Malvern Hills & Commons

Health Economic Assessment

April 2019

by

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I. Executive Summary

This Health Economic Assessment explores the physical and mental health benefits of the Malvern Hills and Commons. The area covers some 3000 acres of open access land in the Malvern Hills Area of Outstanding Natural Beauty (AONB), around the borders of Herefordshire and Worcestershire. The Hills and Commons are owned and managed by a charitable body called the Malvern Hills Trust for the purposes of public amenity and conservation.

A growing body of evidence suggests that accessible, high quality greenspaces close to where people live contribute to people's health and wellbeing. All age and socio-economic groups benefit from contact with natural environments. Living in greener environments is associated with maintaining a healthy immune system and reduced mortality.

Natural environments support higher levels of physical activity and therefore physical health outcomes. Studies have shown that regular park users are healthier than their counterparts. This applies for a range of measures such as diastolic and systolic blood pressure as well as general health which helps to prevent obesity, diabetes, heart diseases and strokes. Accessible greenspace also offers opportunities for informal (accidental) 'green' exercise to members of the public who are usually excluded from formal recreation.

Exposure to nature can improve mental health and wellbeing including lowering rates of stress, fatigue, anxiety and depression. Researchers found a causal relationship between surrounding greenspace and mental health as part of a systematic review. Scientific evidence also suggests a positive correlation between natural environments and social cohesion.

Both physical inactivity and mental health problems cause hundreds of millions of pounds in health and social care costs every year. A proportion of these costs could be avoided by improving contact with the natural environment and by encouraging 'green' exercise. And these cost savings are in addition to the direct quality of life benefits associated with improved public health.

In this investigation, the physical and mental health benefits provided by the Malvern Hills and Commons were assessed in monetary terms. The assessment finds that the annual physical and mental health value is in the magnitude of £4.2 million and £1.6 million, respectively. It is estimated that the health benefits add 87 Quality Adjusted Life Years (QALYs) to users each year.

The total health economic value of the Malvern Hills and Commons is estimated to be in the region of £5.8 million annually or £305 million capitalised over an assessment timescale of

100 years. This includes quality of life benefits, health and social care cost savings as well as economic output gains.

Figure I.1 Health Benefits Provided by the Malvern Hills and Commons

Monetary Accounts			
Annual Natural Capital Value	*Central estimate*	*High*	*Low*
Physical Health Benefit	**£4,195,000**	*£6,932,000*	*£2,573,000*
Mental Health Benefits	**£1,624,000**	*£1,901,000*	*£244,000*
Total	**£5,819,000**	*£8,833,000*	*£2,817,000*
Capitalised Natural Capital Value	*Central estimate*	*High*	*Low*
Physical Health Benefit	**£219,823,000**	*£693,217,000*	*£134,847,000*
Mental Health Benefits	**£85,085,000**	*£190,108,000*	*£10,724,000*
Total	**£304,908,000**	*£883,325,000*	*£145,571,000*
Present values, 2018 prices; capital. value disc. at 1.5% over 100 years for cent. est.; High/Low : Range of sensitivity analysis.			

Source: ***Author calculation.***

This Health Economic Assessment shows just how important the Malvern Hills and Commons are to support public health – locally and to the wider population. It is hoped that this new evidence may encourage a consideration of the application of health budgets to the effective management and facilitated access of parts of the Malvern Hills AONB as a measure of preventative healthcare intervention. This could include initiatives such as organised health walks or prescribed outdoor exercise.

Such investment would be in line with the Government's ambition to 'help people improve their health and wellbeing by using greenspaces including through mental health services', recently published in its 25 Year Environment Plan (2018). It is hoped that this assessment can encourage collaboration between the Malvern Hills Trust and other landowners in the AONB and public health bodies to better achieve the shared goal of improving people's health and wellbeing.

This study has been based on recognised and accepted approaches to economic valuation, such as those used to establish Office for National Statistics (ONS) National Natural Capital Accounts. It also includes more experimental approaches. Assumptions and caveats related to this work can be found in the main body of the report.

Acknowledgements

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1. Introduction and Background

1.1 Project Aims and Objectives

This research builds on the Malvern Hills AONB Natural Capital Scoping Study published in 2017 which explored the valuable benefits of the AONB to support people's wellbeing; mainly in qualitative terms (Hölzinger, 2017).

The overall aim of this study is to specifically assess, in economic terms, the benefits derived from the Malvern Hills AONB in respect of people's health and wellbeing. The specific objectives are:

1. To describe the range of physical and mental health benefits derived from the study area;

2. To outline the methodologies and principles employed in calculating economic health values and to acknowledge any perceived or real weaknesses or shortcomings in the methodological approach, data etc.; and

3. To calculate and monetise the physical and mental health benefits derived from the land owned and managed by the Malvern Hills Trust in the AONB (the Malvern Hills and Commons).

1.2 Assessment Scope: The Malvern Hills and Commons

The Malvern Hills Area of Outstanding Natural Beauty (AONB) is 105 km^2 in size, covering parts of the three counties of Gloucestershire, Herefordshire and Worcestershire. It stretches from the edge of Malvern in the east to the edge of Ledbury in the west, and from the A44 in the north to the M50 in the south. The AONB has an estimated population of 12,200. From the early 1800s the area was very popular for its pure spring water which lead to great popularity with tourists and visitors.

An earlier assessment of the AONB has revealed that healthy, high quality Natural Capital assets which includes for example all greenspaces are critically important to both people and wildlife. This systematic qualitative assessment showed that the AONB and its Natural Capital is not just a 'good to have'. It is essential for the wellbeing of those living in the AONB as well as those visiting the area.

This is because the AONB provides a wide range of so-called ecosystem services to people which include food and timber, great opportunities for outdoor recreation, the aesthetic values and sense of place which give the AONB its designation status, the regulation of flooding events and the mitigation of climate change by storing carbon in vegetation and

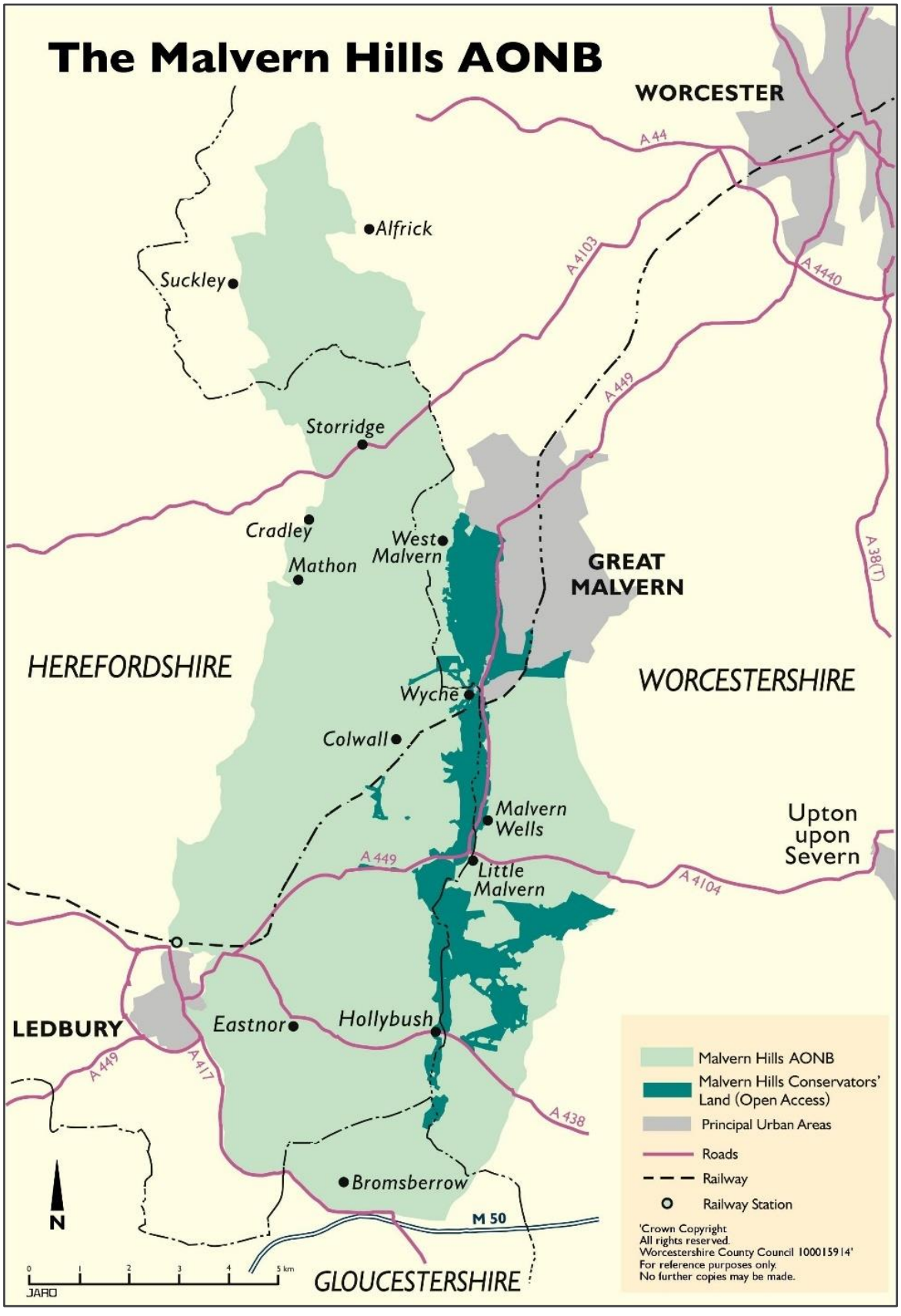
soils; to name just a few. Natural Capital is also directly and indirectly contributing to the visitor-based economy of the AONB (Hölzinger, 2017).

The opportunities for outdoor recreation and the great aesthetic value of the AONB suggests that the area also provides substantial health benefits to visitors from close and far. This study has been commissioned to explore these benefits in more detail by estimating their economic value.

The focus of this study is specifically on the physical and mental health benefits provided by the Malvern Hills and Commons. The Malvern Hills and Commons (labelled as Malvern Hills Trust (Conservators) Land in Figure 1.1) includes the Malvern Hills themselves and areas of open common land on flatter ground around the Hills. The majority of the Hills and Commons is located within the boundaries of the AONB, they cover about 11% of the AONB area.[1] Full of natural and cultural heritage, a charitable body called the Malvern Hills Trust looks after this iconic landscape for the benefit of the local community and for nature conservation purposes.

[1] A smaller area of the Commons (not shown in Figure 1.1) is located outside the AONB boundaries. This area is not included in the assessment.

Figure 1.1 Malvern Hills and Commons Location Map



Source: ***Malvern Hills AONB Partnership***

1.3 Natural Greenspace and its Public Health Benefits

Natural greenspaces do many good things for people even if this is not always recognised (Hölzinger, 2017; Millennium Ecosystem Assessment, 2005; UK NEA, 2011). A growing body of evidence suggests that contact with nature directly contributes to improving people's health and wellbeing (Defra, 2017).

About three out of four UK adults agree that greenspaces are important for their general health (Kuppuswamy, 2009). Large-scale studies from the Netherlands, Sweden and Japan suggest that the availability of accessible local greenspace and human health are directly related (Grahn and Stigsdotter, 2003; Vries et al., 2003).

Accessible high quality greenspace close to where people live is, for example, associated with a positive effect on self-rated health and consistent evidence shows that contact with greenspace during pregnancy is associated with fetal growth and higher birth weight (Defra, 2017). The availability of greenspaces close to where people live is also known to reduce mortality rates:

> *"An extensive and robust body of evidence suggests that living in greener environments (e.g. greater percentage of natural features around the residence) is associated with reduced mortality. Reduced rates of mortality have been found for specific population groups including men, infants and lower socio-economic groups. There is evidence to suggest that health inequalities in mortality may be reduced by greener living environments."*
> (Defra, 2017, p. 2)

A recently released report by Natural England has revealed that, whilst children and young people generally spend more time outdoors than their adult counterparts, childern of lower income areas are less likely to spend time in the natural environment than children of higher income areas. The findings which are based on national survey data from the Monitor of Engagement with the Natural Environment (MENE) highlight the importance of local greenspaces for children's play and experience of the natural world. Across all age groups and backgrounds, local greenspaces provide an important opportunity for children to experience the natural environment on a regular basis (Natural England, 2019).

Another major health benefit of exposure to the natural environment is related to maintaining a healthy immune system and the reduction of inflammatory-based diseases such as asthma. There is strong evidence suggesting that direct contact with nature is important for the development of a healthy microbiome, the consortium of microorganisms that cohabit the human body (Sandifer et al., 2015).

The Government recognises the positive effects of greenspaces on people's health and commits in its 25 Year Environment Plan (HM Government, 2018, p. 71) to:

- Help people improve their health and wellbeing by using green spaces including through mental health services.
- Encourage children to be close to nature, in and out of school, with particular focus on disadvantaged areas, and
- 'Green' our towns and cities by creating green infrastructure and planting one million urban trees.

To kick-off the process, the Government made 2019 a year of action for the environment, working with partners to help children and young people from all backgrounds to engage with nature and improve the environment.

In this report the general physical and mental health benefits of greenspaces are introduced in Sections 1.3.1 and 1.3.2 below. Later in Sections 2.2 and 2.3 the value of the physical and mental health benefits provided by the Malvern Hills and Commons are considered in economic terms.

1.3.1 Greenspace and Physical Health

The Active Lives Survey carried out by Sport England shows that 60.5% of the adult population in Worcestershire and Herefordshire were regularly physically active (150+ minutes a week) in 2016/17 which is similar to the English average (Sport England, 2017).

Apart from the negative effects on human wellbeing and reduced life expectancy, physical inactivity also causes significant expenses to the healthcare system and therefore society. The annual costs of physical inactivity to the NHS Clinical Commissioning Groups are estimated to be between £455 and £944 million annually. These figures represent conservative estimates as only five diseases and no indirect costs were considered as part of this calculation (Public Health England, 2016).

Several studies have shown that regular park users are healthier than their counterparts. This applies for a range of measures such as diastolic and systolic blood pressure, depression score and perception of general health (Ho et al., 2003). The availability of accessible greenspace close to where people live is increasingly being recognised as improving people's health by providing a setting for physical activity (Coombes et al., 2010). It is also known that the prevalence of street trees can encourage people to walk or cycle to work more often (van den Berg et al., 2003). This, in turn, helps prevent the onset of diseases such as obesity, diabetes, heart diseases and strokes.

In a systematic evidence review of the links between greenspace and obesity, Lachowycz and Jones (2011) found that the majority of reviewed papers (68%) suggest a weak positive association between greenspace and obesity-related health indicators. However, overall findings were mixed and inconsistent.

The availability of accessible greenspaces also offers opportunities for informal (accidental) 'green' exercise to members of the public who, due to a lack of time, income or confidence, do not go to the gym or take part in other organised sports such as joining a football club (Withall et al., 2011). Hence, making greenspace more accessible to those groups could help to reduce health-inequalities.

In an evidence review of the links between urban greenspace and health, the World Health Organisation (WHO) suggests that particularly older people find it very difficult to maintain moderate physical activity levels. Providing greenspaces that are accessible and attractive to the older population can therefore help to keep the older population active and therefore contribute to public health. This even applies if the encouraged physical activity is only light (WHO, 2016).

The WHO (2016) review also found that the availability of greenspaces close to where people live can lead to positive behaviour change with respect to physical activity levels. Evidence from Australia suggests that the availability of greenspaces close to home can help to maintain recreational walking over time (Sugiyama et al., 2014). Furthermore, it is suggested that physical activity in greenspaces and natural environments are linked to enhanced benefits when compared to similar exercise in other environments (Marselle et al., 2013). Running in a park, for example, is associated with a more restorative experience when compared to running in an urban environment (Bodin and Hartig, 2003).

A recent evidence statement on the links between natural environments and human health, Defra states that:

> *"Natural environments are associated with and may support higher levels of physical activity and therefore physical health. Studies have found that specific natural environments such as woodlands, gardens, parks, grassland and farmland, are supportive of vigorous activity."*
> (Defra, 2017, p. 2)

Whilst further research is required, the available evidence shows a link between the availability of accessible greenspace close to where people live and physical health. Physical activity in natural environments, in turn, can also contribute to improved mental health. Mitchell (2013) suggests that physical activity in natural environments may provide greater mental health benefits than physical activity elsewhere and that regular use of woodland

and forests for exercise, for example, could cut the risk of poor mental health in half when compared to non-users.

1.3.2 Greenspace and Mental Health

More than 40% of English adults state that they have had a mental disorder at some point with 13% of adults reporting that they had a mental disorder diagnosed in the last 12 month (Stansfeld et al., 2016). The Centre for Mental Health estimates that in 2009/10, the economic and social costs of mental health problems in England were estimated to be in the region of £105 billion. The study concludes that timely and effective responses to people with mental health difficulties are excellent value for public money (Centre for Mental Health, 2010). One way to achieve better mental health outcomes could be to improve access to and facilitate contact with nature.

A consistent body of evidence suggests that exposure to natural environments improves mental health. A twin study conducted by Cohen-Cline et al. (2015), for example, suggests that greater access to greenspace is associated with reducing depression, though it provided less evidence of positive effects on stress or anxiety. Gascon et al. (2015) also found evidence of a causal relationship between surrounding greenspace and mental health as part of a systematic review of the relationship between long-term exposure to natural environments and mental health. A study by Alcock et al. (2014) of the longitudinal effects of moving to greener and less green urban areas on mental health suggests that moving to greener urban areas was associated with sustained mental health improvements.

Accessible greenspace can also reduce social inequalities. Mitchell et al. (2015) found that socioeconomic inequality in mental wellbeing is 40% narrower among those who report good access to green/recreational areas, compared with those with poorer access. Weimann et al. (2015) also found that particularly vulnerable groups of the population (with a poorer prognosis for good general health) may benefit more from greener neighbourhoods than the general population.

A systematic review also found a positive correlation between social cohesion and natural environments (Hartig et al., 2014). In Chicago, residents were randomly assigned to similar high-rise buildings; but with various amounts of surrounding vegetation. This unintended social experiment revealed that the presence of greenery around buildings was positively associated with the use of common spaces and the contact with neighbours. This, in turn, was positively related to the sense of safety of residents (Kuo et al., 1998).

A recent review of the links between natural environments and human health by the European Centre for Environment and Human Health and the University of Exeter Medical School for Defra concludes that:

> *"There is relatively robust evidence of a relationship between mental health and wellbeing outcomes, including lower rates of stress, fatigue, anxiety and depression, and exposure to natural environments."*
> (Defra, 2017, p. 11)

There are two main theories why greenspaces and natural settings in general can improve mental health. The *psycho-physiological stress reduction theory* proposes that contact with/the view of nature by those with high levels of stress shifts the mind to a more positive emotional state. This is because people perceive natural settings as non-threatening and relaxing. The *Attention Restoration Theory* on the other hand suggests that involuntary attention given to interesting and rich natural settings helps to improve performance in cognitive demanding tasks. There are two types of attention: direct attention and fascination (effortless involuntary attention). The former requires effort and is a limited resource whilst the latter, stimulated through environmental settings for example, restores this limited resource again. Both theories suggest that, whilst through different functions, the natural environment has a restorative function on the mental state of people (WHO, 2016).

2. Methods

2.1 Introduction to the Monetary Valuation of Health Benefits and its Limitations

2.1.1 Introduction to Natural Capital Accounting

In 2011, the UK Government published its Natural Environment White Paper (NEWP) making a commitment to *"put natural capital at the heart of government accounting"* (HM Government, 2011, p. 36). In the academic literature, calls have been made for quite some time to better integrate the value of Natural Capital and ecosystem services into accounting and decision-making (see e.g. Costanza et al., 1997).

In 2012 the Office for National Statistics (ONS) published a roadmap which set out a strategy to incorporate Natural Capital into UK Environmental Accounts by 2020 (ONS, 2012) and subsequently developed National Natural Capital Accounts for different habitat and asset types. The ONS defines Natural Capital Accounts as:

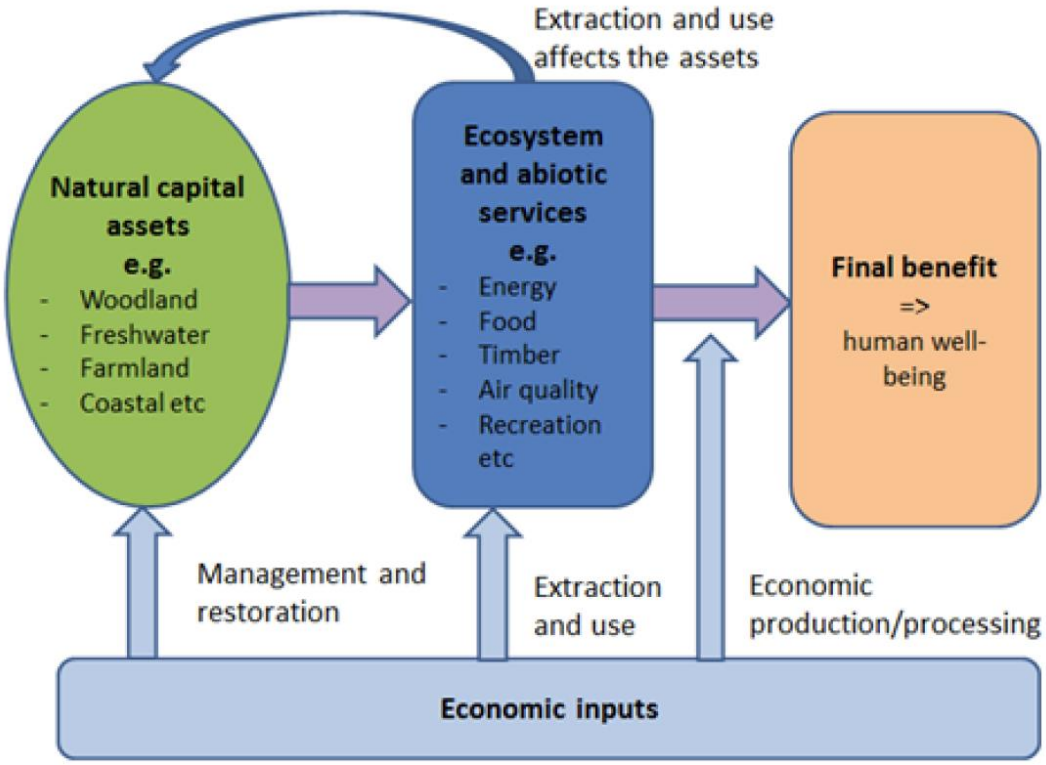
> *"…a series of interconnected accounts that provide a structured set of information relating to the stocks of Natural Capital and flows of services supplied by them."* (ONS and Defra, 2017, p. 3)

The flow of goods and services supplied by Natural Capital is called ecosystem services which are *"the benefits people obtain from ecosystems"* (Millennium Ecosystem Assessment, 2005, p. V) such as space for recreation including associated health benefits and flood risk mitigation services. Natural Capital can be defined as follows:

> *"Natural Capital is the sum of our ecosystems, species, freshwater, land, soils, minerals, our air and our seas. These are all elements of nature that either directly or indirectly bring value to people and the country at large. They do this in many ways but chiefly by providing us with food, clean air and water, wildlife, energy, wood, recreation and protection from hazards."*
> (HM Government, 2018, p. 19)

This study employs the principles of Natural Capital Accounting (ONS and Defra, 2017) to assess only the health benefits of the Malvern Hills and Commons. It should be noted that Natural Capital Accounting at all geographical scales is still a developing area of research. This assessment for the Malvern Hills and Commons adds to this research field.

Figure 2.1 The Links Between Assets, Services & Final Benefits



Source: ***ONS and Defra (2017), p. 4***

2.1.2 The Benefit Transfer Approach and its Limitations

To quantify health benefits provided by the Malvern Hills and Commons in monetary terms, the benefit transfer approach has been applied. Valuation evidence from research carried out elsewhere or, for example, at the national scale were transferred to the assessment area (Malvern Hills and Commons) applying suitable precautions and assumptions as outlined in the following sections. Where possible, adjustments regarding context-specific circumstances and socio-economic variables such as population density have been applied to minimise potential transfer-errors.

Carrying out original primary valuation studies was beyond the scope of this study as such studies demand extensive resources and lengthy timescales. The application of the benefit transfer approach can be seen as a practical and cost-effective way of quantification for decision-making purposes (Defra, 2007).

Whilst the methodological approach utilised here has been applied with caution it is necessary to recognise the following potential limitations and caveats:

1. Application of the benefit transfer approach can result in potential transfer errors. Usually, the study area (where primary valuation studies are conducted) and the policy area (in this case the Malvern Hills and Commons) are not entirely similar.

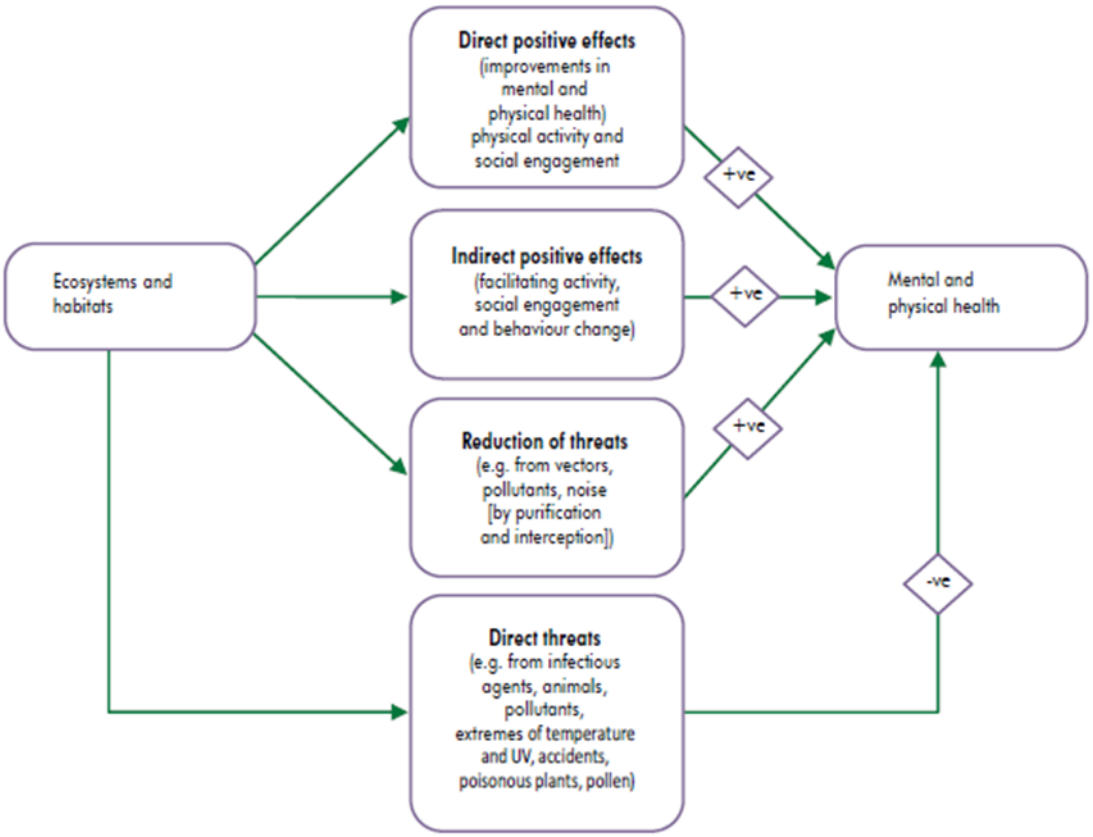
Even if adjustments with respect to socio-economic differences were applied as carefully as possible, a benefit transfer error can never be ruled out.

2. General scientific uncertainties concerning the primary valuation study and the causal links between greenspaces and health (see Section 1.3 and Sections 2.2 and 2.3, respectively).

3. Further limitations are linked to general scientific and socioeconomic uncertainties such as the future impacts of climate change, future population growth or changes in the use of greenspaces as we estimate future values of health benefits.

4. The available scientific evidence to date does not allow for the full calculation of monetary values for all possible health benefits. They often only cover certain aspects (see the relevant Sections for further details). It should be noted that almost all ecosystem services provided by the Malvern Hills and Commons have some impact on human health (see Figure 2.2). Hence, it needs to be stressed that this assessment only covers part of the overall health benefits of the Malvern Hills and Commons.

Figure 2.2 Health Benefits and Threats from Ecosystems



Source: ***Adapted from Pretty et al. (2011, p. 1157)***

For these reasons, calculated values should be regarded as essentially indicative of the magnitude of the benefits. Despite the uncertainties, the ONS and Defra conclude that:

> *"For high-level ecosystem accounting a degree of uncertainty is acceptable where the main purpose is to estimate orders of magnitude…"*
> (ONS and Defra, 2017, p. 10)

Caveats related to this specific assessment are outlined where relevant in the following sections.

2.1.3 Sensitivity Analysis

To take uncertainties into account within this investigation, a sensitivity analysis has been applied. Sensitivity analysis is the study of how uncertainty in the output of a model can be apportioned to different sources of uncertainty in its inputs. In this study we acknowledge for example alternative discount rates (see below) as well as uncertainties with respect to the input data such as the number of beneficiaries of health benefits provided by the Hills and Commons. More details on the assumptions applied for the sensitivity analysis are outlined in Sections 2.2 and 2.3 below. Applying sensitivity analysis, all figures are stated as a 'central estimate'[2] with a value range (high/low estimate) to acknowledge such uncertainties.

2.1.4 Discounting

In this assessment, all health benefits are calculated both, as annual and capitalised values. Capitalised values represent the sum of services over a defined time period, discounted to the 'net present value' (HM Treasury, 2018):

- The *net present value* is a generic term for the sum of a stream of future values (that are already in real prices) that have been discounted to bring them to today's value.
- *Discounting* is a technique used to compare costs and benefits occurring over different periods of time.
- The *discount rate* is the annual percentage rate at which the present value of future monetary values are estimated to decrease over time.

The discount rate acknowledges that individuals and society have a preference for receiving a benefit now rather than in the (far) future. Most people would probably agree that they would prefer to receive £100 now rather than in 10 years' time.

[2] If not stated otherwise values are generally stated as 'central estimate'.

Within the scope of this assessment, capitalised values are calculated over a timescale of 100 years. The same timescale is also applied by the ONS for its National Natural Capital Accounts (ONS and Defra, 2017).

For the purpose of this investigation, a discount rate of 1.5% has been applied to calculate the net present value of future health benefits. The HM Treasury Green Book recommends a Social Time Preference Rate (STPR) or Social Discount Rate which starts with 3.5% (it declines to 3.0% after 30 years and to 2.5% after 75 years). However, for risks to health and life values a lower discount rate of 1.5% is recommended:

> *"The recommended discount rate for risk to health and life values is 1.5%. This is because the 'wealth effect', or real per capita consumption growth element of the discount rate, is excluded. […] health and life effects are expressed using welfare or utility values, such as Quality Adjusted Life Years (QALYs), as opposed to monetary values. The diminishing marginal utility associated with higher incomes does not apply as the welfare or utility associated with additional years of life will not decline as real incomes rise."*
> (HM Treasury, 2018, p. 113)

Considering that all benefits considered here have a direct or indirect health impact, and for consistency reasons, applying a discount rate of 1.5% for the central estimates seems appropriate. For further discussion on justifying a discount rate of 1.5% see for example Hölzinger (2016). For the sensitivity range, alternative discount rates of 0.0% (high estimate) and the Green Book recommended discount rate starting at 3.5% or 1.5% for QALY impacts (low estimate) were applied. The discount rate of 0% for the purpose of the higher estimate of the sensitivity analysis is for example recommended in the National Ecosystem Assessment Follow-On (NEAFO) guidance for Ecosystem Assessments (Hölzinger, 2014) and by the German Federal Environment Agency (2008).

It should be noted that for capitalised values a *ceteris paribus* future (everything else remains unchanged) has been assumed throughout this assessment. This means that all variables such as visitor counts, management practices or impacts of climate change were set constant over time.

2.2 Economic Valuation of the Physical Health Benefits Provided by the Malvern Hills & Commons

To assess the value of physical health benefits the Malvern Hills and Commons[3] provide, the approach developed by White et al. (2016) has been modified to suit this assessment. A similar approach was also used to develop National Natural Capital Accounts for the UK for Defra and the ONS (Eftec, 2017; ONS, 2018). The assessment of physical health benefits was conducted in three subsequent steps:

Step 1: Estimation of total visitor counts to the Malvern Hills and Commons

To estimate the number of annual visits to the Hills and Commons the Outdoor Recreation Valuation Tool (ORVal) version 2.0 was used. This tool was developed by the University of Exeter for Defra and features in the Government's 25 Year Environment Plan (HM Government, 2018).

ORVal's estimations are derived from a statistical model of recreational demand by people over 16 years of age. The model provides estimates of peoples' recreational behaviour, based on their particular characteristics and location. The model is designed to predict how many visits to greenspace are likely to be undertaken by each individual (Day and Smith, 2018b).

ORVal did not have all areas of the Malvern Hills and Commons mapped in the model which is why certain areas of the Hills and Commons were added as 'new' greenspace to the model (even if in reality they already exist).[4] This analysis resulted in an annual visitor count estimate of 715,600 to the Malvern Hills and Commons.

To validate the findings, an estimation of visitor counts was also made using the Monitor of Engagement with the Natural Environment (MENE) survey results.[5] The results in MENE are not directly available for the Hills and Commons but they are for the AONB as a whole. As a proxy for the Hills and Commons, estimates based on respondents who stated they visited 'a mountain, hill or moorland' within the AONB were used. Whilst with 26 respondents, the sample size of this assessment was very low, the estimate of 715,600 of ORVal is within the error margins of the MENE survey which adds some confidence to this estimate.

Step 2: Estimation of 'active' visits by 'active' adults

[3] Areas within the Malvern Hills AONB boundary only.
[4] Please note that, due to the ORVal model, this may lead to a slight overestimation of visitor counts because of potential substitutional effects: If a 'new' site is established some predicted visitors from sites already mapped in the ORVal model may choose to use the 'new' site rather than the already mapped and modelled sites. This could lead to a limited degree of double-counting.
[5] https://www.gov.uk/government/statistics/monitor-of-engagement-with-the-natural-environment-headline-reports-and-technical-reports-2016-2017-to-2017-2018 (Accessed: 03/03/2019)

The next step was to identify 'active visits' to the Malvern Hills and Commons by 'active' people. Active visits are defined here as visits of at least moderate physical intensity such as walking, for the duration of at least 30 minutes. 'Active' people are persons who meet general physical activity guidelines of at least 30 minutes of at least moderate exercise; at least 5 times a week (Department of Health, 2004).

To identify 'active' visits by 'active' people, all visits that meet all of the following three criteria were estimated:

1. The visit had a duration of at least 30 minutes. This is the threshold used by Beale et al. (2007) for estimating the increase in Quality Adjusted Life Years (QALYs). The recent visitor survey of users of the Malvern Hills and Commons carried out by The Research Solution (2018) found that visits to the area are generally well in excess of this threshold with an average visit duration of 2 hours and 23 minutes. Hence, assuming that all visitors meet this threshold seems reasonable.

2. The activity during the visit was of at least moderate intensity of at least 3 METs (Metabolic Equivalent of Task) which is an objective measure of the ratio of the rate at which a person expends energy. The MET is not directly recorded in the 2018 visitor survey of the Hills and Commons but activities during the visit are. Only visits with an activity equivalent to at least 3 METs have been included in this assessment (Ainsworth et al., 2011; Elliott et al., 2015). [6] Referring to the visitor survey, 87% of visitors were on an 'active' visit. This leaves 622,600 'active' annual visits out of a total of 715,600 visits.

3. The visit was by a person who meets general physical activity guidelines of at least 30 minutes of at least moderate exercise; at least 5 times a week (Department of Health, 2004). In the absence of directly observable data for the Malvern Hills and Commons more general statistics from the Active Lives Survey (Sport England, 2017) have been relied upon. The survey found that about 63.6% of the population in Worcestershire, where most visitors of the Hills and Commons are from (The Research Solution, 2018), were active. This proportion has been used as a proxy for 'active' visitors to the Malvern Hills. This leaves 396,000 'active' annual visits by 'active' people. It should be noted, however, that this is probably an underestimate. The population sample visiting the Malvern Hills and Commons is probably generally more active than the general population. It is arguable that a proportion of inactive people would probably never visit the Hills and Commons (because they are inactive). Hence, they would not feature in the estimated visitor count in the first place.

[6] Relevant activities recorded in the visitor survey that meet the moderate intensity requirement include: Off road cycling/mountain biking, running, walking without a dog and walking with a dog.

These steps allowed all 'active visits' by 'active people' to the Malvern Hills and Commons (396,000) to be estimated. A further correction was necessary with regards to the age of visitors as the available data only allows an assessment of the physical health benefits of adults (at least 16 years of age). The visitor survey reveals that 14% of visitors are under 15 years of age which has been used as a proxy because the proportion of children under 16 is not reported (The Research Solution, 2018). This leaves 340,500 'active' annual visits by 'active' adults which is the basis for our calculation of physical health benefits.

Step 3: Benefit calculation and results

Beale et al. (2007) used Health Survey for England data to estimate that 30 minutes a week of moderate-intense physical activity, if undertaken 52 weeks a year, would be associated with a Quality Adjusted Life Year (QALYs) increase of 0.010677 per individual per year. This translates into a QALY increase of 0.0002053231 per active visit by active people. This means that 340,500 visits have an annual benefit of adding about 70 QALYs.

The Department of Health and Social Care values the WTP per QALY at £60,000 (HM Treasury, 2018). This results in an estimated value of 'green exercise' in the Malvern Hills and Commons of £4.2 million annually and £219.8 million capitalised over 100 years. The findings are summarised in Figure 2.3.

Figure 2.3 Physical Health Benefits Provided by the Hills and Commons

Physical Accounts			
		Annually	Over 100 years
Active' visits to Natural Capital by 'active' people (central estimate)		340,500	34,053,400
Added Quality Adjusted Life Years (QALYs) (central estimate)		70	7,000
Monetary Accounts			
Annual Natural Capital Value		*High*	*Low*
Physical Health Benefit	**£4,195,000**	*£6,932,000*	*£2,573,000*
Capitalised Natural Capital Value		*High*	*Low*
Physical Health Benefit	**£219,823,000**	*£693,217,000*	*£134,847,000*
Present value, 2018 prices; capitalised value discounted at 1.5% over 100 years; High/Low : Range of sensitivity analysis.			

Source: ***Author calculation.***

Interpretation of results

Please note that figures presented here represent the total rather than marginal value of benefits. This means that, whilst the stated physical health benefits value is generated in the Malvern Hills and Commons, it does not mean that part of the health benefits could not also be generated elsewhere if the site did not exist. If the site was not there then a proportion of people may still maintain similar exercise levels (and health benefits) in other environments such as other greenspaces or the gym. The 2018 visitor survey found that about 50% of surveyed visitors to the Hills and Commons would exercise between 10% and 20% less if the

Malvern Hills and Commons were not there for them to take part in exercise (The Research Solution, 2018).

This calculation is likely to be underestimating the real benefit because with 2 hours and 23 minutes, the average visit duration to the Malvern Hills and Commons is well in excess of the 30 minutes threshold used in Beale et al. (2007). However, it is not known if visitors would also maintain this level of activity during their everyday life as most visitors do not visit the Malvern Hills and Commons frequently. Also, the data provided in Beale et al. (2007) does not support the assumption that longer exercise automatically translates (linearly) into higher QALY benefits. Hence, the conservative assumption has been adopted that all visits of at least 30 minutes result in the same QALY benefits although it is recognised that this may well be underestimating the true benefit of the Malvern Hills and Commons.

It should also be noted that, for significant areas of the Hills and Commons, only footpaths were mapped and modelled in ORVal rather than the whole accessible sites. This may lead to underestimating the total visitor numbers and therefore health benefits. Because these are modelled rather than observed visitor estimates, figures may be updated when more accurate data becomes available. Furthermore, the physical health benefits to children under 16 were not accounted for. **Therefore, the actual physical health benefits of the Malvern Hills and Commons are probably higher than those presented.**

Sensitivity Analysis

The range of the sensitivity analysis is influenced by three factors:

1. The standard error[7] of visitor estimates of the MENE survey[8],

2. The standard error[9] of the activities undertaken during the visit based on the visitor survey[10] (The Research Solution, 2018) and

3. The assumption that the visitors of the Hills and Commons represent an 'active' sample of the general population rather than a general sample as assumed for the central estimate.[11] The latter only applies to the higher estimate of the sensitivity analysis.

[7] Applying the Role of Thumb (Al-Bayyati, 1971). A conservative rule of thumb is derived for a quick calculation of the sample size needed to compare two groups. The rule is worked out for qualitative variables with a failure or success outcome.

[8] For this purpose, the results have been divided by the total visitor estimate provided by ORVal of 715,600 and then multiplied by the low estimate of MENE of 472,100 for the low estimate (812,500 for the high estimate).

[9] Applying the Role of Thumb.

[10] 7.0% range.

[11] For this purpose it has been assumed that all visitors of the Hills and Commons are 'active' and meet general physical activity guidelines of at least 30 minutes of at least moderate exercise; at least 5 times a week (Department of Health, 2004).

Furthermore, a discount rate of 0% has been applied for the high capitalised estimate of the sensitivity analysis (see Section 2.1.4). For the low capitalised estimate, the same discount rate of 1.5% as for the central estimate was applied. This is because this rate is also recommended in the Green Book for quality of life benefits (HM Treasury, 2018). The findings of the sensitivity analysis are presented in Figure 2.3 above.

2.3 Economic Valuation of the Mental Health Benefits Provided by the Malvern Hills AONB

To estimate the monetary value of mental health benefits provided by the Malvern Hills and Commons) evidence provided by White et al. (2013) was used in combination with valuation estimates provided by the Centre for Mental Health (2010). The same studies have been used for a benefit transfer to estimate the mental health benefits of public greenspace in London (Vivid Economics, 2017) and Birmingham (Hölzinger, forthcoming). It should be noted, however, that this is an experimental approach and further research is required to strengthen both data and methods.

Introduction

White et al. (2013) modelled the impact of local urban greenspace proportion on self-reported mental health using British Household Panel Survey (BHPS) data from over 10,000 individuals. They found that a 1% increase in greenspace[12] in terms of land-use share at the Lower Super Output Area (LSOA) level decreases the General Health Questionnaire (GHQ) score by 0.0023. The GHQ score indicates the level of mental distress on a scale from 0 (very low mental distress) to 12 (very high mental distress).

The Centre for Mental Health (2010) estimates the economic and social costs of mental health in England to be in the region of £105.2 billion in 2009/10 (nominal prices). This figure covers the associated costs for health and social care, productivity losses due to mental health problems and the direct impact on life quality based on Quality Adjusted Life Years (QALYs) lost due to mental health problems. For more details on methods and calculations see Centre for Mental Health (2003).

Step 1: Rural/urban classification

The Defra 2011-based Rural Urban Classification[13] was used to identify Lower Super Output Areas (LSOAs) classified as 'urban'. The White et al. (2013) analysis covers greenspaces in urban areas only. Defra defines all physical settlements with a population of 10,000 or more as 'urban'. If the majority of the population of a particular LSOA live in such a settlement, that LSOA is deemed 'urban'; all other LSOAs are deemed 'rural'. Assignments of LSOAs to

[12] Here, I am using the figure for greenspace excluding domestic gardens as presented in White et all (2013) as the assessment scope does not include gardens.

[13] https://www.gov.uk/government/statistics/2011-rural-urban-classification

urban or rural categories are made by reference to the category to which the majority of their constituent area are assigned (GSS, 2013).

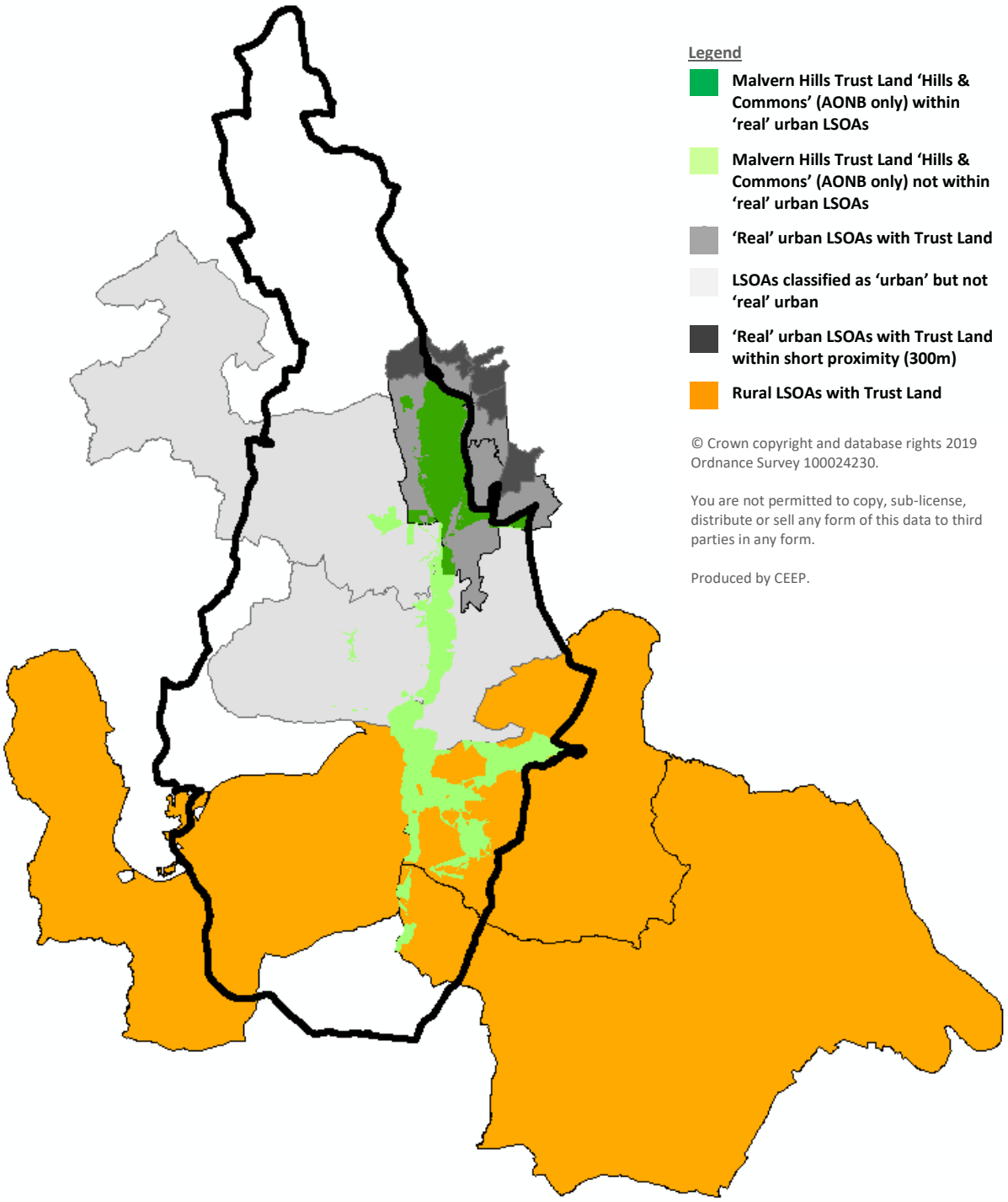
Figure 2.4 shows the Trust Land (Malvern Hills and Commons) in green and the LSOAs classified as urban in grey. For the purpose of this assessment, the urban areas were categorised as follows:

- **'Real' urban LSOAs with Trust Land (medium grey):** These LSOAs are classified as urban by Defra and overlap with the Malvern Hills Trust Land layer.

- **LSOAs classified as 'urban' but not 'real' urban (light grey):** These LSOAs were classified as urban by Defra but after consultation with the Malvern Hills AONB Unit it was decided that they are essentially rural areas in nature. This is already indicated by the geographical extent of these LSOAs. The size of LSOAs is based on the population size (in general, the mean population per LSOA is 1,500 people) which means that the larger the LSOA area extent, the lower is the population density. The light grey areas in Figure 2.4 are significantly larger than the 'real' urban areas in Great Malvern (medium and dark grey) which confirms our 'ground-truthed' observation that these LSOAs are not actually urban.

- **'Real' urban LSOAs with no Trust Land but within short proximity (300m) (dark grey):** These are 'real' urban LSOAs that do not have a direct overlap with the Hills and Commons but are located within short proximity (300m) to it.

Figure 2.4 LSOAs Containing Malvern Hills and Commons Land: Rural-Urban Land Classification



Source: ***Based on ONS Geography Open Data and GIS data provided by the Malvern Hills Trust***

Two assessments were undertaken for the Malvern Hills and Commons in the AONB:

1. Mental health benefits to the local population in 'real' urban areas of Malvern (medium grey on above map), and

2. Mental health benefits to all visitors.

2.3.1 Estimated Mental Health Benefits to the Local Population in the 'real' urban areas of Malvern

For the mental health economic assessment for local residents in Malvern, only 'real' urban areas which contain Malvern Hills Trust Land were included because these areas provide the best 'fit' to the White et al. (2013) research. Here, only the darker green Trust Land areas in the North (see Figure 2.4) are assessed whilst the lighter green Trust Land areas in the South are not. This means that, out of the total Trust Land area within the AONB of 966 ha, only 335 ha (35%) within 'real' urban areas were included in this assessment.

Step 2: GIS analysis of beneficiaries

Geographic Information System (GIS) software was used to estimate the area of Trust-managed greenspace in each assessed LSOA. Based on White et al. (2013), the General Health Questionnaire (GHQ) based self-reported mental health improvement per household was calculated based on the greenspace proportion in each assessed LSOA. GIS software was then used to manipulate spatial OS AddressPoint data provided by the Malvern Hills Trust to estimate the number of residential properties in each assessed LSOA (4,450 altogether within 'real' urban areas).

OS AddressPoint data also contains commercial and other properties. To identify residential properties within the AddressPoint dataset, all addresses indicating a non-residential use were excluded from the dataset. Only the following addresses were classified as residential or deemed to providing comparable benefits:

- Care/Nursing Home (included because likely benefiting from mental health benefits even if not residential),
- Detached,
- Development (included because likely to be mainly residential),
- Dwelling,
- HMO (house in multiple occupation),
- Self-Contained Flat,
- Semi-Detached,
- Sheltered Accommodation, and
- Terraced

This allowed the calculation of the self-reported mental health improvement due to greenspace for each assessed household.

Step 3: Benefit calculation and results for 'real' urban areas

Based on estimates provided by the Centre for Mental Health (2010) the average social and economic costs of mental health per household in England were calculated after adjusting for price level and updated figures on the WTP for a Quality Adjusted Life Year (QALY) based on HM Treasury (2018).[14] This resulted in an average annual mental health (social) cost estimate of £7,754 per English household.

To calculate the mental health benefits provided by the Malvern Hills and Commons in 'real' urban areas, the average mental health costs per English household were multiplied by the relative contribution of urban Trust Land to avoiding these costs. This approach assumes that mental health costs and self-reported mental health state as per GHQ are directly correlated and linear. This means that if the availability of local greenspace would improve the self-reported GHQ score of a household by 10% (1.2 scores), an annual value of £775 would be attributed.

Applying this method to all households in 'real' urban LSOAs with Trust Land results in a total annual mental health benefit provided by the Hills and Commons to local residents of £215,000. This figure is based on an estimated £33,000 in health and social care cost savings, £47,000 in economic output gains due to reduced mental health-related sickness absence and quality of life benefits valued at £135,000.

It is estimated that the Hills and Commons mental health benefits add just over 2 QALYs each year to the local population (226 over the total assessment period of 100 years) which the Department of Health and Social Care quantifies at a value of £60,000 each. Findings are summarised in Figure 2.5.

[14] The Centre for Mental Health (2010) calculated the quality of life benefits based on a value of £30,000 per QALY whilst the Department of Health and Social Care now recommends using a value of £60,000 instead (HM Treasury, 2018).

Figure 2.5 Mental Health Benefits to Local Residents in 'Real' Urban Areas

Physical Accounts			
		Annually	Over 100 years
Added QALYs (quality of life benefits):		2	230
Monetary Accounts			
Annual Natural Capital Value	*Central estimate*	*High*	*Low*
Health and social care cost savings	**£33,000**	*£43,000*	*£23,000*
Economic output gains	**£47,000**	*£61,000*	*£33,000*
Quality of life benefits	**£136,000**	*£177,000*	*£95,000*
Total Mental Health Benefit	**£215,000**	*£281,000*	*£150,000*
Capitalised Natural Capital Value	*Central estimate*	*High*	*Low*
Health and social care cost savings	**£1,726,000**	*£4,290,000*	*£685,000*
Economic output gains	**£2,456,000**	*£6,103,000*	*£975,000*
Quality of life benefits	**£7,104,000**	*£17,657,000*	*£4,957,000*
Total Mental Health Benefit	**£11,286,000**	*£28,051,000*	*£6,617,000*
Present values, 2018 prices; capital. value disc. at 1.5% over 100 years for cent. est.; High/Low : Range of sensitivity analysis.			

Source: ***Author calculation.***

Interpretation of results

Please note that this assessment of mental health benefits only covers a small fraction of potential mental health benefits provided by the Hills and Commons. The figures above only cover the benefits of the northern part of the Hills and Commons to the local population in one part of the urban area of Malvern. These figures were established with greater confidence than the figures in Section 2.3.2 below although it should be kept in mind that this is an experimental approach.

It should also be acknowledged that the Hills and Commons are greenspaces of 'Outstanding Natural Beauty'. This means that it is likely to attract many more visitors when compared to the 'average' urban greenspace within a similar population density setting on which the White et al. (2013) assessment is based. Hence, the White et al., (2013) based calculations probably underestimate the use and therefore the mental health benefits of the Hills and Commons. The calculations in Section 2.3.2 intend to cover more of the real value the Malvern Hills and Commons provides in terms of mental health benefits.

Sensitivity Analysis

The sensitivity analysis takes two aspects into account, the standard error reported in White et al. (2013) and the application of alternative discount rates for the capitalised values. For the high (low) estimate of the sensitivity analysis the standard error of 30.2% as reported in the White et al. (2013) assessment was added (deducted).[15]

[15] In White et al. (2013), the standard error is only reported for greenspace including domestic gardens. This estimate has been adopted here as well even if domestic gardens are not part of the assessment.

To take uncertainties regarding the discount factor into account (see Section 2.1), a discount factor of 0.0% was applied for the high estimate of capitalised values. For the low estimate, a discount rate of 3.5% was used (declining over time after 30 years) as recommended in the HM Treasury Green Book (2018). This discount rate only applies to the health and social care cost savings and economic output gains. The quality of life benefits remain discounted at 1.5% as per Green Book recommendation (HM Treasury, 2018). Findings are summarised in Figure 2.5.

2.3.2 Total Estimated Mental Health Benefits Provided by the Malvern Hills and Commons

To estimate the total mental health benefits provided by the whole Hills and Commons located within the AONB boundary also some of the less certain beneficiaries of the Hills and Commons have been captured.

Step 4: Inclusion of urban LOAS within short proximity to Trust Land

To capture more likely beneficiaries, 'real' urban areas that do not include but are within close proximity to the Hills and Commons (dark grey LSOAs in Figure 2.4) were included. One can argue that LSOA boundaries are somewhat artificial and do not represent a real barrier to people. If two similar people both live within 100m from the Hills and Commons, both could arguably benefit similarly from the space but if one lives within the LSOA that overlaps with the Hills and Commons and the other does not, only the one within the overlapping LSOA is accounted for when quantifying the benefits (as in Section 2.3.1).

Therefore, I assessed the 'real' urban LSOAs that contain Hills and Commons land (medium grey areas in Figure 2.4) together with 'real' urban LSOAs that are close to the Hills and Commons (dark grey areas). All medium and dark grey LSOAs (and the population/greenspace within) were aggregated and assessed as one area for this purpose assuming that all people in that area benefit equally from the mental health benefits the Hills and Commons within the urban areas (dark green in Figure 2.4) provide. This adds about £89,000 annually to the estimate from Section 2.3.1.

Step 5: Inclusion of rural LSOAs

In a next step, potential rural beneficiaries were included as well. Whilst White et al. (2013) only assess the impact of the urban greenspace proportion on mental health, it is almost certain that people in rural areas also benefit from the mental health benefits of high-quality accessible greenspace within close proximity. In the absence of alternatives, the White et al. (2013) model was also applied to rural LSOAs (light grey and orange areas in Figure 2.4). It is assumed that the rural population receives the same mental health benefits from an increased accessible greenspace proportion in the local area as the urban population. This adds a further £45,000 in mental health benefits.

Adding potential beneficiaries from rural LSOAs with Hills and Commons land as well as from urban LSOAs close to the Hills and Commons increases the mental health benefits value to £349,000 annually.

Step 6: Inclusion of external visitors

Lastly, beneficiaries visiting from outside the local area were also included. The figure above only includes benefits to the local population (within or close to LSOAs with Hills and Commons land overlap). However, the majority of visitors to the Hills and Commons come from outside the local area. The Malvern Hills & Commons visitor survey 2018 found that 2/3rd of visitors were non-residents (defined as not living within a 3 mile radius in the visitor survey) and only 10% of surveyed visitors walked or cycled to the Hills and Commons (The Research Solution, 2018).

The definition of 'local residents' within the visitor survey (within 3 miles) is much wider than the definition of local residents in this assessment which is only a few hundred metres. Hence, the 10% of visitors who walk/cycle to the Hills and Commons may be a closer proxy to our definition of 'local' than the visitors living within 3 miles from the Trust Land. As a conservative estimate, it was assumed that 21.5% of visitors are local (as defined in this study) which is the mean of the visitor proportion within 3 miles and those who walk/cycle to the Hills and Commons. Based on this assumption, 78.5% of visitors come from outside the local area. Visitors from outside the local area are furthermore assumed to benefit as much from the mental health benefits the Hills and Commons provide as local residents. This adds a further £1.28 million to the annual value.

Step 7: Benefit calculation and results for all potential beneficiaries

Adding urban areas within short proximity to the Hills and Commons (Step 4), rural areas (Step 5) and potential beneficiaries from outside the local area (Step 6) increases the mental health benefits value of the Hills and Commons to £1.62 million annually. This figure is based on an estimated £248,000 in health and social care cost savings, £353,000 in economic output gains due to reduced mental health-related sickness absence and quality of life benefits valued at £1.0 million annually.

It is estimated that the Hills and Commons mental health benefits add just over 17 Quality Adjusted Life Years (QALYs) each year to the local population (1,704 over the total assessment period of 100 years). The findings are summarised in Figure 2.6. However, it should be noted that some significant assumptions have been made which means that findings should be treated with extra care.

Figure 2.6 Total Estimated Mental Health Benefits Provided by the Hills and Commons

Physical Accounts			
		Annually	Over 100 years
Added QALYs (quality of life benefits)		17	1,704
Monetary Accounts			
Annual Natural Capital Value	*Central estimate*	*High*	*Low*
Health and social care cost savings	**£248,000**	*£323,000*	*£37,000*
Economic output gains	**£353,000**	*£246,000*	*£53,000*
Quality of life benefits	**£1,022,000**	*£1,331,000*	*£153,000*
Total Mental Health Benefit	**£1,624,000**	*£1,901,000*	*£244,000*
Capitalised Natural Capital Value	*Central estimate*	*High*	*Low*
Health and social care cost savings	**£13,014,000**	*£32,344,000*	*£1,111,000*
Economic output gains	**£18,512,000**	*£24,648,000*	*£1,580,000*
Quality of life benefits	**£53,559,000**	*£133,116,000*	*£8,034,000*
Total Mental Health Benefit	**£85,085,000**	*£190,108,000*	*£10,724,000*
Present values, 2018 prices; capital. value disc. at 1.5% over 100 years for cent. est.; High/Low : Range of sensitivity analysis.			

Source: ***Author calculation.***

Interpretation of results

Due to the experimental nature of this approach the outcomes should be treated with some care. Limitations of the mental health economic assessments presented in this Section include the simplistic definition of greenspace in White et al. (2013), the fact that trends in wellbeing such as anticipation and adaptation effects before and after moving to/away from greenspace were not accounted for, and that not all potential explanatory variables could be controlled for in the assessment by White et al. (2013). It should also be stressed that the mental health cost estimates provided by the Centre for Mental Health (2010) are of provisional nature - especially with respect to the human costs. The assumption of a direct and linear correlation between healthcare costs/social wellbeing on the one hand and self-reported mental distress on the other also needs to be tested through further research.

The added value attributed to non-local visitors should be treated with extra caution because mental health benefits relate not only to accessing the Hills and Commons (which also applies to external visitors), but also relate to living close to the Hills and Commons which may for example add a natural green and pleasant view on the Hills and Commons from home (see Section 1.3.2). These are benefits visitors from outside the local area would not receive. Unfortunately, the available evidence does not allow the benefits from accessing the Hills and Commons to be isolated from the amenity benefits only local residents can enjoy.

Sensitivity Analysis

To acknowledge that visitors to the Hills and Commons from outside the local area may not benefit in the same way as local residents, benefits to external visitors have been excluded from the low estimate of the sensitivity analysis.

In addition, for the high (low) estimate of the sensitivity analysis the standard error of 30.2% as reported in the White et al. (2013) has been added (deducted). This is the same as for the sensitivity analysis of benefits to local residents in the real urban area of Malvern (Section 2.3.1).

A discount rate of 0.0% has been applied for the high estimate of capitalised values. For the low estimate, a discount rate of 3.5% (declining over time after 30 years) was applied. This discount rate only applies to the health and social care cost savings and economic output gains. The quality of life benefits remain discounted at 1.5%. Findings are summarised in Figure 2.6.

3. Results

The total estimated physical and mental health benefits provided by the Malvern Hills and Commons add up to just over £5.8 million per year. This includes the value of 87 added Quality Adjusted Life Years (QALYs) each year. The capitalised value over 100 years adds up to almost £305 million. The health economic assessment clearly shows that the Malvern Hills and Commons provide significant benefits to people; far beyond their aesthetic and recreational value.

Figure 3.1 Estimated Physical and Mental Health Benefits Provided by the Hills and Commons

Monetary Accounts			
Annual Natural Capital Value	*Central estimate*	*High*	*Low*
Physical Health Benefit	**£4,195,000**	*£6,932,000*	*£2,573,000*
Mental Health Benefits	**£1,624,000**	*£1,901,000*	*£244,000*
Total	**£5,819,000**	*£8,833,000*	*£2,817,000*
Capitalised Natural Capital Value	*Central estimate*	*High*	*Low*
Physical Health Benefit	**£219,823,000**	*£693,217,000*	*£134,847,000*
Mental Health Benefits	**£85,085,000**	*£190,108,000*	*£10,724,000*
Total	**£304,908,000**	*£883,325,000*	*£145,571,000*

Present values, 2018 prices; capital. value disc. at 1.5% over 100 years for cent. est.; High/Low : Range of sensitivity analysis.

Source: ***Author calculation.***

Please note that these estimates are essentially indicative of the real physical and mental health value provided by the Malvern Hills and Commons. Uncertainties have been reflected as well as possible in the sensitivity analysis. For assumptions and caveats see the relevant report sections.

4. Conclusions & Recommendations

Economic valuation of natural assets is sometimes criticised and rejected as being too rough and uncertain. However, already the great British economist John Maynard Keynes said that *"it is better to be roughly right than precisely wrong."*[16] That is exactly the aim of this assessment – to be roughly right by getting as close to the true health value as possible rather than being precisely wrong by ignoring and neglecting value domains that are more difficult to quantify altogether.

This Health Economic Assessment shows just how important the Malvern Hills and Commons are to support public health. It also demonstrates that their benefits reach far beyond the local population. It is hoped that this new evidence may encourage a consideration of the application of health budgets to the effective management and facilitated access of parts of the Malvern Hills AONB as a measure of preventative healthcare intervention. This could include initiatives such as organised health walks or prescribed outdoor exercise.

The Government's ambition in the 25 Year Environment Plan to *"help people improve their health and wellbeing by using green spaces including through mental health services"* (HM Government, 2018) provides an important policy hook here. A first step would be to open a discussion with public health representatives on how preventative healthcare can be best delivered through collaborative approaches.

Looking forward, it would be beneficial to more accurately estimate the number of visitors to the Malvern Hills and Commons to strengthen the physical health estimates.

[16] Originally: "It is better to be vaguely right than exactly wrong" (Read, 1898)

5. Glossary

Discounting: Discounting is a technique used to compare costs and benefits occurring over different periods of time.

Discount rate: The discount rate is the annual percentage rate at which the present value of future monetary values are estimated to decrease over time.

General Health Questionnaire (GHQ): The General Health Questionnaire is a screening device for identifying minor psychiatric disorders in the general population and within community or non-psychiatric clinical settings such as primary care or general medical out-patients.

Geographic Information System (GIS): A Geographic Information System is a system designed to capture, store, manipulate, analyse, manage, and present spatial or geographic data.

Lower Layer Super Output Area (LSOA): A Lower Layer Super Output Area is a geographic area. Lower Layer Super Output Areas are a geographic hierarchy designed to improve the reporting of small area statistics in England and Wales.

Metabolic Equivalent of Task (MET): The metabolic equivalent of task is the objective measure of the ratio of the rate at which a person expends energy, relative to the mass of that person, while performing some specific physical activity compared to a reference, set by convention at 3.5 ml of oxygen per kilogram per minute, which is roughly equivalent to the energy expended when sitting quietly.

Monitor of Engagement with the Natural Environment (MENE): The Monitor of Engagement with the Natural Environment survey is funded by Natural England, with support from Defra. The survey relates to engagement with the natural environment. The main focus of the survey is people's experiences of nature, including time spent on visits to the outdoors in the natural environment, away from home.

Net Present Value (NPV): The Net Present Value is a generic term for the sum of a stream of future values (that are already in real prices) that have been discounted to bring them to today's value.

Quality Adjusted Life Year (QALY): The Quality Adjusted Life Year is a generic measure of disease burden, including both the quality and the quantity of life lived. It is used in economic evaluation to assess the value for money of medical interventions. One QALY equates to one year in perfect health.

Sensitivity Analysis: Sensitivity analysis involves exploring the sensitivity of expected outcomes of an intervention to potential changes in key input variables. It can be used to test the impact of changes in assumptions and should be clearly presented in the results of appraisal.

Social Time Preference Rate (STPR): The Social Time Preference Rate is defined as the value society attaches to present, as opposed to future, consumption.

Total Economic Value (TEV): The Total Economic Value is a concept in cost–benefit analysis that refers to the value derived by people from a natural resource, a man-made heritage resource or an infrastructure system, compared to not having it.

6. Abbreviations

AONB	Area of Outstanding Natural Beauty
Defra	Department for Environment, Food & Rural Affairs
GDP	Gross Development Product
GHQ	General Health Questionnaire
GIS	Geographic Information System
LSOA	Lower Super Output Area
MENE	Monitor of Engagement with the Natural Environment (Survey)
MET	Metabolic Equivalent of Task
NEAFO	National Ecosystem Assessment Follow-On
NPV	Net Present Value
ONS	Office for National Statistics
ORVal	Outdoor Recreation Valuation Tool
QALY	Quality Adjusted Life Year
STPR	Social Time Preference Rate
TEV	Total Economic Value
WHO	World Health Organization

7. References

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