of those who complete the survey quickly are likely to be those that want to provide a pre-determined view of the road scheme (to influence policy) and have not read through and considered all of the materials properly. Speedsters may be motivated by the incentive to complete the maximum amount of surveys in a short time, thus reducing the reliability of their WTP bid function.

**b)** In order to be conservative, we defined "other" responses as extreme outlier WTP and WTA values above the £250 level. This was based on a prior decision to cap WTP/WTA values at 25% of the highest amount on the payment card. We note that this led to the exclusion of only 14 responses (one of £500, four between £1,000-£5,000, and nine from £10,000-£35million).

**c)** Those who did not indicate a monetary amount in an open-end response (i.e. gave some qualitative text comments) were also excluded.

**d)** Inconsistent follow-up responses (those who indicated that their stated WTP was motivated by a belief that they would not really need to pay) were excluded (following best practice, see Bateman et al. 2002).

**e)** Respondents who ascribed to an "other" gender or did not state their region were excluded since their inclusion would not make it possible to apply weights based on region and gender.

6.1.2 Overall, we removed 216 observations as per Table 1. This reflects about 6% of responses across all three surveys.

[27] The four-minute threshold is based on the dropping of speedsters based on a five-minute threshold in (Maddison and Mourato 2001a). The difference in threshold is proportionate to the differences in survey length and have been discussed with the peer reviewer.

**Table 1 Number of responses removed from survey sample data sets**

| | Survey A (Visitors) | Survey B (Local population) | Survey C (General population) | Total |
|---|---|---|---|---|
| Total number of respondents | 432 | 1,001 | 2,102 | 3,535 |
| Incomplete | 0 | 0 | 0 | 0 |
| Speedsters | 0 | 48 | 94 | 142 |
| Inconsistent follow-up | 3 | 11 | 23 | 37 |
| Unacceptable WTP or WTA values | 0 | 14 | 16 | 30 |
| Gender: "Other" | 0 | 1 | 2 | 3 |
| Region missing | 0 | 4 | 0 | 4 |
| **Number of responses removed** | **3** | **78** | **135** | **216** |
| **Number of responses kept in analysis (survey sample)** | **429** | **923** | **1,967** | **3,319** |

*Note: These figures relate to the survey sample populations (which is distinct from the study group sample sizes).*

### Missing data

6.1.3 A significant proportion of people in the visitor survey (20%) were unwilling to reveal their income, noticeably higher than the local (10%) and general population (12%) surveys. This is a common finding for face to face surveys, where respondents may be biased by interviewer presence. Income is a key variable for population-weighting WTP and WTA calculations along with gender, age and region. For the individuals who did not answer the question on income within the general population study group, we imputed their income levels based on the distribution of income in the study group, on a one-off random basis when generating the variable used to weight the mean results. The peer reviewer notes that this approach can be biased, unless the randomisation is repeated at least 10,000 times. However, as conducting this exercise would have had led to 10,000 iterations of the population-weighting variable, it would have been complex to robustly implement and hence disproportionate to the evaluation process.

### Study groups

6.1.4 We reconstructed the two populations of the road user and general population surveys into study groups based on whether respondents in the general population indicated that they had used the A303 in the past year, as illustrated

in Figure 3. Initially, we conducted survey B with the aim to isolate people most likely to be regular users of the A303. The criterion for inclusion into the sample for this survey was to live within 50 miles of Stonehenge. The respondents to survey B included people who had used the A303 as well as people who had not used the road. We also found that a number of respondents in the General population survey (survey C) had used the road. The study group of road users contains 465 road users from survey B, and 467 road users from survey C. The general population study group is made up of 458 non-road users from survey B and 1,500 non-road users from survey C. Note that with the reconstruction of the two populations the general population study group required re-weighting to ensure representativeness with the UK population. We therefore constructed weights formed by the demographic categories of gender, age and income for each region in the United Kingdom for the general population survey (given that income is a known driver of WTP/WTA we need to ensure that our sample is representative of the population income distribution). It was unnecessary to weight the road users, as the group revealed themselves directly from both surveys. As a result, the road user study group is the best available estimate of the demographic characteristics of the wider road user population.

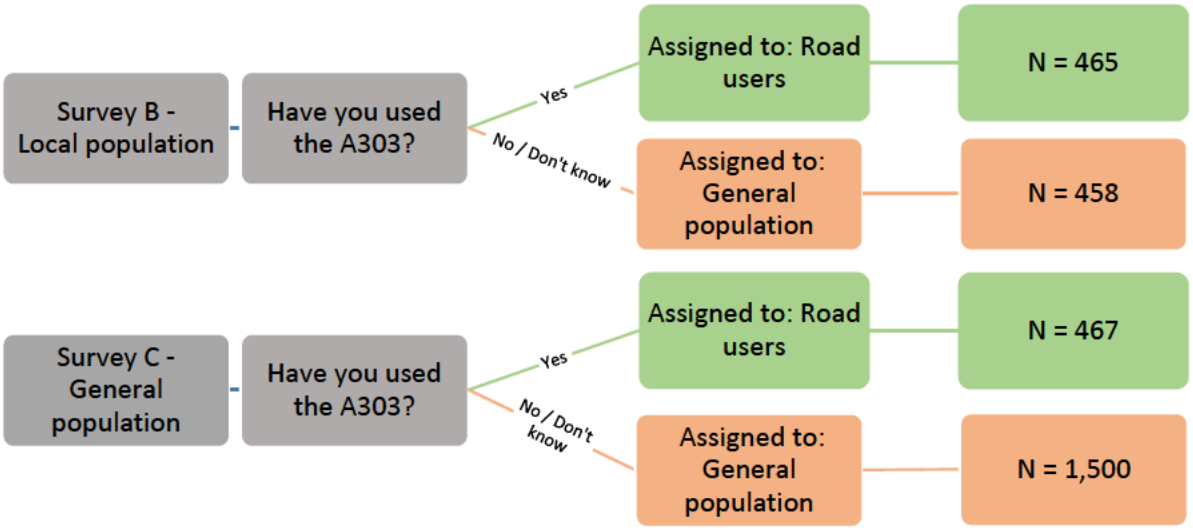


**Figure 2 Composition of road user and general population study groups[28]**

## 6.2 Descriptive Statistics

6.2.1 Table 2 shows the population weighted descriptive statistics of the study groups.

[28] Note: These figures relate to the study group sample size. Please note that 92 individuals 'didn't know' whether they had used the A303 in the past 12 months. These individuals were added to the general population.

**Table 2 Descriptive Statistics**

| | Visitors Study Group - Weighted | Road Users Study group | General population study group (non-use) – Weighted |
|---|---|---|---|
| Female (%) | 53% | 46% | 53% |
| Age (mean) | 47 | 45 | 45 |
| Household income (£, mean) | £49,166 | £41,730 | £26,437 |
| No response to income question (%) | 20% | 10% | 12% |
| Dependent children under 16 years (%) | 17% | 39% | 30% |
| Married/with partner (%) | 69% | 61% | 49% |
| University education (%) | 50% | 44% | 36% |
| In employment (full-time, part-time, self-employed) % | 69% | 64% | 51% |
| London | 3% | 7% | 8% |
| Health (good, very good, excellent) (%) | 92% | 83% | 72% |
| Ethnicity (BME) | 4% | 10% | 10% |
| Member (English Heritage/National Trust/Stonehenge preservation organisation) (%) | 56% | 33% | 10% |
| Driving license (%) | 89% | 87% | 70% |
| Total | 429 | 932 | 1958 |

6.2.2 The visitor and road user surveys show a significantly higher household income level than the general population, a better health status and a very high membership in a heritage related organisations such as English Heritage. The visitor survey specifically had a lower percentage of Black and Minority Ethnic visitors when compared to the general population and road users.

## 6.3 Estimating WTP and WTA

6.3.1 Figure 4 sets out the process by which respondents were allocated to a WTP or WTA payment/compensation card.

6.3.2 All respondents were asked whether they would be willing to pay a tax levied over three years to fund the improvement of the heritage experience at the Stonehenge WHS via the removal of the A303. If they answered this question with 'yes' or 'maybe' they were shown a payment card. Those who said 'yes' / 'maybe' and selected £0, or those who said `no' were then channelled to the WTA branch and first asked whether the removal of the road would have an impact on their life satisfaction. If they said that the removal of the A303 would reduce their life satisfaction they were shown the willingness to accept card to elicit the value of this reduction. Those who indicated that the road scheme would not affect their life satisfaction, or who indicated that it would reduce their life satisfaction but selected £0 were allocated the value zero.

6.3.3 We calculated non-parametric mean and median WTP from the mid-point between the amount chosen on the card and the next amount up, and mean and median WTA from the mid-point between the amount chosen on the card and the next amount down. The use of the mid-point estimate is a practical step to avoid having to use a continuous WTP or WTA card, as recommended by Bateman et al. (2002). This is theoretically consistent with the statistical theory for calculating WTP from interval data (Cameron and Huppert 1989). It means that for a person who, say, chose the value £10 (when the next value is £15) we can say that they are willing to pay £10 but not £15. However, we do not know where their willingness to pay sits in between the end points of £10.00 to £14.99). To address this Bateman et al. (2002) recommends using the mid-point, i.e. in this case this would be £12.50.

6.3.4 Within the study group samples, we calculated the mean WTP. Using the mean WTP rather than the median is good practice in CV studies (Darling et al 2000). The mean is relevant if the context of the valuation exercise is cost benefit analysis because it represents an average WTP for the population which can be aggregated (by the population size) to derive the total WTP across the population. In general it is recommended that if aggregated WTP for benefits outweighs costs, a project should proceed (Pearce and Özdemiroglu 2002).

6.3.5 We note that it is standard practice in the calculation of individual mean and median WTP/WTA to include zero responses (Bateman et al. 2002). This ensures that those who do not hold any value in the non-market good are included in the estimation process, and helps to avoid unrealistic and overestimated mean WTP/WTA figures. In the current case, the zero values are not included in the calculation of mean individual WTP and WTA (that refer to those with positive values only) but are instead included in the aggregation, when calculating population-level values. We feel this approach provides a clearer picture of the influence of zero answers. Specifically, we elicit both positive WTP values and 'negative' values, via WTA compensation questions, for the road tunnel scheme. Those who are not willing to pay are given the opportunity to state a WTA compensation value. This is somewhat equivalent to a negative WTP for the tunnel. Consequently, the valuation of the road scheme is not bounded at zero (as is the case in most CV studies). This leaves a third group of individuals who are neither willing to pay nor willing to accept compensation. We assume that this group represents those individuals who do not hold any value (positive or negative), and are likely to be indifferent to the proposed the road scheme. In other words, their welfare is unaffected by the road scheme, be it because the heritage impacts do not form part of their utility (welfare) function, or that the utility gains of the scheme are exactly offset by the utility losses. We deal with this zero-response group in the aggregation process. We calculate the proportion of positive WTP/WTA responses for each study group, and extrapolate positive WTP/WTA values to the same proportion in the relevant population (section 7.1). Figure 4 sets out the process to allocate respondents to the three groups. Following this logic, Table 3 demonstrates how each type of possible response is accounted for in aggregation.

**Table 3 Aggregation formula**

| | Aggregation Formula |
|---|---|
| Annual tax (WTP over three years) | $NPV\ Mean\ positive\ WTP\ \times$ $\%\ Share\ of\ study\ group\ that\ has\ a\ positive\ WTP\ \times$ $Population\ size;$ |
| | minus |
| Compensation (one off WTA) | $Mean\ positive\ WTA\ \times$ $\%\ Share\ of\ study\ group\ that\ has\ a\ positive\ WTA\ \times$ $Population\ size;$ |
| | plus |
| WTP and WTA = £0 | $£0\ \times\ \%\ Share\ of\ study\ group\ that\ is\ WTP\ \&\ WTA = 0\ \times$ $Population\ size$ (Always zero) |

6.3.6 At the end points (i.e. the green box and orange boxes in Figure 4) the responses of the survey respondents were weighted by income, gender and age for the WTP and WTA calculations and sensitivity analysis (see section 8).

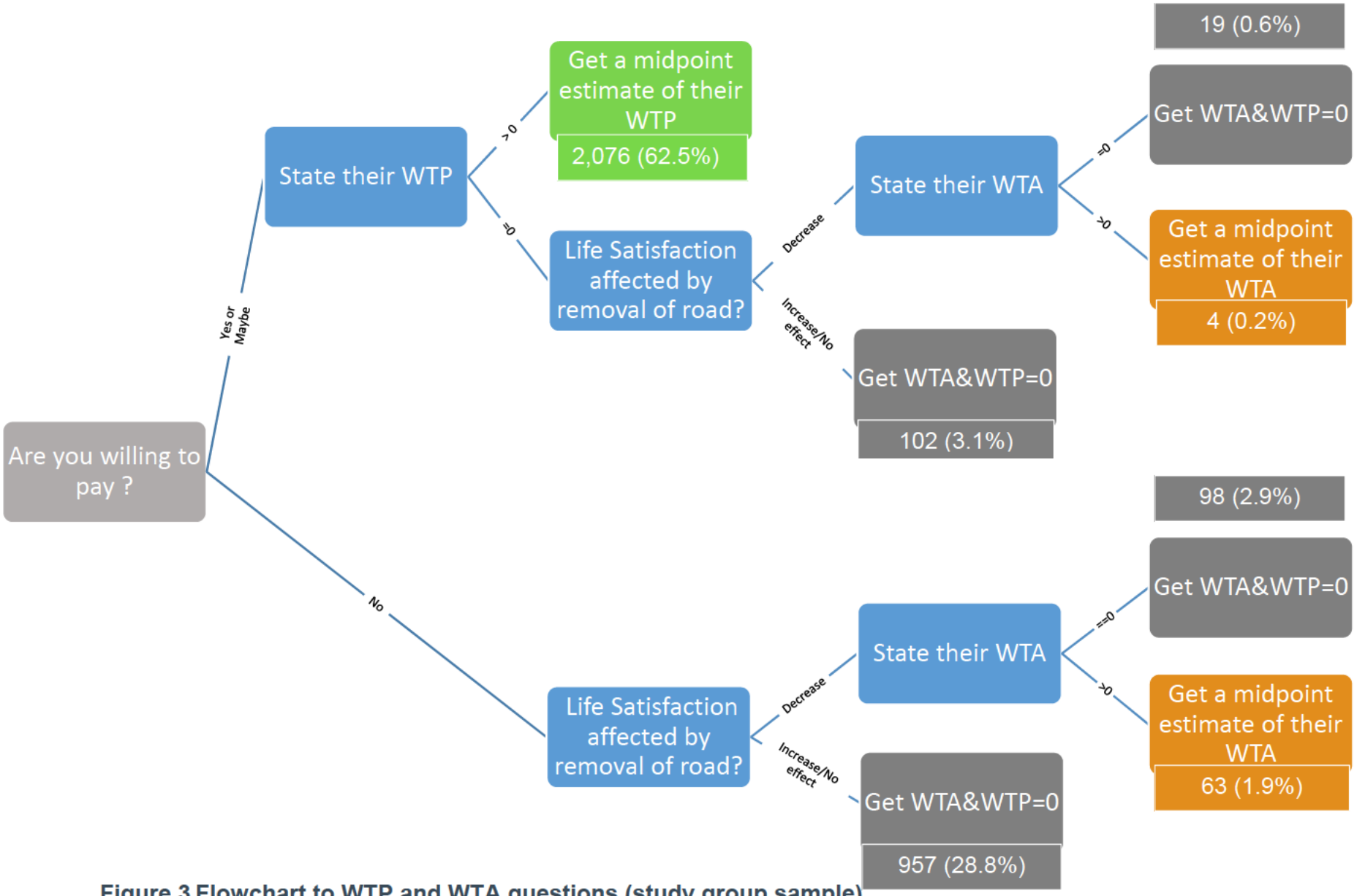


**Figure 3 Flowchart to WTP and WTA questions (study group sample)**

## 6.4 Validity testing

6.4.1 It is a best-practice requirement to conduct a range of validity tests for CV studies (Bennett, Morrison, and Blamey 1998). There are a number of ways to test the validity of the results. Here, we discuss content validity and theoretical validity.

**Content validity**

6.4.2 Content validity tests look at the adequacy, realism and neutrality of the survey instrument as well as at respondents' understanding, perception and reactions to the questionnaire. Additionally, the rate of protest provides valuable information on how respondents reacted to the scenarios.

6.4.3 We conducted stakeholder meetings at the project inception stage with the steering group to agree the valuation scenarios for the contingent valuations (for both the visitor and online surveys). We then undertook extensive testing of the draft survey instruments with input from the fieldwork provider, Ipsos Mori. We used a face-to-face pilot survey followed by in-depth cognitive debriefing about all parts of the questionnaire with 15 visitors at Stonehenge; and online pilot surveys with some cognitive follow-ups on key parts of the questionnaire with 100 panel respondents in total, in both cases mimicking the conditions in which the final surveys would be implemented.

6.4.4 We provide pilot reports on each survey in Appendix C. Table 4 summarises the pilot survey results.

**Table 4 Survey pilots**

| | Survey A | Survey B | Survey C |
|---|---|---|---|
| Number of respondents (who completed debrief questionnaire) | 15 | 54 | 46 |
| Date | 12th September 2016 | 14 h-15th September 2016 | 20th-21st September 2016 |

6.4.5 Feedback from survey pilot respondents indicated that the instrument was of an appropriate length, clear and easy to answer. The pilots led to only a few small changes in the questionnaire and WTP/WTA payment card range. This included minor changes to wording and added values to the lower end of the payment range (i.e. the card starts with £0.05 and £0.10 instead of the previous level of £0.20).

6.4.6 In terms of protest answers, we asked those with a non-positive WTP or WTA follow-up questions on their reasons for their answer. Table 5 shows that around 15% of respondents across all three surveys could potentially be classified as protesters, i.e. stated they would not be WTP or WTA when in fact they might value the change being proposed. In order to be conservative, these respondents are not excluded from any calculations. The majority of

protest responses (12.6% of the total survey sample) indicated that they did not give a positive WTP/WTA due to the annual tax payment vehicle. In other words, they may have given a positive WTP if another payment vehicle (road tax, local tax, donation, or visitor fees) had been provided. Pre-empting our results in section 7, 85% of those who were not WTP also indicated that the removal of the A303 would not reduce their life satisfaction. We may assume that these individuals do have a positive WTP value for the road scheme, but are unwilling to give a positive WTP bid due to their protest over the tax payment mechanism. This could suggest that the current WTP figures represent a slight underestimation.

6.4.7 Other responses accord with what would typically be defined as protests, such as political views on reducing road use, uncertainties related to the current political climate, and protests related to perceived risk of damage within the WHS from tunnel construction (stating that there should be a longer tunnel). Overall, the relatively small protest rates within these three categories (highlighted in bold in the table, 3.8%) bode well for the validity of our estimated WTP measures. It should be noted that the interpretation of protests is subjective and therefore, the valuation presented by these protest respondents may be a valid representation of the utility impact of the road scheme.

**Table 5 Protest responses**

| | Across all surveys | |
|---|---|---|
| | Number of responses | % |
| **There should be a longer tunnel scenario** | 14 | 0.4% |
| **We should be reducing road use, not building more roads** | 43 | 1.3% |
| Any changes to the road layout should be paid for through local council tax | 106 | 3.2% |
| Any changes to the road layout should be paid for through road tax | 192 | 5.8% |
| Any changes to the road layout should be paid for through voluntary donations | 31 | 0.9% |
| Any changes to the road layout should be paid for through increases in visitor fees | 88 | 2.7% |
| **I do not feel confident stating a value that I would be willing to pay in the current uncertain political climate** | 70 | 2.1% |
| Total | 544 | 15.4% |
| Total survey sample | 3535 | |

*Notes: Unweighted figures summed across the three surveys: visitor, road user, and general population. Non-protest responses not shown in table ('I have more important things to think about'; 'I would prefer to keep the A303 in its current location but do not require compensation'; 'I am not willing to pay increased taxes over a period of three years'; 'I do not care about Stonehenge'). Traditional protest categories highlighted in bold.*

**Theoretical validity and certainty of payment**

6.4.8 The two main validity tests advocated by the literature are theoretical validity tests and certainty of payments (Bateman et al. 2002). We test both in the same model.

6.4.9 The credibility of estimated values from CV studies is commonly assessed by examining their theoretical validity (Bateman et al. 2002). Testing for theoretical validity is typically done by estimating a bid function, exploring how WTP responds to respondent characteristics and other variables collected in the survey to test whether the relationship between WTP and other indicators is in accordance with expectations. Some of these indicators are predictors from economic theory, while others reflect empirical regularities, which seem intuitively correct, from introspection and reasoned thought, and which have been found to hold across a large number of studies (Bateman et al. 2002). An example of the former is a positive relationship between WTP and income. An example of the latter is the effect on WTP of indicators such as interest in local history. Put another way, if key variables are found to be either statistically insignificant or, most importantly, to be associated with WTP in unexpected and illogical ways, this casts doubt on the theoretical validity of results. Typically, the following ordinary least squares regression (OLS) model is used as the base for all the WTP analyses:

$$WTP_i = \alpha + \boldsymbol{\beta_n X_i} + \varepsilon_i \qquad (1)$$

6.4.10 where $WTP_i$ is the amount the individual i has stated they are willing to pay, $\alpha$ is the deterministic factor and $\varepsilon$ is the error term containing unobserved factors that determine willingness to pay (Wooldridge 2010). In $X_i$ controls for the *n* observed determinants of willingness to pay (Bateman et al., 2002). Regressions for validity tests only included those respondents who had responded to the income question due to the importance of income as a theoretical driver of WTP (Bateman et al., 2002) (recall section 4.1).

6.4.11 We test the distribution of residuals for heteroskedasticity using robust standard errors and for normality using kernel density estimates, and tested for multicollinearity using VIF (Variance Inflation Factor) tests. The results of these tests are given in Appendix D.

6.4.12 We test for differences in WTP between those who indicated that they were "certain" that they would pay (at least 3 on a 5-point scale with 1 being "Not certain at all" and 5 "Very Certain") and those that were either "uncertain" or "somewhat certain". We would anticipate that those who report greater certainty in their stated WTP value would hold higher values, since being uncertain about the WTP amount may lead people to state a lower amount.

6.4.13 Specifically, we estimate the following model using OLS regression based on (1) to test for theoretical validity and the impact of certainty:

$$WTP_i = \alpha + \beta_1 Cert_i + \boldsymbol{\beta_n X_i} + \varepsilon_i \qquad (2)$$

where $WTP_i$ is the amount individual $i$ states they are willing to pay; $Cert_i$ is the individual's stated certainty to pay that value; $\boldsymbol{X_i}$ is a vector of control variables

for the *n* determinants of WTP; and $\varepsilon_i$ is the error term under the standard assumptions in OLS (Wooldridge 2010).

6.4.14 We process hypothetical bias by recoding WTP bids that fail to provide sufficient assurance of certainty as zero responses. Low certainty is defined in this case as those rating their certainty as 1 or 2 on a 5-point certainty scale, where 1 is not at all certain. This allows us to maintain all subjects in the sample while excluding low certainty responses from WTP analysis (following Champ et al. 1997). This allows us to perform sensitivity analysis by comparing aggregate values at different certainty levels (Haab et al. 2013).

6.4.15 The set of variables included in equation 2 is presented in Table 6. In our choice of predictors of WTP, we followed the recommendations of Bateman et al. (2002), which are common practice in modern applications of CV. In particular, we include a range of **socio-economic variables** (i.e. gender, age, children, education and income), variables relating to **usage** (number of visits to Stonehenge and seeing Stonehenge from the road) and **attitudinal** variables (member of English Heritage/National Trust). For some variables there are no clear priors on the sign of the impact; that is, for example, in some of these cases the relationship with WTP could plausibly be positive or negative (e.g. having dependent children).

**Table 6 Variables used in validity tests**

| Variable | Description |
|---|---|
| Female | Dummy variable (1-female; 0-male) |
| Log age | Log of age (mid-point of intervals) |
| Log income | Log of annual household income before tax (mid-point of intervals) |
| Children | Dummy variable (1- dependent children under 16; 0-otherwise) |
| Married/with partner | Dummy variable (1- married or with partner; 0-otherwise) |
| University education | Dummy variable (1- university degree or higher; 0- otherwise) |
| In employment (full time, part time, self-employed) | Dummy variable (1- full time, part time or self-employed worker; 0- otherwise) |
| Health | Dummy variable (1- excellent, very good or good health; 0- fair or poor health) |
| Ethnicity | Dummy variable (1- all other ethnicities; 0- white) |
| Student | Dummy variable (1-student; 0-otherwise) |
| Retired | Dummy variable (1-retired; 0-otherwise) |
| Number of times visited Stonehenge | Number of visits to Stonehenge |
| Likely | Dummy variable (1-very likely or likely to visit Stonehenge again; 0 – otherwise) |
| Member | Dummy variable (1- Member of English Heritage / National Trust / Stonehenge preservation organisation; 0- otherwise) |
| Driver's license | Dummy variable (1- has a driver's license; 0-otherwise) |
| Familiar with the impact of the A303 on WHS | Dummy variable (1- Very or extremely familiar with information regarding the impact of the A303 on WHS; 0- Not at all, slightly or Moderately familiar with information) |
| Certainty | Dummy variable (1- very certain or certain regarding WTP (3-5 on a scale of 1-5); 0- quite uncertain or not certain at all regarding WTP) |
| Road User | Dummy variable (1- In road user study group; 0 – otherwise) |
| General Population | Dummy variable (1- In general population study group; 0 – otherwise) |

## 6.5 Aggregation of values

6.5.1 To estimate overall values for the road options we aggregate the mean WTP and WTA values from the survey to the relevant national populations. This results in an estimate of the overall value the UK resident population places on the increased tranquillity, reduction in landscape severance, noise visual impact brought by the removal of the A303. The aggregation is conducted in the following steps:

6.5.2 **First,** we estimate the size of the visitor, road user and general populations as described in paragraphs 6.5.7. to 6.5.9.

6.5.3 **Second,** for each study group we calculate the proportions of people who are willing to pay for the road scheme (i.e. those with a utility gain), and those requiring compensation (i.e. those with a utility loss from the road scheme).

6.5.4 **Third,** we multiply the proportions estimated in the second step, by the relevant populations estimated in the first step. This results in an estimate of the number of people in each study group's wider population who are WTP/ WTA.

6.5.5 **Fourth,** for each study group we multiply the NPV of mean WTP by the wider populations' WTP (as estimated in third step) and subtract it by the mean WTA value multiplied by the estimate of the wider population that is WTA.

6.5.6 We outline below the methods used to estimate the size of the visitor, road user and general populations (Table 7).

6.5.7 **The total number of visitors** per year to Stonehenge was sourced from the English Heritage (EH) visitor data and the Association of Leading Visitor Attractions. [29]

The total number of visitors to Stonehenge per year was 1.37 million in 2015. Of these 40% are estimated to be UK residents by EH[30].
**This results in an estimate of 0.55 million UK resident visitors annually.**

6.5.8 **Total number of road users** was calculated using survey responses from the general population survey due to a lack of reliable data available externally.

- 2.3% of the general population survey stated that they used the A303 road weekly (this includes drivers and passengers).
- This represents a conservative estimate of road usage in the general population survey. This helps to correct for potential over-estimation of road usage frequency by survey respondents caused by failure to recall usage effectively (recollection bias) or focusing bias (caused by the focus of the survey on Stonehenge and the A303 road).
- We applied this percentage to the UK resident population aged 16 and over (for details of UK population size, see 6.5.9), producing an estimate of just over **1.22 million A303 road users.**[31]
- For the CV study, each individual road user counts once within the year. This means a person who uses the road several times a day counts the same as a passenger in a car driving past once a week.

6.5.9 **Total population figures (for Survey C)** are taken from the Annual Population Survey (APS) of the Office for National Statistics (ONS).

- The APS estimates the UK population on 30th June 2015.
- We uprate these estimates to 2016 figures using ONS projections of 0.7% UK population growth.[32]

[29] Source: http://www.alva.org.uk/details.cfm?p=423

[30] English Heritage Stonehenge annual Visitor Survey, summer 2015

[31] Note this figure relates only to UK residents because the panel from which the survey sample was taken only includes UK residents.

[32] Source: http://webarchive.nationalarchives.gov.uk/20160105160709/http://www.ons.gov.uk/ons/rel/pop-estimate/population-estimates-for-uk--england-and-wales--scotland-and-northern-ireland/mid-2014/sty---overview-of-the-uk-population.html

- This results in an estimated population size of 53.2m residents aged 16 and over.
- The estimated population numbers of Stonehenge WHS visitors and road users (see above) are subtracted to avoid double counting. [33]
- This results in general population estimate of **51.43 million**.

**Table 7 Aggregation: Study group to population**

| Study groups | Weighting method* | Study group (n)** | Population (N) | Population description |
|---|---|---|---|---|
| Visitors (those visiting in the previous 12 months??) | Weighting based on age | 429 | 0.55m | Domestic annual visitors to Stonehenge (source: EH) |
| Road users | Quota-based sampling and study group formation | 932 | 1.22m*** | Domestic annual number of A303 road users (source: Survey C) |
| General Population | Quota-based sampling, study group formation, weighting based on income, gender, age and region. | 1,958 | 51.43m | UK Population aged 16 and above[34] less the Road Users and Visitors (source: ONS, 2016) |

*Notes: * see Figure 4; ** Study group sample size differs from survey sample size given in Table 2; *** this figure is based on the number of respondents in the general population survey who responded that they use the A303 about once a week (for more precision, this figure was based on the full survey sample excluding only speedster respondents (N = 2,006)).*

6.5.10 We consider the need to apply welfare weights to the respondents to adjust for differences in marginal utility of income. Following best practice (Fujiwara 2013; HM Treasury 2011), this overcomes issues around the marginal utility of income. This reflects differences in marginal utility of income between high and low income groups (see section 4.2 for further discussion). We test for differences in the mean income of individuals who were willing to pay (i.e. those with a welfare gain from the policy), and requiring compensation (i.e. those with a welfare loss from the road scheme). We find no significant differences, leading us to conclude that welfare weighting was not necessary in this case.

## 6.6 Time scale and appraisal period

6.6.1 **Willingness to pay:** Respondents were asked for their willingness to pay as an annual tax for three years. This time frame was approved by the steering

[33] The overall UK population is estimated to be 65.1m on 30th June 2015. Of these, 12.3m were aged 0-15 years old. Source: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/bulletins/annualmidyearpopulationestimates/mid2015#uk-population-continues-to-age

[34] We have included the total population above the age of 16. Including people under 16 in a survey requires written consent from a parent or guardian and a different formulation of the question as children are not constrained by income and budgets, and are unlikely to be paying tax. As a result, including respondents aged under 16 would be inconsistent with the microeconomic assumptions underlying the CV method (Shaw, Brady, and Davey 2011).

group as reflecting a realistic amount of time for the new tunnel to be built. Values for year two and year three were discounted using the Green Book's 3.5% discount rate (HM Treasury 2011, 26–28). This provides a net present value for those who are willing to pay for the road scheme.

6.6.2 Willingness to accept was asked as a one-off compensation payment in year one and therefore does not need to be discounted.

6.6.3 We note that the effects of the road scheme will have impacts into the future beyond the three-year tax payment period. It has the potential to impact on future generations who will also value the options for the A303 road. The WTP for the three-year tax payment represents the current generation's maximum WTP for the road scheme split into three annual instalments. Similarly, the WTA for the loss of the road represents the value that those that prefer the view of Stonehenge from the current road place on the road as a one-off payment.

6.6.4 Non-use value is contained in both the WTP and WTA values including the bequest value element of non-use value. This means that impacts on future users and future generations are internalised and captured in the WTP and WTA values of current generations (Frey 1997). Therefore, although the road options will impact on and be valued by future generations (and this is a genuine value that needs to be accounted for in transport policies with long term impacts) there is no need to apply the WTP and WTA values elicited now to population numbers in the future because this would lead to double counting of the benefits as impacts on future generations are already captured in the bequest value element of non-use value in our surveys.

6.6.5 The values estimated from our CV study can be added to the range of other impacts captured in the overarching appraisal. Such impacts – for example journey time savings – are assessed over a 60 year appraisal period. The length of the appraisal period reflects the fact that new transport infrastructure typically has an indefinite life. Towards the end of the appraisal period, values are heavily discounted, such that extending the appraisal period beyond 60 years would have a limited effect on the results. Whilst the CV study does not have a defined time period, the estimates are likely to capture impacts on current and future generations within this time period. While this might lead to an underestimate of the total value in cases where respondents in the current survey do not consider bequest values, it also avoids significant potential for double counting.

# 7 Results

## 7.1 Introduction

7.1.1 This section presents the results of the WTP and WTA analysis and the results of validity testing. We present the WTP and WTA results for the three different study groups: visitors to Stonehenge and the WHS, road users and the general population.

7.1.2 Following the methodology described in section 6, including the weighting by different income subgroups, gender and age the figures presented below reflect the weighted, aggregate values for the removal of the road.

## 7.2 Average WTP and WTA

7.2.1 Table 8 presents the percentage of people within three outcomes:

a) Those willing to pay a positive amount for the road scheme (i.e. the green box in Figure 4)

b) Those not willing to pay for the road scheme and requiring compensation (i.e. the two orange boxes in Figure 4), and;

c) Those who are neither willing to pay nor require a compensation for the road scheme (i.e. the grey boxes in Figure 4).

7.2.2 The percentage of people willing to pay a positive amount for the road scheme was highest for visitors and road users (both 67.4%). 59.2% of the general population were willing to pay a positive amount for the road scheme.

7.2.3 The percentage shares of people requiring compensation were very low for all study group populations, and was lowest for Stonehenge visitors (0.5%). Across the three outcomes, between 30.5% and 38.5% of people neither required any compensation, nor were willing to pay. This suggests that the welfare of those who neither required any compensation, nor were willing to pay is unaffected by the road scheme, be it because the heritage impacts do not form part of their utility (welfare) function, or that the utility gains of the scheme are directly offset by the utility losses (recall section 6.3).

**Table 8 Summary statistics of people willing to pay or requiring compensation for the removal of the A303 into a tunnel (the road scheme)**

| Outcome | Visitor study group | | Road user study group | | General population study group | |
|---|---|---|---|---|---|---|
| | N. | % | N. | % | N. | % |
| A - Willing to pay for road scheme | 289 | 67.4% | 628 | 67.4% | 1,159 | 59.2% |
| B - Requiring compensation for road scheme | 2 | 0.5% | 20 | 2.1% | 45 | 2.3% |
| C - Neither willing to pay nor requiring compensation | 138 | 32.2% | 284 | 30.5% | 754 | 38.5% |
| Total | 429 | 100% | 932 | 100% | 1,958 | 100% |

*Note: sample size is based on final study group samples. Protest responses highlighted in table 5 are included in all samples.*

7.2.4 Mean WTP and WTA results for outcome groups (A) and (B) are provided in Table 9. These are values for those respondents who are willing to pay or require compensation. Individual level mean WTP values do not include the zero WTP/WTA group (outcome C). Zero WTP/WTA responses are instead accounted for in the aggregation process (recall section 6.3). Accordingly, individual level mean WTP values represent an average money metric impact for outcomes (A) and (B) in Table 8. Given that zero responses are not accounted for in these calculations, individual mean WTP values should not be interpreted directly as an overarching measure of the value that individuals place on the road scheme, or compared to individual mean WTP elicited in previous studies (e.g. Maddison and Mourato, 2002).

7.2.5 The mean WTP for the road scheme (Outcome A) was highest for visitors at **£23.39** per year for three years. It is only slightly lower for road users at **£21.51** per year for three years. The general population have a lower WTP than visitors and road users at **£14.41** per year for three years.

7.2.6 The mean WTA for the road scheme (Outcome B) was highest for visitors at **£187.50**. Note that this figure is based on a sample of n=2. The average WTA of the road users who required compensation is **£81.35** and lower at **£57.90** for the general population. There is a wide confidence interval surrounding these estimates due to the generally low number of people requiring compensation for the removal of the road.

**Table 9 Mean and Median WTP and WTA values**

| Study group | Outcome (WTP/WTA variable) | N | Mean (£) | Low 95% CI | High 95% CI | Median (£) | Max (£) |
|---|---|---|---|---|---|---|---|
| Visitor | A - Willing to pay for road scheme (annual tax) | 289 | **£23.39** | £19.32 | £27.46 | £10.50 | £200.00 |
| | B - Requiring compensation for road scheme (one-off WTA) | 2 | **£187.50** | £187.50 | £187.50 | £187.50 | £187.50 |
| Road User | A - Willing to pay for road scheme (annual tax) | 628 | **£21.51** | £18.23 | £24.80 | £10.50 | £250.00 |
| | B - Requiring compensation for road scheme (one-off WTA) | 20 | **£81.35** | £45.40 | £117.30 | £53.75 | £187.50 |
| General population | A - Willing to pay for road scheme (annual tax) | 1,159 | **£14.41** | £12.74 | £16.07 | £5.50 | £200.00 |
| | B - Requiring compensation for road scheme (one-off WTA) | 45 | **£57.90** | £35.20 | £80.61 | £28.50 | £187.50 |

*Note: CI = Confidence interval. Note that individual mean WTP/WTA are estimated excluding zero responses. This is because we elicit both positive WTP values and negative WTA values at the individual level. Consequently, the valuation of the road scheme is not bounded at zero. This zero-response group who are neither willing to pay nor willing to accept compensation are accounted for in the aggregation process (section 6.5).*

## 7.3 Aggregate population level values for the road scheme

7.3.1 Table 10 shows the average WTP and WTA values aggregated to the relevant population levels of each study group. We calculate the proportion of positive WTP/WTA responses for each study group (recall Table 8). We then extrapolate the mean levels of WTP and WTA from the survey samples up to the relevant proportions within the national levels of visitors (population weighted based on age), road users and the general population (weights based on income, gender, age and region). In this way, zero-response bids (Outcome C, Table 8) are accounted for in the aggregation figure, by essentially excluding the equivalent proportion of the relevant populations from aggregation.

7.3.2 For example, for the visitor group:

- **% study group** (column 4, Table 10): 67% of the study group were willing to pay for the road scheme (Outcome A, Table 8);
- **Relevant population** (column 5, Table 10)**:** Mean visitor WTP (£23.39) is aggregated to the relevant population, which represents 67% of the annual UK resident visitors to Stonehenge (n=368,292).
- **% study group:** 0.5% of the visitor group were willing to accept compensation for the road scheme (Outcome B, Table 10);
- **Relevant population:** Mean visitor WTA (£187.50) is aggregated to the relevant population of 0.5% of annual Stonehenge resident visitors (n=2,549).

7.3.3 We discount (HM Treasury Green Book, 3.5%) aggregated WTP values, given that the WTP values represent annual taxes to support the road scheme broken down into three different years of payments. The net present value (NPV) of the three years' worth of WTP payments therefore represents the overall individual WTP for the road removal. The NPV WTP values are presented in Table 10 below.

7.3.4 As discussed above the WTA values are elicited as a one-off compensation amount for the removal of the road and therefore represent the overall cost to individuals (who value the road) for the removal of the road.

7.3.5 Net value is calculated for each study group by subtracting aggregate WTA from aggregate WTP. In other words, this creates the net value by subtracting the aggregated estimate of the dis-benefit for those whose welfare or utility would decrease due to the road scheme, from the aggregated estimate of the benefit for those whose welfare would increase.

7.3.6 As discussed in section 6.6.4, the WTP and WTA values incorporate future impacts (impacts on future users and generations) and hence do not need adding over time as this would lead to double-counting of the benefits.

7.3.7 The **aggregate net benefit** of moving the A303 road into a tunnel to **visitors** is **£24.50m**, for **road users** it is **£49.15m**, and for the **general population** it is **£1.20 billion**.[35] The aggregate net benefits figures calculated for whole population groups are driven by the individual WTP and WTA estimates and the size of the relevant population. The relative size of these figures is, therefore, as expected: while the individual WTP of visitors is higher than that of road users and the general population, the total number of visitors is a lot smaller than the number of road users and the general population.

7.3.8 The aggregate figures are consistent with the Maddison and Mourato study (2001). However, a direct comparison is not possible because of differences in road options, survey design etc. For example, Maddison and Mourato were considering the removal of two roads at the time – the A344 (which has since been removed) and the A303, they assumed a two-year period of payments, they did not include a road user sample, and the values were calculated at the

[35] All figures are Net Present Values in 2016 prices.

household and not individual level. More detail on this in section 3.3 and Appendix B.

7.3.9 This results in an estimated **aggregate net present value of £1.3 billion for the whole of the UK for the removal of the section of the A303 into a tunnel.**

**Table 10 Aggregation to population values**

| | WTP/WTA variable | Number of responses | % of study group | Relevant population | Mean individual (£) | NPV individual WTP (£) | Aggregated values for population group |
|---|---|---|---|---|---|---|---|
| Visitors | Annual tax (WTP over three years) | 289 | 67.4% | 368,292 | £23.39 | £67.8 | **£24,501,877** |
| | Compensation (one off WTA) | 2 | 0.5% | 2,549 | £187.50 | *n/a* | |
| | WTP and WTA = £0 | 138 | 32.2% | 175,863 | *n/a* | *n/a* | |
| Road Users | Annual tax (WTP over three years) | 628 | 67.4% | 822,033 | £21.51 | £62.3 | **£49,145,539** |
| | Compensation (one off WTA) | 20 | 2.1% | 26,179 | £81.35 | *n/a* | |
| | WTP and WTA = £0 | 284 | 30.5% | 371,747 | *n/a* | *n/a* | |
| General Population | Annual tax (WTP over three years) | 1159 | 59.2% | 30,445,460 | £14.41 | £41.7 | **£1,203,428,521** |
| | Compensation (one off WTA) | 45 | 2.3% | 1,182,093 | £57.90 | *n/a* | |
| | WTP and WTA = £0 | 754 | 38.5% | 19,806,624 | *n/a* | *n/a* | |
| **Total net present value** | | | | | | | **£1,277,075,937** |

*Notes: (i) The NPV calculation uses the standard HM Treasury discount rate (3.5%); (ii)The population sizes are described in section 6.1; (iii) The percentage calculations of relevant populations are based on four decimal places (only one decimal place reported in the table); (iv) For each study group, the aggregated value multiplies NPV individual WTP by the relevant population and subtracts it by the mean WTA multiplied by relevant population. (v)The relevant population column is calculated by multiplying the % of study group by the total population; (vi) The calculations presented in the table use numbers with multiple decimal places. The aggregated values for population group will not, therefore, exactly match the result if using the rounded numbers in the table.*

## 7.4 Validity test results

7.4.1 Table 11 shows the results for equation (2) where we test for theoretical validity of the WTP estimates using a pooled regression model that includes data from all three study groups. We include variables which are relevant covariates of WTP (Bishop 2002) plus the variable which reflects the respondent's certainty that they would be willing to pay and a dummy variable

for each study group in the sample (with the baseline being the visitors group).[36] The dependent variable includes positive WTP responses only.

**Table 11 Validity testing: Regression results for WTP**

| Variable | WTP | P-value |
|---|---|---|
| Female | -4.247*** | 0.01 |
| Log age | 1.552 | 0.63 |
| Log income | 6.500*** | 0.00 |
| Children | 4.541** | 0.02 |
| Married/with partner | -3.201* | 0.06 |
| University education | -2.908 | 0.11 |
| In employment (full time, part time, self-employed) | -1.328 | 0.58 |
| Health | 0.870 | 0.55 |
| Ethnicity | 2.749 | 0.44 |
| Student | -0.796 | 0.87 |
| Retired | -0.348 | 0.90 |
| Number of times visited Stonehenge | 1.093* | 0.06 |
| Likely | 2.979** | 0.05 |
| Member | 7.064*** | 0.00 |
| Drivers license | -0.442 | 0.80 |
| Familiar with the impact of A303 | 7.798*** | 0.00 |
| Certainty | 6.802*** | 0.00 |
| Road users | -4.541 | 0.16 |
| General population | -4.057 | 0.18 |
| Constant | -61.849 | 0.001 |
| ***Observations*** | **1666** | |
| *Note: *** significance at <1%; ** significance at <5%; * significance at <10%.* | | |

Note: *** significance at <1%; ** significance at <5%; * significance at <10%. Respondents who had not answered the question on income are excluded from the validity tests. The WTP dependent variable only includes those with a positive WTP. The baseline for the sample dummies is the visitor study group.

7.4.2 **Theoretical validity**: As predicted by economic theory (Bateman and Willis 2001), **income** has a statistically significant and positive association with WTP ; **certainty of paying** has a statistically significant and positive association with WTP; people that **visit Stonehenge more often** have a higher WTP, **Membership** in a heritage organisation has a statistically significant association with WTP; **Familiarity** with information provided on the impact of A303 on the WHS has a statistically significant and positive association with WTP. Despite visitors having a higher mean WTP in Table 9, the general population and road user group dummies are insignificant. This is likely to be

[36] Since the theoretical foundations of WTA values are less well-known and researched we focus on validity checks for WTP here.

due to controlling for the factors which drive the higher visitor WTP such as income, likelihood of future use or membership in a heritage organisations.

7.4.3 **Certainty**: the second element of validity testing is to test whether certainty of paying has an impact on people's stated WTP amount. Certainty has a statistically significant and positive association with WTP. A positive association implies that on average, those who are certain that they would make the payment have a higher WTP, which in itself adds validity to the mean WTP calculations. However, we note that previous studies have found inconsistencies in the reported direction of the association between certainty and WTP (Bakhshi et al. 2015). We therefore recommend further sensitivity analysis of certainty levels (see section 8).

# 8 Sensitivity Analysis

## 8.1 Confidence intervals

8.1.1 Table 12 shows aggregated net benefit and the 95% confidence intervals.[37] The lower/ upper bound aggregations use the lower/ upper bound WTP/WTA amounts shown in Table 9, in place of the mean individual WTP/ WTA. This results in a range for the overall net WTP for the whole population. Table 12 shows the results:

**Table 12 Confidence intervals for the aggregate WTP**

| | Lower bound of 95% confidence interval | Aggregated net benefit | Upper bound of 95% confidence interval |
|---|---|---|---|
| Visitors | £20,155,514 | £24,501,877 | £28,848,251 |
| Road Users | £42,253,524 | £49,145,539 | £56,037,529 |
| General Population | £1,083,180,378 | £1,203,428,521 | £1,323,675,770 |
| Total | £1,145,589,416 | £1,277,075,937 | £1,408,561,550 |

8.1.2 These results show that even at the lower bound of the confidence interval the aggregate net WTP for the removal of the A303 into a tunnel is **£1.15 billion**, with an upper bound of **£1.41 billion**.

## 8.2 Certainty of payment

8.2.1 Willingness to pay studies can be subject to hypothetical bias, as discussed in section 5. Respondents know that they are unlikely to have to pay the amount they state. This can lead to an overclaiming of the WTP. While it is not possible to completely overcome this bias one way of addressing it is to ask responds how certain they are (on a scale of 1 to 5 – with 5 being very certain) that they would pay the stated amount. Empirical studies such as Bakshi et al show that this has a positive impact on the validity of results (Bakshi et al. 2015).

8.2.2 To test the impact of those respondents who are not certain that they would pay the amount stated on the aggregate value we equalise their WTP to zero. Table 13 below shows the impact of assuming that the respondents who were uncertain about their stated WTP value had a £0 WTP.[38] This results in an aggregated value of **£1.17 billion**, which sits within the confidence interval described in Table 12. While this does not eliminate the hypothetical bias it

[37] A confidence interval is a statistical measure. It is a range of values so defined that we are 95% certain that the value provided lies within it.

[38] These were respondents who did not know how certain they were or responded as 1-2 on a 5 point scale where 1 = not at all certain and 5 = very certain about their WTP amount.

provides those who are uncertain with an opportunity to express this, and the researchers the opportunity to test the robustness of the valuation.

**Table 13 Certainty sensitivity analysis impact on aggregated results**

| | WTP/WTA variable | Number of responses | % of study group | Relevant population | Mean individual (£) | NPV individual WTP (£) | Aggregated values for population group |
|---|---|---|---|---|---|---|---|
| Visitors | Annual tax (three year WTP) | 262 | 61.1% | 333,884 | £24.59 | £71.32 | **£23,333,387** |
| | Compensation (one off WTA) | 2 | 0.5% | 2,549 | £187.50 | *n/a* | |
| | WTP and WTA = £0 | 165 | 38.5% | 210,270 | *n/a* | *n/a* | |
| Road Users | Annual tax (three year WTP) | 577 | 61.9% | 755,275 | £22.25 | £64.51 | **£46,590,044** |
| | Compensation (one off WTA) | 20 | 2.1% | 26,179 | £81.35 | *n/a* | |
| | WTP and WTA = £0 | 335 | 35.9% | 438,505 | *n/a* | *n/a* | |
| General Population | Annual tax (three year WTP) | 997 | 50.9% | 26,189,925 | £15.35 | £44.51 | **£1,097,288,571** |
| | Compensation (one off WTA) | 45 | 2.3% | 1,182,093 | £57.90 | *n/a* | |
| | WTP and WTA = £0 | 916 | 46.8% | 24,062,158 | *n/a* | *n/a* | |
| **Total net present value** | | | | | | | **£1,167,212,003** |

*Notes: (i) The NPV calculation uses the standard HM Treasury discount rate (3.5%); (ii)The population sizes are described in section 6.1; (iii) The percentage calculations of relevant populations are based on four decimal places (only one decimal place reported in the table); (iv) For each study group, the aggregated value multiplies NPV individual WTP by the relevant population and subtracts it by the mean WTA multiplied by relevant population. (v)The relevant population column is calculated by multiplying the % of study group by the total population; (vi) The calculations presented in the table use numbers with multiple decimal places. The aggregated values for population group will not, therefore, exactly match the result if using the rounded numbers in the table.*

# 9 Conclusion

9.1.1 The study applies best practice stated preference methods (contingent valuation) to elicit the total net benefits associated with the hypothetical reduction in noise, increased tranquillity, increased visual amenity and reduced landscape severance associated with the removal of the A303 from part of the Stonehenge WHS for three population groups: Stonehenge visitors, road users, and the UK resident general population (aged 16 and over). Individual level mean WTP and WTA values and zero response rates are in line with comparable results from heritage studies in the UK and international studies of World Heritage sites. Validity tests show that WTP and WTA are consistent with theoretically consistent drivers of value (Bateman et al. 2002), with additional sensitivity analyses performed on respondent certainty levels. Surveys were carefully designed following best practice to reduce known biases in CV surveys (Bakhshi et al. 2015).

9.1.2 While the values elicited in this study cannot be directly translated into cashable benefits, they represent the value that the improvements achieved by the road scheme will have for users and non-users of the WHS. They therefore form a key component of the overall cost-benefit analysis of this scheme. They have been conducted in strict adherence to the Green Book guidance on appraisal and evaluation.

# 10 References


Ajzen, Icek, Thomas C. Brown, and Lori H. Rosenthal. 1996. 'Information Bias in Contingent Valuation: Effects of Personal Relevance, Quality of Information, and Motivational Orientation'. *Journal of Environmental Economics and Management* 30 (1): 43–57. doi:10.1006/jeem.1996.0004.

Arrow, Kenneth, and Robert Solow. 1993. *Report of the NOAA Panel on Contingent Valuation*. National Oceanic and Atmospheric Administration Washington, DC. http://www.cbe.csueastbay.edu/~alima/courses/4306/articles/NOAA%20on%20contingent%20valuation%201993.pdf.

Báez, Andrea, and Luis César Herrero. 2012. 'Using Contingent Valuation and Cost-Benefit Analysis to Design a Policy for Restoring Cultural Heritage'. *Journal of Cultural Heritage* 13 (3): 235–45. doi:10.1016/j.culher.2010.12.005.

Báez-Montenegro, Andrea, Ana María Bedate, Luis César Herrero, and Jose Ángel Sanz. 2012. 'Inhabitants' Willingness to Pay for Cultural Heritage: A Case Study in Valdivia, Chile, Using Contingent Valuation'. *Journal of Applied Economics* 15 (2): 235–58. doi:10.1016/S1514-0326(12)60011-7.

Bakhshi, H., Daniel Fujiwara, R. N. Lawton, Susana Mourato, and Paul Dolan. 2015. 'Measuring Economic Value in Cultural Institutions'. Cultural Value Project. London, UK: Arts and Humanities Research Council.

Bakshi, H., Fujiwara, Daniel, Ricky Lawton, Susana Mourato, and Paul Dolan. 2015. 'Measuring Economic Value in Cultural Institutions (Cultural Value Project)'. Arts and Humanities Research Council, London, UK.

Bateman, I. J., R. T. Carson, B. Day, M. Hanemann, N. Hanley, T. Hett, M. Jones-Lee, et al. 2002. *Economic Valuation with Stated Preference Techniques: A Manual*. Cheltenham, UK: Edward Elgar.

Bateman, Ian J., R.T. Carson, Brett Day, M Hanemann, Nick Hanley, T Hett, and et al. 2002. *Economic Valuation with Stated Preference Techniques: A Manual*. Cheltenham, UK: Edward Elgar.

Bateman, Ian J., and Kenneth George Willis. 2001. *Valuing Environmental Preferences: Theory and Practice of the Contingent Valuation Method in the US, EU, and Developing Countries*. Oxford University Press.

Bedate, Ana María, Luis César Herrero, and José Ángel Sanz. 2009. 'Economic Valuation of a Contemporary Art Museum: Correction of Hypothetical Bias Using a Certainty Question'. *Journal of Cultural Economics* 33 (3): 185–99. doi:10.1007/s10824-009-9098-y.

Bennett, Jeff, Mark Morrison, and Russell Blamey. 1998. 'Testing the Validity of Responses for Contingent Valuation Questioning'. *The Australian Journal for Agriculture and Resource Economics* 42 (2): 131–48.

Bishop, Richard C. 2002. 'Where to from Here?' In *A Primer in Nonmarket Valuation*. The Economics of Non-Market Goods and Resources. Kluwer Academic Publishers.

Boxall, Peter C., Jeffrey Englin, and Wiktor L. Adamowicz. 2003. 'Valuing Aboriginal Artifacts: A Combined Revealed-Stated Preference Approach'. *Journal of Environmental Economics and Management* 45 (2): 213–30. doi:10.1016/S0095-0696(02)00063-3.

Boyle, Kevin J. 2002. 'Contingent Valuation in Practice'. In *A Primer on Nonmarket Valuations*, 111–70.

Brown, Thomas C, and Robin Gregory. 1999. 'Why the WTA–WTP Disparity Matters'. *Ecological Economics* 28 (3): 323–35. doi:10.1016/S0921-8009(98)00050-0.

Burgess, Jacquelin, Judy Clark, and Carolyn Harrison. 2000. 'Culture, Communication, and the Information Problem in Contingent Valuation Surveys: A Case Study of a Wildlife Enhancement Scheme'. *Environment and Planning C: Government and Policy* 18 (5): 505–24. doi:10.1068/c1s.

Cameron, Trudy Ann, and Daniel D Huppert. 1989. 'OLS versus ML Estimation of Non-Market Resource Values with Payment Card Interval Data'. *Journal of Environmental Economics and Management* 17 (3): 230–46. doi:10.1016/0095-0696(89)90018-1.

Carson, Richard T. 1997. ‘Contingent Valuation Surveys and Tests of Insensitivity to Scope’. In *Determining the Value of Non-Marketed Goods*, edited by R. J. Kopp, W. W. Pommerehne, and N. Schwarz, 127–63. Studies in Risk and Uncertainty 10. Springer Netherlands. http://link.springer.com/chapter/10.1007/978-94-011-5364-5_6.
Chakraborty, Archishman, and Rick Harbaugh. 2010. ‘Persuasion by Cheap Talk’. *American Economic Review* 100 (5): 2361–82. doi:10.1257/aer.100.5.2361.
Champ, Patricia A., and Richard C. Bishop. 2001. ‘Donation Payment Mechanisms and Contingent Valuation: An Empirical Study of Hypothetical Bias’. *Environmental and Resource Economics* 19 (4): 383–402.
Champ, Patricia A., Richard C. Bishop, Thomas C. Brown, and Daniel W. McCollum. 1997. ‘Using Donation Mechanisms to Value Nonuse Benefits from Public Goods’. *Journal of Environmental Economics and Management* 33 (2): 151–62. doi:10.1006/jeem.1997.0988.
Creigh-Tyte, S. W. 2000. ‘The Built Heritage: Some British Experience’. *Recherches Économiques de Louvain / Louvain Economic Review* 66 (2): 213–29.
Cummings, Ronald G., and Laura O. Taylor. 1999. ‘Unbiased Value Estimates for Environmental Goods: A Cheap Talk Design for the Contingent Valuation Method’. *The American Economic Review* 89 (3): 649–65.
Darling, Arthur C., and et al. 2000. ‘Uncertainty in Cost-Benefit Analysis Based on Referendum Contingent Valuation’. *Mpact Assessment and Project Appraisal,* 18 (2): 125–37. doi:10.3152/147154600781767466.
Del Saz Salazar, S., and J. Montagud Marques. 2005. ‘Valuing Cultural Heritage: The Social Benefits of Restoring and Old Arab Tower’. *Journal of Cultural Heritage* 6 (1): 69–77. doi:10.1016/j.culher.2004.09.001.
Eftec. 2005. ‘Valuation of the Historic Environment The Scope for Using Results of Valuation Studies in the Appraisal and Assessment of Heritage-Related Projects and Programmes’. London, UK: Economics for the Environment Consultancy. http://www.english-heritage.org.uk/publications/valuation-historic-environment/valuation-historic-environment-final-rep.pdf.
Ericson, Keith M. Marzilli, and Andreas Fuster. 2014. ‘The Endowment Effect’. *Annual Review of Economics* 6 (1): 555–79. doi:10.1146/annurev-economics-080213-041320.
Frederick, Shane, and George Loewenstein. 1999. ‘Hedonic Adaptation’. In *Well-Being: The Foundations of Hedonic Psychology*, edited by D. Kahneman, E. Diener, and N. Schwarz, 302–29. New York, NY: Russell Sage Foundation.
Frey, Bruno S. 1997. ‘Evaluating Cultural Property: The Economic Approach’. *International Journal of Cultural Property* 6 (2): 231–46.
Fujiwara, D., R. Lawton, and S. Mourato. 2015. ‘The Health and Wellbeing Benefits of Public Libraries’. London, UK: SImetrica, Arts Council England. http://www.artscouncil.org.uk/media/uploads/Health_and_wellbeing_benefits_of_public_libraries_full_report.pdf.
Fujiwara, Daniel. 2013. ‘The DWP Social Cost-Benefit Analysis Framework (WP86) - Publications - GOV.UK’. https://www.gov.uk/government/publications/the-dwp-social-cost-benefit-analysis-framework-wp86.
Haab, Timothy C., Matthew G. Interis, Daniel R. Petrolia, and John C. Whitehead. 2013. ‘From Hopeless to Curious? Thoughts on Hausman’s “Dubious to Hopeless” Critique of Contingent Valuation’. *Applied Economic Perspectives and Policy*, October, ppt029. doi:10.1093/aepp/ppt029.
Hanley, Nick, Susana Mourato, and Robert E. Wright. 2001. ‘Choice Modelling Approaches: A Superior Alternative for Environmental Valuatioin?’ *Journal of Economic Surveys* 15 (3): 435–62. doi:10.1111/1467-6419.00145.
Hausman, Jerry. 2012. ‘Contingent Valuation: From Dubious to Hopeless’. *Journal of Economic Perspectives* 26 (4): 43–56. doi:10.1257/jep.26.4.43.
HM Treasury. 2011. ‘The Green Book: Appraisal and Evaluation in Central Government’. HM Treasury. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/220541/green_book_complete.pdf.

———. 2013. ‘Public Sector Business Cases Using the Five Case Model: Green Book Supplementary Guidance on Delivering Public Value from Spending Proposals’.
Horowitz, John K., and Kenneth E. McConnell. 2002. ‘A Review of WTA/WTP Studies’. *Journal of Environmental Economics and Management* 44 (3): 426–47. doi:10.1006/jeem.2001.1215.
Kahneman, Daniel, Alan B. Krueger, David Schkade, Norbert Schwarz, and Arthur A. Stone. 2006. ‘Would You Be Happier If You Were Richer? A Focusing Illusion’. *Science* 312 (5782): 1908–10. doi:10.1126/science.1129688.
Kahneman, Daniel, and Amos Tversky. 1979. ‘Prospect Theory: An Analysis of Decision under Risk’. *Econometrica* 47 (2): 263–91. doi:10.2307/1914185.
Kim, Samuel Seongseop, Kevin K. F. Wong, and Min Cho. 2007. ‘Assessing the Economic Value of a World Heritage Site and Willingness-to-Pay Determinants: A Case of Changdeok Palace’. *Tourism Management* 28 (1): 317–22. doi:10.1016/j.tourman.2005.12.024.
Kim, Younjun, Catherine L. Kling, and Jinhua Zhao. 2015. ‘Understanding Behavioral Explanations of the WTP-WTA Divergence Through a Neoclassical Lens: Implications for Environmental Policy’. *Annual Review of Resource Economics* 7 (1): 169–87. doi:10.1146/annurev-resource-100913-012501.
Lee, Joo-Suk. 2014. ‘Measuring the Benefits of the Intangible Cultural Heritage Hall in Jeonju Korea: Results of a Contingent Valuation Survey’. *Journal of Cultural Heritage*. Accessed November 6. doi:10.1016/j.culher.2014.05.001.
Lockwood, Michael. 1996. ‘Analysing Conflict between Cultural Heritage and Nature Conservation in the Australian Alps: A CVM Approach’. *Journal of Environmental Planning and Management* 39 (3): 357–70. doi:10.1080/09640569612462.
Loewenstein, George, and Daniel Adler. 1995. ‘A Bias in the Prediction of Tastes’. *The Economic Journal* 105 (431): 929–37. doi:10.2307/2235159.
Maddison, David, and Terry Foster. 2003. ‘Valuing Congestion Costs in the British Museum’. *Oxford Economic Papers* 55 (1): 173–90. doi:10.1093/oep/55.1.173.
Maddison, David, and Susana Mourato. 2001a. ‘Valuing Different Road Options for Stonehenge’. *Conservation and Management of Archaeological Sites,* 4 (4): 203–12. doi:10.1179/135050301793138182.
Mitchell, Robert Cameron, and Richard T. Carson. 1989. *Using Surveys to Value Public Goods: The Contingent Valuation Method*. Resources for the Future.
Mourato, S., E. Fimereli, D. Contu, C. Gaskell, and C. Boniatti-Pavese. 2014. ‘The Economic Benefits of Cultural Built Heritage Interiors Conservation from Climate Change Damages in Europe’. WP6 Final Report. London, UK: Grantham Research Institute on Climate Change and the Environment.
https://www.google.co.uk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwjAx_WBlOTNAhXmAMAKHX9cAJ8QFggeMAA&url=http%3A%2F%2Fwww.climateforculture.eu%2Findex.php%3Finhalt%3Ddownload%26file%3Dpages%2Fuser%2Fdownloads%2Fproject_results%2FD_06.1_final_publish.pdf&usg=AFQjCNEmpiNVVbd1Kr66uDCAHhWep4PYWw&sig2=vfs6IqUMCX-ccnmg1HWP7w.
Mourato, Susana, Andreas Kontoleon, and Alexi Danchev. 2002. *Preserving Cultural Heritage in Transition Economies: A Contingent Valuation Study of Bulgarian Monasteries*. Cheltenham, UK: Edward Elgar.
Noonan, Douglas S. 2003. ‘Contingent Valuation and Cultural Resources: A Meta-Analytic Review of the Literature’. *Journal of Cultural Economics* 27 (3–4): 159–76. doi:10.1023/A:1026371110799.
Pearce, David, Giles Atkinson, and Susana Mourato. 2006. ‘Cost-Benefit Analysis and the Environment’. *Recent Developments, Organisation for Economic Co-Operation and Development*.
Pearce, David, and Ece O’zdemiroglu. 2002. ‘Economic Valuation with Stated Preference Techniques Summary Guide’. DETR.
Ruijgrok, E.C.M. 2006. ‘The Three Economic Values of Cultural Heritage: A Case Study in the Netherlands’. *Journal of Cultural Heritage* 7 (3): 206–13. doi:10.1016/j.culher.2006.07.002.

Schkade, David A., and Daniel Kahneman. 1998. ‘Does Living in California Make People Happy? A Focusing Illusion in Judgments of Life Satisfaction’. *Psychological Science* 9 (5): 340–46. doi:10.1111/1467-9280.00066.
Shaw, Catherine, Louca-May Brady, and Ciara Davey. 2011. ‘Guidelines for Research with Children and Young People’. ncb Research Centre.
Shogren, Jason F., Seung Y. Shin, Dermot J. Hayes, and James B. Kliebenstein. 1994. ‘Resolving Differences in Willingness to Pay and Willingness to Accept’. *The American Economic Review* 84 (1): 255–70.
Sieber, Patrik, and Jan Melichar. 2014. ‘Ekonomické Hodnocení Hluku Ze Silniční Dopravy: Studie Podmíněného hodnocení<BR>[The Economic Valuation of Road Traffic Noise: The Contingent Valuation Study]’. *Politická Ekonomie* 2014 (6): 824–49.
Throsby, C. D., and Glenn A. Withers. 1986. ‘Strategic Bias and Demand for Public Goods’. *Journal of Public Economics* 31 (3): 307–27. doi:10.1016/0047-2727(86)90063-0.
Toluna. 2016. ‘ESOMAR 28’.
Tuan, Tran Huu, and Stale Navrud. 2007. ‘Valuing Cultural Heritage in Developing Countries: Comparing and Pooling Contingent Valuation and Choice Modelling Estimates’. *Environmental and Resource Economics* 38 (1): 51–69. doi:10.1007/s10640-006-9056-5.
US EPA. 2000. ‘Guidelines for Preparing Economic Analyses’. Washington DC: US Environmental Protection Agency.
Whynes, David K., Jane L. Wolstenholme, and Emma Frew. 2004. ‘Evidence of Range Bias in Contingent Valuation Payment Scales’. *Health Economics* 13 (2): 183–90. doi:10.1002/hec.809.
Willis, Kenneth George. 1994. ‘Paying for Heritage: What Price for Durham Cathedral?’ *Journal of Environmental Planning and Management* 37 (3): 267–78.
Wooldridge, Jeffrey M. 2010. *Econometric Analysis of Cross Section and Panel Data*. MIT Press.