

Natural England Research Report NERR084

# The Economic Benefits Supported by Land Management – A Case Study of Shapwick Heath National Nature Reserve



Natural England Research Report NERR084

# The Economic Benefits Supported by Land Management – A Case Study of Shapwick Heath National Nature Reserve

Rebecca Clark, Simon Clarke, Ella Hayden and Eva-Maria Scholz



Published September 2020

This report is published by Natural England under the open Government Licence - OGLv3.0 for public sector information. You are encouraged to use, and reuse, information subject to certain conditions. For details of the licence visit [Copyright](#). Natural England photographs are only available for non commercial purposes. If any other information such as maps or data cannot be used commercially this will be made clear within the report.

ISBN 978-1-78354-654-1

© Natural England 2020



# Project details

---

This report should be cited as: Clark, R., Clarke, S., Hayden, E., and Scholz, E.-M., 2020. The Economic Benefits Supported by Land Management – A Case Study of Shapwick Heath National Nature Reserve. Natural England Research Report NERR084.

## Project officer/contact

Eva-Maria Scholz

[eva-maria.scholz@naturalengland.org.uk](mailto:eva-maria.scholz@naturalengland.org.uk)

## Acknowledgements

This report benefitted from advice and information provided by members of the team working at Shapwick Heath NNR.

# Executive Summary

---

Shapwick Heath National Nature Reserve (NNR) is a magnificent 530ha wetland reserve, situated at the heart of the Somerset Levels and Moors. The Reserve has a fascinating geology and history, and a hugely rich and diverse flora and fauna. Its range and mosaic of habitats enables a wide array of birds, mammals, invertebrates and plants to carve out their niches and find a home there. The reserve is also an important site for public engagement. Thousands of visitors use the reserve each year for wildlife watching and quiet recreation, alongside a vibrant public engagement and volunteering programme.

The report assesses the benefits that were supported by land management at Shapwick Heath NNR in 2017. It does this from three perspectives.

- First, by developing a **corporate natural capital account** for Shapwick Heath NNR to document the environmental benefits the NNR provides (Section 2).
- Second, by assessing the **economic contribution** the NNR makes to the local and regional economy in terms of the economic activity and employment it supports (Section 3).
- Third, by assessing the **value of the health benefits** from exercise supported by the NNR (Section 4).<sup>1</sup>

The study demonstrates that the benefits supported by Shapwick Heath NNR could be roughly estimated using readily available data. The results will help understand and communicate the various benefits the NNR provides to society. However, most estimates of economic benefits are partial and there is a low level of confidence in them. One should be mindful of these limitations when interpreting the figures (which are for 2017) and using them to inform communication or to support decision-making.

It would be relatively straightforward to make such estimates for several NNRs or land management at a landscape scale if the necessary data were available. To assist with similar assessments at different sites the report specifies the site-specific information that is needed for an assessment and suggests survey questions for data collection (Appendix A). It also provides detail of the methods used in the different assessments (Section 2.1, Section 3.1, and Section 4.1). Details on the calculations can be found in the Excel workbook that was used for the study.

The remainder of this section provides a brief introduction and summary of the results of Shapwick Heath NNR's corporate natural capital account, the NNR's contribution to the local and regional economy, and the health benefits supported by the NNR.

## A corporate natural capital account for Shapwick Heath NNR

Natural capital is defined by the Natural Capital Committee (2014) as 'The elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions'. When a natural capital perspective is adopted, these elements are considered to be assets that produce flows of ecosystem goods and services. Ecosystem goods and services are outputs and processes provided by the environment that supply benefits to people. The goods and services may be consumed directly by people (such as a place for recreation, improved air quality) or they may be inputs to human production processes (such as production of timber for use in construction). The approach commonly adopted to estimate the value of ecosystem goods and services is to estimate their economic value, described by economists as the impact on the utility of individuals, or the welfare of society. The monetary values of the assets are estimated in terms of the value of anticipated future flows of the goods and services.

---

<sup>1</sup> Health benefits are also captured in the NNR's corporate natural capital account, however, not explicitly but as part of recreational and other physical activities.

Natural capital accounting is a tool that has been developed for monitoring the management of natural capital assets. It also provides an assessment of the assets at a point in time. In contrast to traditional accounts, corporate natural capital accounts include those benefits that are not provided through the market. An example is the recreational opportunities the NNR provides. These do not appear in the NNR's financial accounts as they are provided 'for free' but do feature in its natural capital account as they provide important benefits to people. There are different approaches to developing natural capital accounts. For this study, natural capital assets were assessed using an account based on the Corporate Natural Capital Account (CNCA) framework.<sup>2</sup> The account provides information on the quantity, quality and value of the assets at a point in time. This information could be used to monitor changes over time, but that is beyond the scope of this project.

## Ecosystem goods and services provided by Shapwick Heath NNR

Ecosystem goods and services are outputs and processes provided by the environment that are of benefit to people. Though there was a relatively long list of goods and services that were provided at significant levels by the NNR, few of them could be quantified and even fewer could be valued. As a result, the estimate of total value of supported benefits gives an incomplete picture. It omits the value of several goods and services that are provided at significant levels by the NNR. Moreover, most estimates of value are underestimates and there is a low level of confidence in them. One thus has to interpret the figures below with care. The estimates are for 2017.

Of the goods and services that could be valued, the service with the highest value was **recreational visits** (£301,000 for 80,000 visits). This value is an under-estimate as it does not include the value of visits by children (who are estimated to have made 25% of the visits) and the value per visit is likely to be an under-estimate.

The service with the second highest value was the **net sequestration of carbon** (£45,800 for 704 t CO<sub>2</sub> equivalent per year). This reflects the habitats on the NNR. These include grassland on drained peat soil and shallow lakes which are expected to have net emissions of carbon dioxide and/or methane. The NNR has 46 ha of woodland that are known to sequester carbon and other habitats that sequester carbon but at lower rates.

Other ecosystem goods and services that could be valued:

- **Benefits to volunteers** (£26,400 for 33 volunteers) who volunteer regularly (at least once a month), contributing to land management and species surveys and monitoring. The value is expected to be an under-estimate.
- **Educational visits by the public** (£5,460 for 1,300 visits). The estimate is partial as it does not include the educational value of the visits for adults, and employs a value for educational visits by children that under-estimates the value by at least 50%.
- **Educational visits by school pupils** (£1,290 for 726 visits). Note that the value of visits is under-estimated by at least 50%.
- Revenue of £1,210 from the **sale of firewood**.

## Natural capital account balance sheet

The natural capital account balance sheet draws together estimates of the value of natural capital assets and the costs (liabilities) of maintaining the assets. The estimates are calculated using 20-year projections for a plan to deliver a long term goal. The goal employed for the account was to maintain current levels of good access to the public, continue to provide good quality engagement with the public and maintain current favourable condition of habitats on the NNR.

---

<sup>2</sup> The analysis was conducted prior to development of the natural capital account for all NNRs managed by Natural England (Sunderland and others 2019). As a result, it was not informed by the approach that was developed for that account (which is different to CNCA) or the data used in it.

For the plan, the value of the assets with no costs deducted (gross value) is £12 million. This comprises a value of £0.1 million to Natural England from revenue (sales of firewood) and a value of goods and services to society of £11.9 million (recreational and educational visits, benefits to regular volunteers, and carbon sequestration). The benefits to society are not included in Natural England's financial accounts. The gross asset value reveals that society receives 99% of the benefits provided by the NNR and Natural England receives less than 1% of the benefits (in the form of revenue).

The present value of the liabilities (costs) of the plan to deliver the goal is £10.6 million, which comprises £7.4 million met by Natural England and £3.2 million met externally through inputs by volunteers. These figures indicate the significant contribution that volunteers make to the NNR; they provide 30% of the present value of the total costs.

The value of the natural capital assets with costs deducted (net value) is £1.4 million. As explained above, the estimates of gross and net value of natural capital assets are partial (not all goods and services could be valued and the values that were used are under-estimates), and there is a low level of confidence in them.

## **Contribution to the local and regional economy**

NNRs contribute to local and regional economies. They do this through employing staff, purchasing goods and services, providing a site for the operations of other businesses (shops, cafés, farming tenants and graziers) and encouraging people to visit. These contributions to the local and regional economy result in further rounds of benefits (multiplier effects). These multiplier effects arise from suppliers purchasing goods and services from other businesses in the local and regional economy (indirect effects) and employees spending their salaries / wages (induced effects).

The contribution that the NNR made to the local and regional economy was assessed in terms of its direct contribution to employment (full time equivalent (FTE)) and the contribution to economic activity (the value of goods and services produced in an area, measured in terms of gross value (GVA)). The contribution was assessed separately for the local economy (the area within 0 - 10 miles of the NNR) and the regional economy (the area within 0 - 30 miles, which includes the local economy).

In 2017, the NNR, shop and café on the site supported employment of approximately 10 FTE and £266,000 of GVA in the local economy (within 10 miles). Within 30 miles (the regional economy), they supported the same level of employment and £292,000 of GVA (more because it is a larger area). Visitor expenditure supported an additional 6 FTE and GVA of £215,000 in the local economy. These contributions were all through direct, indirect and induced effects. Because data from other sources, some of which were for all sectors, were used for the analysis, the level of confidence in these estimates is low.

## **Health benefits supported by the NNR**

Two different approaches were used to estimate visitors' health benefits from exercise supported by the NNR. These focussed on two types of visitors, each of which undertakes a different kind of exercise on the NNR. The health benefits are estimated for adults who go for a walk and for 'active' visits by 'active' individuals. The estimates are for health benefits supported by the NNR (that would arise even if the NNR was not accessible) in 2017.

### **Health benefits for adults who go for a walk on the NNR**

NNR staff estimated that each year, 28,500 adults go for a walk on Shapwick Heath NNR, making on average 2 visits per year, walking 2 miles on each visit. This walking was estimated to prevent 0.1 premature deaths per year among people who walk on the NNR. The health benefit was estimated using the World Health Organisation's Health Economic Assessment Tool (HEAT). The economic value was calculated using the value of a statistical life and amounts to a value of £179,000 per year. The level of confidence in these estimates is low because accurate data were not available on visitors and their visits. The results do not estimate the full health benefits to people using the NNR



as they do not include the mental health benefits, benefits to children who visit the NNR and to people who undertake exercise other than walking (such as cycling and running). NNR staff estimated that, if the NNR was unavailable for some reason, people who go for a walk on the NNR would go for a walk somewhere else instead. Consequently, there are no health benefits from walking that are reliant on the NNR. However, it is likely that people who go for walks are reliant on using a wider area that includes the NNR.

### **Health benefits specifically for 'active' adults who make 'active' visits**

In this study, an 'active' adult visitor is someone who reports that they undertake exercise for 30 minutes or more five or more times per week. They make an 'active' visit if their visit involved raising their breathing rate for 30 minutes or more. NNR staff estimated that 'active' adults made 9,200 'active' visits to the NNR per year. The total health gain to 'active' visitors making 'active' visits was estimated to be 1.9 Quality Adjusted Life Years (QALYs) per year. This is a measure of the increase in the quantity and quality of people's lives from the exercise that active adults undertake on the NNR. The economic value was estimated to be £113,000 per year. The level of confidence in these estimates is low due to the low accuracy in the data used in the calculations. These results are not estimates of the full health benefits of recreation on the NNR because they do not include the health benefits of visits that are not 'active', visits by adults who are not 'active', or visits by children. The NNR staff estimated that all active visits by 'active' visitors would take place somewhere else if the NNR was not available. However, there are likely to be health benefits for 'active' visitors that are reliant on the wider area that Shapwick Heath is located in (though research would be needed to establish the scale).

# Contents

---

<b>1</b>	<b>Introduction</b>	<b>9</b>
<b>2</b>	<b>A corporate natural capital account for Shapwick Heath NNR</b>	<b>10</b>
2.1	<i>Method</i>	10
2.2	<i>Results</i>	17
<b>3</b>	<b>Contribution to the local and regional economy</b>	<b>24</b>
3.1	<i>Method</i>	24
3.2	<i>Results</i>	27
<b>4</b>	<b>Health benefits supported by the NNR</b>	<b>30</b>
4.1	<i>Method</i>	30
4.2	<i>Results</i>	32
	<b>References</b>	<b>30</b>
	<b>Appendices</b>	<b>30</b>
A	<i>Site-specific data requirements</i>	
B	<i>Further details on the CNCA method used</i>	
C	<i>Contribution to the local and regional economy</i>	

# List of tables

---

Table 2.2.1 Ecosystem goods and services provided by Shapwick Heath NNR	18
Table 2.2.2 Quantity and value of ecosystem goods and services in 2017	19
Table 2.2.3 Indicators of the quantity and quality of natural capital assets	21
Table 2.2.4 Natural capital asset values and present value of liabilities	22
Table 3.1.1 Estimates of NNR expenditure in the local and regional economy	25
Table 3.1.2 Estimates of expenditure within 10 miles by visitors to nature reserves	26
Table 3.2.1 Estimates of the NNR's contribution to the local and regional economy	28
Table 4.1.1 Data employed in the estimation of health benefits for adults who walk on the NNR	31
Table 4.1.2 Data employed in the estimation of health benefits for 'active' adults who make 'active' visits to the NNR	32
Table B.1 Estimates of the net carbon flux for Shapwick Heath NNR	44
Table B.2 Estimation of the benefits to volunteers of volunteering regularly	46
Table B.3 Valuation of volunteer inputs	47
Table B.4 Total salary costs for Natural England staff	47
Table B.5 Gross and net asset values including and excluding net carbon flux	48
Table C.1 Calculation of gross value added (GVA) per full time equivalent (FTE) job for two relevant sectors	49
Table C.2 Calculation of output per full time equivalent (FTE) job and GVA per £1 of output for the 'all industries' sector	49
Table C.3 Visitor expenditure per full time equivalent (FTE) job and gross value added (GVA) per £1 of visitor expenditure	49

# List of figures

---

Figure 2.1.1 Summary values	12
Figure 2.1.2 Steps in producing the account	13

# 1 Introduction

---

Shapwick Heath National Nature Reserve (NNR)<sup>3</sup> is a magnificent 530ha wetland reserve, situated at the heart of the Somerset Levels and Moors. Combined with adjoining reserves in the area, known as the 'Avalon Marshes', it forms one of the largest areas of wetland in the country. Shapwick Heath is highly protected under law, being designated as a Special Protection Area (SPA) for its large flocks of water birds, a Ramsar site (a wetland of international importance) and is a Site of Special Scientific Interest (SSSI). The Reserve has a fascinating geology and history, and a hugely rich and diverse flora and fauna. One of the keys to its biodiversity is its range and mosaic of habitats, from open water and reedbeds, through mire, fen, wet grassland and on into wet woodland. These enable a wide array of birds, mammals, invertebrates and plants to carve out their niches and find a home there. The reserve is also an important site for public engagement. Thousands of visitors use the reserve each year for wildlife watching and quiet recreation, alongside a vibrant public engagement and volunteering programme.

This report assesses the benefits that were supported by land management at Shapwick Heath NNR in 2017 (a typical year at that time). It does this from three perspectives.

- First, by developing a **corporate natural capital account** for Shapwick Heath NNR to document the environmental benefits the NNR provides (Section 2).
- Second, by assessing the **economic contribution** the NNR makes to the local and regional economy in terms of the economic activity and employment it supports (Section 3).
- Third, by assessing the **value of the health benefits** from exercise supported by the NNR (Section 4).<sup>4</sup>

The study was informed by the work of Ella Hayden, who was an innovation apprentice at Shapwick Heath NNR in 2016-17 and data and advice provided by the Senior Reserve Manager, Simon Clarke (both referred to subsequently in the report as 'NNR staff'). The analysis was carried out by Rebecca Clark, economist in Natural England. In 2017, the NNR staff provided and entered the site-specific data into the Excel workbook developed by the analyst for the purposes of this study.

The study was commissioned by the SRM of Shapwick Heath NNR, with a view to establishing the assessment that might be feasible for the NNR and at a landscape scale. Other SRMs in Natural England had also expressed their interest in such an assessment. To assist with similar assessments at different sites the report specifies the site-specific information that is needed for an assessment and suggests survey questions for data collection (Appendix A). It also provides detail of the methods used in the different assessments (Section 2.1, Section 3.1, and Section 4.1). Details on the calculations can be found in the Excel workbook that was used for the study.

---

<sup>3</sup> NNRs were established for 'preserving flora, fauna or geological or physiographical features of special interest in the area and/or for providing opportunities for the study of, and research into, those features' under the National Parks and Access to the Countryside Act (1949). The Natural Environment & Rural Communities Act (2006) extended their role to include the provision of opportunities for public enjoyment of nature and/or open-air recreation. That legislation specifies the three main purposes of NNRs: nature conservation, research and access (also known as the 'three pillars' (Natural England 2016); not all NNRs are available for research or access). Management of NNRs also encompasses other principles that include community and stakeholder involvement and helping to safeguard and restore ecosystems beyond the NNRs' boundaries, which are set out in the NNR Management Standard (Natural England 2016).

<sup>4</sup> Health benefits are also captured in the NNR's corporate natural capital account, however, not explicitly but as part of recreational and other physical activities.

# 2 A corporate natural capital account for Shapwick Heath NNR

---

Natural capital accounting is a tool that can be used to monitor the management of the environment. Development of an account involves estimating the quantity and value of goods and services from the environment that people benefit from. These estimates are used to calculate the value of environmental assets for the account. Information on the quantity and quality of the assets is also included in the account. This chapter starts by explaining the method used in producing a corporate natural capital account for Shapwick Heath NNR (Section 2.1). It then presents and discusses the results (Section 2.2).

## 2.1 Method

This section provides a brief introduction to natural capital and Corporate Natural Capital Accounting. This is followed by a description of the steps taken in producing an account for Shapwick Heath NNR.

### **A brief introduction to natural capital, ecosystem services and benefits**

Natural capital is defined by the Natural Capital Committee (2014) as ‘The elements of nature that directly or indirectly produce value to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions’. When a natural capital perspective is adopted, these elements are considered to be assets that produce flows of ecosystem goods and services.

Ecosystem goods and services are outputs and processes provided by the environment that supply benefits to people<sup>5</sup>. The goods and services may be consumed directly by people (such as a place for recreation, improved air quality) or they may be inputs to human production processes (such as production of timber for use in construction). The approach commonly adopted to estimate the value of ecosystem goods and services is to estimate their economic value, described by economists as the impact on the utility of individuals, or the welfare of society.<sup>6</sup> The monetary values of assets are estimated in terms of the value of anticipated future flows of the goods and services.

### **A brief introduction to Corporate Natural Capital Accounting**

Natural capital accounting is a tool that has been developed for monitoring the management of natural capital assets. It also provides an assessment of the assets at a point in time. In contrast to traditional accounts, corporate natural capital accounts include those benefits that are not provided through the market. For example, the recreational opportunities the NNR provides do not appear in the NNR’s financial accounts as they are provided ‘for free’ but do feature in its natural capital account as they provide important benefits to people. Further comparison with financial accounts is provided in Appendix B Section 1.

---

<sup>5</sup> Brief introductions to ecosystem goods and services can be found in Parliamentary Office of Science and Technology (2007) and Lusardi (2014).

<sup>6</sup> The approach adopted for valuing ecosystem services in natural capital accounts may be different, as is discussed later in this section.

There are different approaches to developing natural capital accounts. For this study, the account is based on the Corporate Natural Capital Account (CNCA) framework<sup>7,8</sup> developed by Eftec and others (2015a and b).<sup>9</sup> The account is also informed by and draws on a previous study to assess whether corporate natural capital accounting is appropriate for monitoring NNRs managed by Natural England (Clark 2017). The CNCA framework is used here because it was developed for organisations that have responsibility for large quantities of natural capital assets (amongst others). CNCA was developed to monitor natural capital assets for an organisation and support investment to maintain or improve the assets (Eftec and others 2015a). The account developed for this study has not been used to monitor assets, though it could be used to inform monitoring in future. Because the analysis was conducted prior to development of the natural capital account for all NNRs managed by Natural England (Sunderland and others 2019), it was not informed by the approach that was developed for that account (which is different to CNCA) or the data used in it.

The account developed for this study differs from CNCA in that it provides information on the quantity, quality and value of the assets at a point in time and has not been used to monitor changes over time. It sets out what is known as the 'reference scenario' for CNCA, which could be used as the basis for monitoring the NNR using a natural capital account in future.

The following provides a brief introduction to the components of a corporate natural capital account, summary values and strands of information in the account. Further information is provided in Appendix B. Details of other features of CNCA (such as its use in monitoring) are described in Eftec and others (2015a and 2015b).

### **Components<sup>10</sup>**

CNCA provides reporting statements that an organisation can use to measure and monitor its natural capital assets. Specifically:

- Estimates of the value of natural capital assets and the costs (liabilities) of maintaining the assets are drawn together in a **natural capital balance sheet**. Note that the term 'maintenance' is used in CNCA to refer to managing and investing in natural capital, which may include restoration or enhancement.
- Monitoring is provided by a **statement of change** in natural capital assets, which reports change in asset values (plus the reasons for the changes) and costs over the period that has been monitored. This is not included in the account for Shapwick Heath NNR.

The reporting statements build on a set of supporting schedules:

- **Natural capital asset register:** an inventory of the quantity and quality of the natural capital assets.
- **Physical flow account:** the anticipated flow over time of goods and services, which is dependent on the natural capital assets (in the asset register).
- **Monetary account:** the expected value of the flows of goods and services in the physical flow account. In CNCA, production costs that can be attributed to specific goods and services are subtracted from the values in the monetary account.

---

<sup>7</sup> Another type of natural capital account is the accounts for the UK that are being developed by the Office of National Statistics. Those employ the United Nations System of Environmental-Economic Accounting which closely follows the United Nations System of National Accounts (so they are comparable with economic indicators such as gross domestic product). CNCA also follows these same principles as far as is relevant, but differs in certain other aspects (for example in employing a reference scenario (Eftec and others 2015a and 2015b)).

<sup>8</sup> Since its development in 2015, there have been various applications of CNCA, including an account for Beam Parkland (Eftec 2015) and for parks and open spaces in the London Borough of Barnet (Eftec and others 2017). Forestry England has worked with Eftec to develop and report against an account for its management of the Public Forest Estate in England (Forest Enterprise England 2016, 2017). In 2017, the RSPB developed an account for the nature reserves that it manages.

<sup>9</sup> It should be noted that there is no formally agreed method for CNCA. This study employed the best available advice from Eftec in 2016 based on the consultants' knowledge and expertise; it may be superseded in future as work progresses in this field.

<sup>10</sup> Source: Eftec and others 2015a unless specified otherwise.

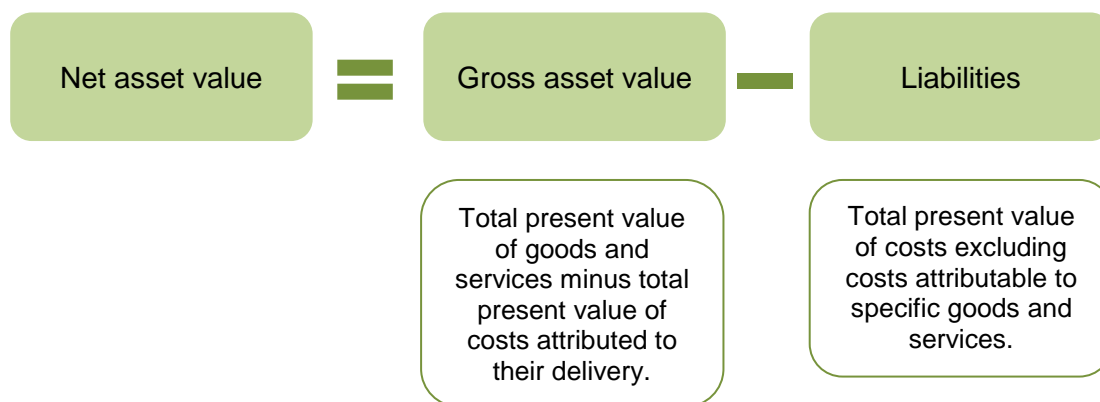
- **Maintenance cost account:** costs (referred to as liabilities) of current and future maintenance of natural capital assets (and any improvements). These are costs that cannot be attributed to specific goods and services.

### Summary values

An important feature of natural capital accounts is that they consider the stocks of assets as well as the flow of goods and services that they provide. The monetary value of the assets is calculated as the sum of the value of projected flows of goods and services over the long term. The time period used is the anticipated life of the natural capital assets or the duration of the organisation's stewardship of them. Discounting<sup>11</sup> is employed so that values of assets from different years can be added together. The sum of discounted values for a projected flow over different years is known as its 'total present value'.

CNCA employs future projections for a plan to achieve a long term goal. The following summary values are presented in the CNCA balance sheet (Eftec and others 2015a):

- **Gross asset value:** this is the sum of discounted monetary values of ecosystem goods and services delivered by the long term goal over the period of the account. It uses data from the monetary account schedule, which draws on the physical account schedule. For CNCA, in calculating gross asset value, costs of labour and inputs of machinery and other man-made assets that are specific to the good or service are deducted if possible.<sup>12</sup> For this study, because attributable costs could not be identified they were not deducted in calculation of the gross asset value.<sup>13</sup>
- **Liabilities:** the sum of the discounted values of the costs of delivering the long term goal (excluding any costs that can be attributed to specific goods and services). This is calculated using data from the CNCA maintenance cost account schedule.
- **Net asset value:** this is the gross asset value minus the liabilities. It is the net accounting value of delivery of the long term plan (Figure 2.1.1).



**Figure 2.1.1 Summary values**

In CNCA, ideally goods and services are valued using exchange values,<sup>14</sup> though where these are not readily available, economic values may be used instead (and have been used in CNCA accounts

<sup>11</sup> Discounting is employed because society prefers to receive benefits now rather than in the future, and to delay paying costs. HM Treasury (2018b) specifies the discount rate that should be used for analysis by the public sector in the UK (3.5% for periods of up to 30 years).

<sup>12</sup> By deducting the attributable costs, an estimate of the 'gross' value of benefits provided by the ecosystem is calculated (United Nations and others 2014).

<sup>13</sup> Similarly, costs were not allocated to specific goods and services (Eftec and others 2017). In their account, Forest Enterprise England (2017) were able to allocate some costs to specific goods and services.

<sup>14</sup> This is so it is consistent with the principles of national accounting methodologies, including the United Nations System of Environmental-Economic Accounting (Eftec and others 2015a). Exchange values are market prices or values that are consistent with the prices that would have been obtained if a market existed.



that have been developed). For some goods and services, exchange values are the same as economic values, for others the method used may be different but the value similar.<sup>15</sup> In the account developed for this study, economic values were used. That is because it is more useful to Natural England and to the manager of the NNR to have estimates of the benefits of the NNR to society. The economic value was different from the exchange value only for recreational visits, and that difference was not significant (Appendix B Section 3).

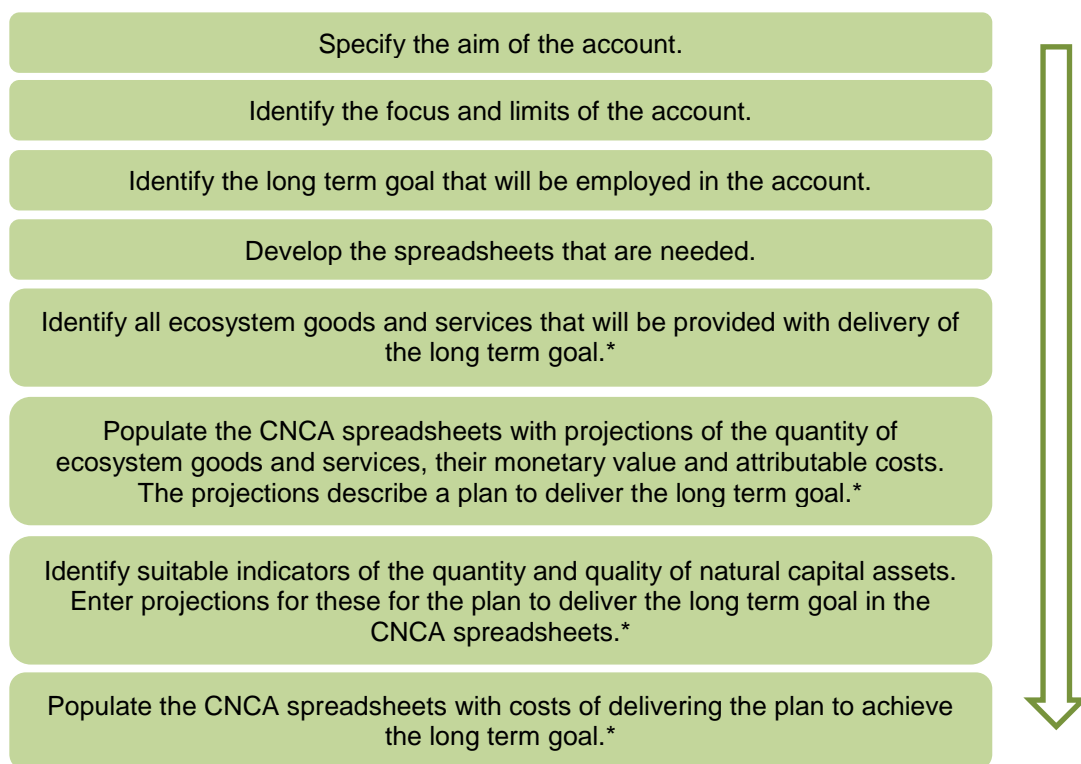
### **Strands of information**

CNCA presents information in different strands (Eftec and others 2015a). Specifically:

- Values of ecosystem goods and services to the organisation (private value, such as revenue) are presented separately to values of goods and services to society (external value, such as net carbon sequestration). Similarly, costs incurred by the organisation are presented separately to costs incurred by others.<sup>16</sup>
- The data in the account are compared against the data that appear in financial accounts. This flags up values of goods and services and costs that may not be adequately recognised by the organisation.

### **Steps in producing the account**

Figure 2.1.2 summarises the steps used in developing the account (based on Eftec and others (2015a and b)). Further information on what was done for this study is provided below on steps marked with \*. Assumptions are provided in Appendix B Section 2.



**Figure 2.1.2 Steps in producing the account**

### **Focus and limits of the account**

The focus and limits of the account developed for the study are as follows:

<sup>15</sup> The method used to value recreational values is different, but the values may be similar.

<sup>16</sup> CNCA may also separate total costs into those required to deliver legal requirements and costs to deliver beyond those. However, that was not done for this study.

- The account focussed on the NNR assets owned or rented by Natural England and the operations of Natural England (not tenants<sup>17</sup>). Consequently, greenhouse gas emissions from tenants' livestock were not included in the account.
- For the purposes of CNCA, net carbon flux is focussed on the environment; emissions from machinery and vehicles are not included (Eftec personal communication 2016).
- Conservation of carbon stocks<sup>18</sup> is not considered to be a service in CNCA, so is not included in the monetary value of services in the account (Eftec personal communication 2016). Eftec (personal communication 2016) suggest that carbon stocks are included in the asset register on the grounds that otherwise they are not included in the account. Due to constraints on resources, that was not done for this study.
- The costs of maintaining and running NNR workshops, offices, classrooms and visitor centres were included. This is because they are required for NNR management and delivery of education which were included in the account.

Rent received by the NNR was not included in the analysis to protect confidential information. In developing the account, the authors focussed on the main costs and goods and services, capturing the majority of information but not small details that were unlikely to have a significant effect. They used information that was readily available. Development of the account involved making generalisations and approximations. This is consistent with the approach adopted by Eftec and others (2015a). Assumptions made in the account are summarised in Appendix B Section 2. To avoid unnecessary complexity, assessments of confidence in the data were not included for the estimates used in the account. This would be possible if needed (as demonstrated in Sunderland and others (2019)).

***Identify all ecosystem goods and services that will be provided with delivery of the long term goal.***

The ecosystem goods and services provided by the NNR were identified by the NNR staff. The staff were prompted by a list of categories (with examples) based on the Common International Classification of Ecosystem Services (CICES; European Environment Agency 2013). Because CICES assumes that impacts on health and wellbeing are integral to impacts on recreation and other physical activities / experiences, they were not identified separately.

***Populate the CNCA spreadsheets with projections of the quantity of ecosystem goods and services, their monetary value and attributable costs.<sup>19</sup> The projections describe a plan to deliver the long term goal.***

For the account, NNR staff estimated quantities for the identified ecosystem goods and services (focussing on final services<sup>20</sup>) for the first year of the analysis and for subsequent years if the quantity was likely to fluctuate. Some goods and services were difficult to quantify and/or the necessary data were not be available. The net carbon flux for the broad habitat types on the NNR was estimated by an expert in Natural England (details are provided in Appendix B Section 3).

For the ecosystem goods and services that could be quantified, the economic value was estimated (using established techniques<sup>21</sup>). This was the case for the following (details are provided below):

- Goods and services sold by the NNR

<sup>17</sup> Tenants could have been included if the focus of the account was on the operations of Natural England and tenants on the NNR.

<sup>18</sup> The amount of carbon held in the ecosystem.

<sup>19</sup> The NNR staff were unable to identify costs that could be attributed to specific goods and services (the SRMs who participated in Clark (2017) were also mostly unable to estimate attributable costs). Consequently, these were not subtracted from the value of goods and services in calculation of the gross asset value.

<sup>20</sup> Final goods and services are used by households directly (such as places for recreation, fine views) or are inputs to the activities of businesses (such as timber and grazing). The quantities of intermediate goods and services (that are inputs to environmental processes, such as habitats for breeding, maintenance of the hydrological cycle) were not estimated because they support and are integral to final goods and services.

<sup>21</sup> Established techniques are described in Annex 1 of Defra (2007).

- Net flux of carbon
- Recreational visits
- Educational visits
- Benefits to volunteers

Economic values were not estimated for the following:

- Health benefits to people using the NNRs for recreation. These were not valued because the economic value of a recreational visit is likely to include at least some of the value of health benefits anticipated by individuals making a visit.<sup>22</sup> Health benefits are estimated separately in Section 4.
- Training of volunteers who do not make regular input. If needed, the value of this could be estimated using the NNR's training records and the cost of providing equivalent training. Note that the value of training regular volunteers is included in the value of the benefit to those volunteers.
- Research projects. The value of providing a resource for research is difficult to estimate.
- The benefits of a resilient healthy natural environment aside from the contribution that it makes to the value of ecosystem goods and services. Estimates of the non-use value<sup>23</sup> were not employed because suitable data were not available.

**Goods and services sold by the NNR** were valued in terms of revenue, which provides an estimate of economic value. NNR staff provided data on revenue per unit in the first year of the account, which was also used for subsequent years. To avoid over-complicating the analysis, minor sources of revenue were not included.

**Net flux of carbon** was valued by the analyst using the value for non-traded carbon set out in government guidance (BEIS 2017).<sup>24</sup> To enable this, the estimated net flux in units of carbon was converted into the units of carbon dioxide equivalent.<sup>25</sup> For habitats that provide net sequestration of carbon, the monetary value was positive because they provide a benefit to society (they contribute to mitigation of climate change). For habitats with net emissions of carbon dioxide and/or methane, the monetary value was negative because the emissions impose a cost on society (they contribute to climate change). The value per unit employed for net sequestration and net emissions was the same. In the calculations of value, the figures were converted into positive or negative values as appropriate.<sup>26</sup>

Shapwick Heath NNR does not charge for **recreational visits**. In the absence of an estimate that is specific to the site, the economic value of a recreational visit by an adult (£5.01) was estimated using the online Outdoor Recreation Valuation Tool (ORVal).<sup>27</sup> The tool employs a random utility model developed using survey data of recreational visits by adult members of the public to specific sites in the natural environment in England. It provides estimates that are based on the habitats and proximity to centers of population but that do not reflect the specific features of a site. Given the special characteristics of Shapwick Heath NNR, ORVal may under-estimate the value of a visit.

<sup>22</sup> Eftac and others (2017) suggest that significant double counting can be avoided if physical activity supported by a site is valued in terms of avoided health care costs to the public sector. They adopt this approach for the natural capital account for Barnet. That approach was not adopted here.

<sup>23</sup> The non-use value is the impact on people's satisfaction that arises from them knowing that a healthy natural environment is there, for themselves and for others now and in the future.

<sup>24</sup> Eftac employ these values in the CNCA accounts presented in Eftac 2016, Eftac and others 2015a.

<sup>25</sup> By multiplying the net flux in units of carbon by the molecular weight of carbon dioxide divided by the molecular weight of carbon (44/12).

<sup>26</sup> Because the quantity of carbon sequestration is a negative figure (see Appendix B Section 3 for further details), in the calculation of the monetary value, the quantity multiplied by the unit value was converted into a positive figure. Conversely, because the quantity of net emissions of carbon dioxide and methane is a positive figure, in the calculation of the monetary value, the quantity multiplied by the unit value was converted into a negative figure.

<sup>27</sup> URL: //leap.exeter.ac.uk/orval/ [Accessed 22 May 2020]. ORVal is suitable for estimating numbers of visits and value per visit for specific sites, small networks of sites, and regional totals. However, it is not well suited to providing estimates for long distance paths such as National Trails.

Though the estimate from ORVal is comparable to an estimate based on average adult admission fees charged by a sample of nature reserves that charge for access (see Appendix B Section 3), that is also likely to be an under-estimate. In the absence of data on the economic value of recreational visits by children (estimated to make 25% of recreational visits to the NNR), the value of these was not estimated. Consequently, the total value of recreational visits is under-estimated. The level of confidence in the values used is low (a two out of ten chance of being correct).<sup>28</sup>

**Educational visits by school pupils** were valued using the fees charged by the NNR (£1.77 per person per half day visit). This is 50% less than the fees charged by a sample of other nature reserves that charge for educational visits (Appendix B Section 3), which are likely to be under-estimates of the economic value.<sup>29</sup> The fees charged by Shapwick Heath NNR were used for the analysis to be consistent with CNCA guidance and because estimates of the economic value of educating school pupils in the living environment were not available. However, they under-estimate the value by at least 50%. The level of confidence in the values used is low (a two out of ten chance of being correct). In the absence of data on the economic value, in its account, RSPB (2017) estimated the value of school educational visits using staff costs for the visits.

The NNR does not charge for **educational visits by the public**. In the absence of data on the value of educational visits by the public,<sup>30</sup> the economic value of educational visits by adult members of the public was estimated using the value of a recreational visit. This is likely to under-estimate the value of educational visits because it does not reflect the additional educational benefits. Educational visits by the public that are made by children were assumed to have the same value as educational visits made by school pupils (£1.77 per person per visit), which is an under-estimate for reasons discussed above. It was assumed that the percentage of educational visits that are made by children was the same as for recreational visits. The level of confidence in the values used is low (a two out of ten chance of being correct).

People who volunteer regularly on the NNR gain benefits themselves, as well as contributing towards the costs of managing the NNR. There is not an established technique for estimating the value of the **benefits to volunteers**. The value is estimated for this study using the prices that people pay for similar wellbeing, health and training benefits, focusing on those aspects that could be estimated easily (an alternative estimate is discussed in Appendix B). This employs the same approach as Linsley and others (2018), and is informed by evidence of the benefits to volunteers managing land for wildlife (eg from Rogerson and others (2017)). Specifically, the benefits were estimated in terms of making friends and camaraderie, contributing to a worthwhile cause, undertaking exercise and receiving training. The value of the benefits to people who volunteer regularly (at least once a month) was estimated at £800 per year (for further details see Appendix B Section 3). This is likely to be an under-estimate as it values only some aspects of the benefits. It is comparable to the value of £844 per person per year estimated by Linsley and others (2018) for people who volunteer for the North York Moors National Park. The analysis for Shapwick Heath NNR assumes that only people who volunteer at least once a month gain the benefits, because they are more likely to do so than people who volunteer less frequently.<sup>31</sup> The value that was used is likely to be an under-estimate, as noted in Linsley and others (2018).<sup>32</sup> An alternative value of the benefits of volunteering was also estimated (method described in Appendix B Section 3).

---

<sup>28</sup> Employing categories from the Intergovernmental Panel on Climate Change (2005).

<sup>29</sup> They are likely to under-estimate the economic value because they are likely to be subsidised and the market may not be competitive.

<sup>30</sup> Charges for educational visits made by other nature reserves are not suitable to use as estimates. That is because these visits are often subsidised (for nature reserves that charge for access, the fee for educational visits by the public may be less than the admission fee) to fulfil public engagement objectives.

<sup>31</sup> The assumption is made in the absence of survey data for all volunteers, which is the approach adopted in Linsley and others (2018) to estimate the percentage of all volunteers that experience each benefit.

<sup>32</sup> Employing a different technique, Fujiwara and others (2013) estimate that adults in the UK who volunteer frequently derive a wellbeing benefit from it that has a monetary value of about £13,500 on average per year (in 2011 prices). That value is not employed here because it is high relative to other values used in the account and so is likely to distort the results. The account for all NNRs managed by Natural England values the benefits of volunteer activity using an estimate of the replacement cost (Sunderland and others 2019).

***Identify suitable indicators of the quantity and quality of natural capital assets. Then, in the CNCA spreadsheets, enter projections for these for the plan to deliver the long term goal.***

As suggested by Eftec and others (2015a and b) the NNR staff identified indicators that concerned:

- Quantities (such as area of habitat, length of linear features critical to the NNR).
- The quality of the environment, focussing on indicators that describe the most important features of ecosystems and offer greatest insights into the quality of ecosystems (including thresholds, tipping points, capacity and major dependencies on other ecosystems).
- Factors required for delivery of ecosystem services.
- Early warnings that ecosystem health or delivery of goods and services would be impacted on.

***Populate the spreadsheets with costs of delivering the plan to achieve the long term goal.***

The NNR staff provided estimates for the first year of the analysis, and estimates for subsequent years if the costs were likely to fluctuate. Costs were separated into relevant categories, such as leases, fleet, utilities and rates; capital items; other running costs. Monetary values of inputs of volunteer time were estimated employing the values used by the National Lottery Heritage Fund (NLHF) (Appendix B Section 4). Staff inputs were valued using data from the range of full salary costs for the appropriate pay band (Appendix B Section 4) (actual salaries were not used to protect personally sensitive data).

## **2.2 Results**

The presentation of the results of the corporate natural capital account follows the structure set out in Figure 2.1.2. Specifically, it discusses: the long term goal of the account; ecosystem goods and services provided by Shapwick Heath NNR; indicators of quantity and quality of natural capital assets; costs; and the natural capital balance sheet.

### **Long term goal of the account**

The goal employed for the account was to maintain current levels of good access to the public, continue to provide good quality engagement with the public and maintain current favourable condition of habitats on the NNR. This was supplied by the Senior Reserve Manager. The projections of benefits and costs in the account are for a plan to deliver this goal. The data were provided by NNR staff.

The goal is important as it determines the plan that is described by the data projections in the account (in the initial account and in subsequent reporting). The duration of the projections (20 years) was specified by the analyst (informed by Clark (2017)).

### **Ecosystem goods and services provided by Shapwick Heath NNR**

The ecosystem goods and services provided by Shapwick Heath NNR are listed in Table 2.2.1. The categories used are based on the Common International Classification of Ecosystem Services (European Environment Agency 2013). The table also provides a qualitative assessment of the level of their provision (using the categories 'one of the main goods/services provided by the NNR' or 'provided at low levels').

**Table 2.2.1 Ecosystem goods and services provided by Shapwick Heath NNR <sup>a</sup>**

<b>Good / service</b>	<b>Level</b>
<b>Provisioning</b>	
<b>Inputs to food for human consumption (not inputs to animal or crop production):</b>	
Wild plants, algae and their outputs.	○
Wild animals and their outputs.	○
Animals from on-site aquaculture.	○
<b>Biomass for human use:</b>	
Materials for agricultural use.	●
<b>Water for human use (not drinking):</b>	
Surface water.	●
Ground water.	●
<b>Energy for human use (other than food):</b>	
Plant resources that generate energy.	○
<b>Regulation and maintenance</b>	
<b>Degradation of waste and toxic materials &amp; moderation of other nuisances:</b>	
Filtration, sequestration, storage or accumulation of pollutants by organisms.	●
Filtration, sequestration, storage or accumulation of waste by ecosystems.	○
Dilution of waste by the atmosphere, freshwater or marine ecosystems.	○
Moderation of smell, noise or visual impacts.	○
<b>Maintenance and moderation of flows:</b>	
Stabilisation of land masses and control of erosion rates.	○
Flood protection.	○
Wind protection.	○
Ventilation and transpiration.	●
<b>Maintenance of physical, chemical or biological conditions:</b>	
Pollination and seed dispersal.	●
Maintaining habitats for reproduction and nurseries.	●
Weathering processes.	●
Decomposition and fixing processes.	●
Chemical condition of freshwaters.	●
Impacts on greenhouse gas concentrations (contributing to global climate regulation).	●
Micro and regional climate regulation.	○
<b>Cultural</b>	
<b>Recreation &amp; other physical activities &amp; experiences:</b>	
Experiences that directly involve plants, animals and land/sea scapes.	●
Physical uses of land/sea scapes.	○
<b>Intellectual activities &amp; representations of nature (eg in art):</b>	
Scientific (Research)	○
Educational.	○
Heritage, cultural.	○
Access off-site and entertainment.	○
Aesthetic.	●
<b>Spiritual, symbolic &amp; other interactions with nature:</b>	
Symbolic.	○
Sacred and/or religious.	○
Existence for current generation.	○
Current value of conservation for future generations.	○

<sup>a</sup> Key: ● One of the main goods/services relative to others provided by NNR; ○ Provided at low levels relative to other goods/services provided by NNR.

Though there was a relatively long list of goods and services that were provided at significant levels by the NNR, few of these could be quantified and even fewer could be valued (this is consistent with the findings of other studies). As a result, the ‘final value’ of supported benefits gives an incomplete picture. It omits the value of several goods and services that are provided at significant levels by the NNR. Moreover, while there is medium to high confidence<sup>33</sup> in the number of recreational and educational visits and very high confidence<sup>34</sup> in the firewood sold and number of regular volunteers, most estimates of value are underestimates (details are provided below). One thus should interpret the figures below with care.

For the main ecosystem goods and services that could be quantified and valued, estimates are set out in Table 2.2.2.

**Table 2.2.2 Quantity and value of ecosystem goods and services in 2017**

Note: monetary values are rounded to three significant figures

<i>Ecosystem goods and services</i>	<b>Quantity in 2017</b>	<b>Value in 2017</b>
<b>Provisioning</b>		
Firewood sold in bags	167 bags <sup>a</sup>	£651 <sup>a</sup>
Firewood sold in loose	5.4 loose loads	£555
<b>Regulation and maintenance</b>		
Net sequestration of carbon dioxide:	704 t CO <sub>2</sub> equivalent <sup>b</sup>	£45,800 <sup>c</sup>
<b>Cultural</b>		
Recreational visits:	80,000 visits	£301,000
Educational visits with educational input from NNR team:		
by school pupils:	726 visits	£1,290
by the public:	1,300 visits	£5,460
Benefits to the people who volunteer regularly (at least once a month):	33 people	£26,400
Training of volunteers who do not make regular input.	30 people	No estimate
Number of research projects:	3 projects	No estimate

<sup>a</sup> Estimated to continue at same level in future years. Excludes sales through an outlet that closed in 2018.

<sup>b</sup> This estimate is partial. Suitable estimates of net carbon flux were not available for wet woodland (which covers 10% of the NNR). It is estimated with low confidence. The data used were generalised values for broad habitat types that were best estimates (not based on studies at the site).

<sup>c</sup> The value per unit increases each year in future (as specified in the government guidance).

Significant goods and services provided by the NNR that could be described but not quantified include:

- Advice the NNR staff give to local land managers and conservation organisations. This contributes to improved land management in the wider area.
- Improvements in water quality.
- Storage of water during high rainfall events and erosion control.
- Moderation of noise and screening of transport routes.

<sup>33</sup> A five to eight out of ten chance of the estimates being correct.

<sup>34</sup> At least a nine out of ten chance of being correct.

- Conservation of archaeological heritage.
- Conservation of habitats and of species. The NNR is an important breeding site for birds, including the iconic bittern.
- Aesthetic value, including contribution to the landscape.

Not all goods and services provided by the NNR that could be quantified could also be valued. Amongst other things, the value of the NNR as a resource for research and the conservation of habitats and species could not be estimated. It is unlikely that estimates of the values for these will become available because they are difficult or prohibitively expensive to value.

Of the goods and services that could be valued, the service with the highest total value was **recreational visits** (£301,000 for 80,000 visits in 2017). This value is an under-estimate as it does not include the value of visits by children (who are estimated to have made 25% of the visits) and the value per visit is likely to be an under-estimate. In comparison, using a similar estimate of value per visit, the value of recreational visits to East Dartmoor NNR<sup>35</sup> in 2016 was £307,000 for 80,000 visits (Clark 2017). To put these figures in context, Sunderland and others (2019) estimate that in 2017/18, there were 5.5 million visits to all NNRs managed by Natural England, with a value of £22 million.

The service with the second highest value was the **net sequestration of carbon** (estimated at 704 t CO<sub>2</sub> equivalent per year<sup>36</sup>; the level of confidence in this estimate is low), with an economic value in 2017 of £45,800.<sup>37</sup> This reflects the habitats on the NNR which include grassland on drained peat soil and shallow lakes that are expected to have net emissions of carbon dioxide and/or methane. The NNR has 46 ha of woodland that are known to sequester carbon and other habitats that sequester carbon but at lower rates.

The net carbon flux is different for other NNRs. It is determined by the habitats and their area. For example, East Dartmoor NNR has a large area of oak woodland (225 ha) (which has high rates of net carbon sequestration) and no habitats that are net emitters of carbon dioxide and/or methane. The net sequestration of carbon by East Dartmoor NNR is approximately 180,000 t CO<sub>2</sub> equivalent per year, which in 2016 had an economic value of £11.4m (Clark 2017). Sunderland and others (2019) estimate that in 2017/18, the total net carbon flux for all NNRs managed by Natural England was 185,000 t CO<sub>2</sub> equivalent with a value of £12 million.

Other ecosystem goods and services that could be valued:

- Benefit to the 33 **volunteers** who volunteer regularly (at least once a month), contributing to land management and species surveys and monitoring. This has an estimated value of £26,400, which is expected to be an under-estimate. This is much lower than an alternative estimate based on the total value of the work done by volunteers<sup>38</sup> (£107,000 per year).
- 1,300 **educational visits by the public**, with an estimated economic value of £5,460. The value is under-estimated as it does not include the educational value of the visits for adults, and employs a value for educational visits by children (who made approximately 25% of the visits) that is an under-estimate by at least 50%.
- 726 **educational visits by school pupils** with a total revenue of £1,290. Note that the revenue for this under-estimates the value of the visits by at least 50% (Section 2.1).
- Revenue of £1,210 from the sale of 167 bags plus 5.4 loose loads of **firewood**.

### Indicators of quantity and quality of natural capital assets

The natural capital account focussed on Natural England's operations on Shapwick Heath NNR (covering 500 ha). NNR staff identified indicators of the quantity and quality of assets that were most suitable to use for Shapwick Heath NNR. The indicators are set out in Table 2.2.3. They provide important information on the conservation of habitats and species which are only partially captured in

<sup>35</sup> East Dartmoor is an NNR managed by Natural England, covering 365 ha, also in South West England. It is predominantly oak woodland with some heathland and bog.

<sup>36</sup> This estimate is partial because data on net carbon flux was not available for all habitats on the NNR.

<sup>37</sup> Note that the value per unit increases in subsequent years, as specified in government guidance.

<sup>38</sup> Described in Appendix B Section 3.



the value of assets. The values of the quality indicators reflect the high quality of the NNR's natural capital assets.

**Table 2.2.3 Indicators of the quantity and quality of natural capital assets**

Indicator	Value
<b>Indicators of quantity of assets:</b>	
Area of habitats that are a priority for management (separate area specified for each habitat)	Total: 376 ha
<b>Indicators of quality of assets:</b>	
Number of pairs of breeding bitterns.	16
Number of wintering waterfowl using the reserve each month in winter.	3,000
Is the reserve still grazed by traditional livestock?	Yes
Is there Sphagnum growth?	Yes
Do we still have high visitor numbers?	Yes
Are mires on the reserve functioning?	Yes
Are staff and volunteers available to make input to educational visits?	Yes
Are each of the habitats that are a priority for management in favourable condition?	Yes

### Costs

In terms of costs, in 2017:<sup>39</sup>

- total costs met by Natural England were £296,000 (this is not an annual average; the costs fluctuate over time).
- total costs met by others were £107,000 (27% of the total). This is the value of inputs made by volunteers.

The natural capital account indicates the significant contribution that volunteers make to the NNR; they provide 30% of the present value of the total costs. Natural England meets the remaining costs. The costs are determined by a number of factors including the plan and long term goal used for the account and the NNR itself (including the habitats, site, location, and the maintenance of buildings and infrastructure that are needed).

### Natural capital account balance sheet

The natural capital account balance sheet draws together estimates of the value of natural capital assets and the costs (liabilities) of maintaining the assets for the long term goal of the account.

Estimates of the quantity and value of ecosystem goods and services for the first year in the account are provided in Table 2.2.2. For the plan to deliver the long term goal of the account, the gross value of the assets (with no costs deducted) is £12 million. This comprises a value of £0.1 million to Natural England from revenue (sales of firewood) and a value of goods and services to society of £11.9 million (Table 2.2.4). The latter includes recreational and educational visits, benefits to regular volunteers, and net carbon flux. The benefits to society are not included in Natural England's financial accounts. The gross asset value reveals that society receives 99% of the benefits provided by the NNR and Natural England receives less than 1% of the benefits (in the form of revenue).<sup>40</sup>

<sup>39</sup> Figures rounded to three significant figures.

<sup>40</sup> This is consistent with the findings of other studies. Clark (2017) found that the gross asset value of recreational and educational visits alone greatly exceeded the gross asset value of revenue for five NNRs. In the natural capital account for the Public Forest Estate of England (Forest Enterprise 2017), benefits to society from recreation and carbon sequestration were 98% of the gross asset value and 2% was from sales.

The present value of the net carbon flux makes a significant contribution to the gross and net asset values. It is the second largest contributor to the gross asset value over the period of the account.<sup>41</sup> It has a present value of £2.1m, second only to the present value of recreational visits, which is £8.9m.<sup>42</sup> Net carbon flux is determined by the habitats on the NNR and so is an inherent feature of the site. Because of its significant contribution, it can be helpful to consider gross and net asset values excluding net carbon flux. This is done in Appendix B Section 5. The values for Shapwick Heath NNR (gross and net asset values including and excluding carbon flux) are compared with estimates for East Dartmoor NNR from Clark (2017), which were calculated using comparable data sources and the same approach.

The estimates of gross and net value of natural capital assets are partial (not all goods and services could be valued and the values that were used are under-estimates), and there is a low level of confidence in them.<sup>43</sup> The gross asset value calculated here includes the value provided by inputs of labour, equipment, buildings and visitor infrastructure as well as the environment (because costs could not be attributed to specific goods and services).

The present value of the liabilities (costs) of the plan to deliver the goal is £10.6 million, which comprises £7.4 million met by Natural England and £3.2 million met externally through inputs by volunteers (Table 2.2.4).

The net value of the natural capital assets (with costs deducted) is £1.4 million (Table 2.2.4). This is a partial estimate and the benefits that are valued are under-estimated as explained above. Some of the most important benefits of NNRs, such as research and the non-use value for conservation of habitats and species are not included because estimates of their value were not available. For Shapwick Heath NNR, the absence of research and non-use values from the values is significant, given that research and nature conservation are two of the three purposes of National Nature Reserves.

**Table 2.2.4 Natural capital asset values and present value of liabilities**

All figures are present values in 2017 of initial projections in perpetuity for a plan to deliver the goal (calculated at a discount rate of 3.5%). Negative values are shown in brackets (as in accountancy).

For a plan to deliver the long term goal:	Private	External	Total value	Of which reported in financial accounts
	(Natural England)	(not Natural England)		
	(£ millions)	(£ millions)	(£ millions)	(£ millions)
<b>Gross asset value</b> (present value of the assets, no costs deducted)	.091	11.944	12.035	.091
<b>Liabilities</b> (present value of the costs)	(7.443)	(3.163)	(10.606)	(7.443)
<b>Net asset value</b> (the present value of the assets with costs deducted)	(7.352)	8.781	1.429	

Comparisons of asset values need to be undertaken with care, not least because accounts differ in the methods used and the values employed. However, figures are provided here to help set the values calculated for Shapwick Heath NNR in context. For all the NNRs managed by Natural England, Sunderland and others (2019) estimated that the benefits in 2017/18 were £36 million per year with a gross asset value of £1.8 billion. The authors note that the value of benefits not included

<sup>41</sup> This is partly because the values per unit in government guidance increase in future years.

<sup>42</sup> Clark (2017) also found that net carbon flux can have a large effect on the asset values in natural capital accounts.

<sup>43</sup> Similarly, the estimates of value are partial in the accounts for five NNRs managed by Natural England in Clark (2017), and the accounts for Forest Enterprise (Efec 2017) and the RSPB (2017). For example, none of these accounts include estimates of the non-use value of conserving habitats and species.

in these estimates probably exceeded the benefits that were included. The estimated costs were £14 million. The method and unit values used for that account differ from those employed here.<sup>44</sup>

The main application of asset values calculated by a natural capital account is as input to future monitoring using the account. The account developed for this study could be used as a reference scenario for future monitoring. Development of accounts may help demonstrate adoption of a natural capital approach. However, because they are not easily understood and the estimates are partial, the asset values are not likely to usefully inform communications about a site. The indicators of asset quantity and quality are likely to be more useful to use for describing the assets, not least because indicators can be selected that represent all relevant aspects of a site, including those that cannot be easily quantified or valued. For example, conservation of habitats and species can be clearly represented in indicators of ecosystem quantity and quality but not easily included in asset values.

Information on the natural capital assets provided by multiple NNRs or at a landscape scale can be provided if the necessary resources and data are available to develop a natural capital account (data summarised in Appendix A). Examples include the account for the Public Forest Estate (Forest Enterprise England 2017), for NNRs managed by Natural England (Sunderland and others 2019) and for reserves managed by the RSPB (RSPB 2017).

---

<sup>44</sup> The analysis was conducted prior to development of the natural capital account for all NNRs managed by Natural England (Sunderland and others 2019). As a result, it was not informed by the approach that was developed for that account (which is different to CNCA) or the data used in it.

# 3 Contribution to the local and regional economy

---

NNRs contribute to local and regional economies. They do this by employing staff, purchasing goods and services, providing a site for other businesses and encouraging people to visit. These contributions result in further rounds of benefits (multiplier effects). The multiplier effects arise from suppliers purchasing goods and services from other businesses in the local and regional economy (indirect effects) and employees spending their salaries / wages (induced effects). This chapter starts by explaining the method used in assessing the contribution of Shapwick Heath NNR to the local and regional economy (Section 3.1). It then presents and discusses the results (Section 3.2).

## 3.1 Method

The contribution that the NNR makes to the local and regional economy was assessed in terms of its direct contribution to employment and the contribution to economic activity (the value of goods and services produced in an area, measured in terms of gross value (GVA)<sup>45</sup>). The assessment employed standard techniques,<sup>46</sup> data supplied by the NNR team and data from the national accounts (published by the Office of National Statistics). Note that it is the contribution to the economy that was assessed, not the impact on the economy. Assessment of the impact would involve analysis of the additional contribution made by the NNR compared with what would happen in the absence of the NNR.

The contribution was assessed separately for the 'local' economy (the area within 0 - 10 miles of the NNR) and the 'regional' economy (the area within 0 - 30 miles, which includes the local economy). The distance used to define the local economy is consistent with ICF GHK (2013) and ICF and others (2019). English Partnerships (2008) suggest using the area within which people travel to work or a 10-15 mile radius. The regional economy was used because, like many NNRs, Shapwick Heath NNR is in a relatively remote area. More employees and businesses are likely to be located in the regional economy than in the local economy (because it covers a larger area and is more likely to include towns). A distance of 30 miles was used, informed by AECOM (2016); in its assessment of the impact of Heritage Lottery fund projects, GHK (2009) employed a distance within 50 miles. The definition used is different to a formal region (such as South West England).

Unless specified otherwise, the analysis was carried out using data for the first year of the natural capital account. It is not necessary to develop an account to assess the contribution to the local economy (and rough estimates may be calculated by focussing only on items of non-staff expenditure of over £1000, an approach adopted by GHK (2009)). The operations of the tenant farmer were not included in the analysis.

### Employment

The employment created directly by the NNR and by other businesses based on the NNR was estimated using data supplied by the NNR staff. It was measured in terms of the number of full time equivalents (FTEs) employed. Because the staff were based on the NNR, it was assumed that this employment was in the local economy (within 10 miles of the NNR).

The employment supported by the NNR's expenditure in the local and regional economy was calculated by dividing the expenditure by an estimate of the amount of output that supports a job (Appendix C Table C.1). The output per job was estimated using data for all industries from the

---

<sup>45</sup> Gross value added measures the contribution to the economy by a producer, sector or region. It is the total of wages, profits and rents. It does not include purchases of goods and services from other businesses. Because gross value added does not include purchases of inputs (which are included in gross output), it can be added together for all firms. GVA measures overall output in the economy without double counting (ICF GHK 2013).

<sup>46</sup> Also employed by GHK (2009), ICF GHK (2013) and ICF and others (2019).

national accounts. Figures for all industries were used because it was not proportionate to employ a breakdown of the NNR's expenditure by industry for the analysis.

### Gross value added

The gross value added that is associated with direct employment by the NNR is the expenditure on full salary costs. Data from the range of full salary costs for the appropriate pay band were used (to protect personally sensitive information).

For businesses on the site other than the NNR, the contribution to GVA in the local economy was estimated using the total full time equivalents (FTE) employed by each business<sup>47</sup>, as follows.<sup>48</sup> NNR staff estimated the number of FTEs employed by each business. For each business, the total number of FTEs employed was multiplied by the average gross value added per FTE for the relevant sector (calculated using data from the national accounts). The contribution to GVA in the regional economy was assumed to be the same as for the local economy (the regional economy includes the local economy). The figures are provided in Appendix C Table C.1.

Data on the NNR's expenditure were estimated by the NNR team. NNR staff also estimated the percentage of the NNR's expenditure that was made to business within 0 – 10 miles of the NNR and 0 – 30 miles of the NNR (excluding large regional firms or national firms). These percentages were multiplied by the expenditure data to calculate estimates of expenditure in the local and regional economy (Table 3.1.1). Because projections for expenditure in the natural capital account fluctuate in future years, equivalent annual values<sup>49</sup> of the expenditure projections were used in the calculations.<sup>50</sup> To protect confidential information, rent received by the NNR was not included in the analysis.

**Table 3.1.1 Estimates of NNR expenditure in the local and regional economy**

Category of expenditure by the NNR	Percentage of expenditure		Amount of expenditure (£ / yr)	
	within 0 - 10 miles of the NNR	within 0 - 30 miles of the NNR	within 0 - 10 miles of the NNR	within 0 - 30 miles of the NNR
Expenditure recorded by the NNR in its electronic recording system excluding capital items <sup>a</sup>	10%	20%	5,496	10,991
Expenditure on capital items <sup>b</sup>	0%	0%	0	0
Other costs not entered on the electronic recording system (leases, fleet, utilities & rates, excluding staff salaries and IT costs)	0%	0%	0	0

<sup>a</sup> This does not include staff salaries, cost of IT for staff, leases, fleet, utilities & rates.

<sup>b</sup> Capital items include buildings, machinery, and equipment costing more than £5,000.

The employment and gross value added supported by expenditure by the NNR were estimated using data on output, employment and gross value added from the national accounts (details provided in Appendix C Table C.2). The data from the national accounts were used to provide estimates of the amount of gross value added supported by each £1 spent in the economy, and the amount of expenditure required to support 1 FTE of employment. Data for 'all industries' were employed

<sup>47</sup> because Natural England does not have information on the businesses' expenditure

<sup>48</sup> This is consistent with ICF GHK (2013).

<sup>49</sup> Equivalent annual value = total present value /  $a_{t,r}$ , where  $a_{t,r}$  is the annuity factor (See footnote in Appendix B Section 2). Calculated here using a discount rate of 3.5%.

<sup>50</sup> If the cost estimates had been the same for each year, the estimates for the first year would have been used for the assessment.

because the amount of spend in each sector of the economy could not be estimated easily (which is consistent with ICF GHK (2013)).

Expenditure by volunteers was not included in the analysis because, in its assessment of the economic impact of NNR's managed by Natural England, ICF GHK (2016) found that expenditure by NNR volunteers does not make a significant contribution to the local economy.

### Visitor expenditure

The contribution that visitor expenditure makes to the local economy is determined by:

- The number of visitors who are from outside the local economy;
- The opportunities for them to spend money in the local area;
- The amount they spend. Visitors who stay overnight are likely to spend more than people who do not (day visitors).
- The extent to which that money can be attributed to the NNR. If they visited the area for other purposes, their expenditure cannot be attributed to the NNR.
- Structure of the local economy, and whether businesses in it purchase their goods and services locally.

Expenditure in the local economy that could be attributed to the NNR was estimated using data from studies of the economic impact of nature reserves (Table 3.1.2) because information specific to Shapwick Heath NNR was not available. Expenditure by local visitors was not included in the analysis as it does not make an additional contribution to the economy. People who live locally are likely to have spent money in the local economy even if they had not visited the NNR. The contribution to the regional economy was not estimated because the necessary data were not available.

**Table 3.1.2 Estimates of expenditure within 10 miles by visitors to nature reserves**

	% of visits <sup>b</sup>	Local spend attributed to NNR (£/person/day) <sup>a</sup>	
		in 2009 <sup>c</sup>	in 2017 <sup>d</sup>
Day visits by people not living within 10 miles (day visitors)	14%	4.92	5.51
People not living within 10 miles who stay overnight (overnight visitors)	7%	55.96	62.64

<sup>a</sup> The source of these data (Molloy and others 2011) assumes that 90% of expenditure was in the local economy, to account for petrol bought at home (on the basis that on average 16% of total spend by all types of visitors was on travel).

<sup>b</sup> ICF GHK (2013) estimate that 21% of visits to NNRs are by non-locals based on: an estimate by Natural England of 4.3 million visits to 125 NNRs managed by Natural England in 2006/7; an assumption that 45% of visitors live more than 10 miles from the NNR (based on data from a 2005 NNR visitor satisfaction survey); and an assumption that non-locals visit once a year. ICF GHK (2013) estimate that 14% of visits are by non-local day trippers and 7% of visits are made by non-locals who stay overnight. This is on the basis that Natural England NNR staff suggested that non-local visitors to reserves that they manage are more likely to be day trippers than overnight visitors compared with RSPB reserves (survey data for RSPB reserves in 2009 indicated that the numbers of each were similar (Molloy and others 2011)).

<sup>c</sup> Source: Molloy and others (2011) from a survey of visitors to nature reserves managed by RSPB. The estimates are per person in a party visiting a nature reserve, so are assumed to include children. The study used data on whether the reserve motivated the visit to estimate visitors' spend attributed to the NNR. Use of these data is consistent with ICF GHK (2013).

<sup>d</sup> Factor used to adjust 2009 figures for inflation: 1.12 (HM Treasury 2018a).

### Indirect and induced contributions

In addition to the direct contribution, the expenditure and employment by the NNR and other businesses on the site make indirect and induced contributions to employment and gross value added. These indirect and induced contributions arise from suppliers purchasing goods and services from other businesses and employees spending their salaries / wages. Some of this expenditure leaks out of the local economy. The extent to which it does is affected by the structure, size and scale

of the economy, and whether employees and local suppliers purchase goods and services from local businesses, amongst other things.

Ideally, indirect and induced effects would be estimated by tracking expenditure by the NNR, employees, suppliers and visitors through the economy. This would reflect the specific situation for the NNR. However, obtaining such information is resource-intensive and difficult. Instead, standard estimates of multipliers were used. For the NNR and other businesses on the site, the following multipliers are used to estimate the induced, indirect plus direct contribution to gross value added and employment:

- within 10 miles: a multiplier of 1.2, which is consistent with the multiplier used by ICF GHK (2013)
- within 30 miles: a multiplier of 1.3, which is consistent with the advice in AECOM (2016)

These multipliers were informed by the latest Homes and Communities Agency guidance (2014), which suggests using a composite multiplier of 1.1 at the neighbourhood level and 1.5 at the national level for an average situation. Multipliers for areas within 10 miles and within 30 miles are expected to fall between these two values. Rough estimates were used in the absence of more detailed data.

For visitor expenditure, the indirect, induced and direct contribution was roughly estimated using local tourism multipliers from ICF GHK (2013). These multipliers employ data from local studies that use the Cambridge and STEAM models (Appendix C Table C.3). It was assumed that 90% of visitor expenditure is made in the local economy. This is consistent with Molloy and others (2011) and ICF GHK (2013). The analysis assumes that the rate of visitor expenditure was the same per person for adults and children. Estimates were not calculated for the regional economy (it is less relevant for the contribution of visitor expenditure). Because they employ data from studies of other sites, the estimates for visitor expenditure should be viewed as illustrative.

## 3.2 Results

The contribution of Shapwick Heath NNR to the local and regional economy was assessed in terms of its contribution to employment and economic activity, separately for the local (within 0 – 10 miles of the NNR) and the regional economy (within 0 – 30 miles of the NNR).

In 2017, Shapwick Heath NNR and the art and craft shop and café on the site directly employed 8 full time equivalents (FTEs) in the local economy (within 0 – 10 miles of the NNR). The NNR provided employment for five people, ten people worked part-time at the art and craft shop, and two people worked at the café. The NNR, shop and café directly supported gross value added (GVA) of approximately £222,000 in the local economy (Table 3.2.1). In the regional economy, the NNR, shop and café directly supported GVA of approximately £224,000 within 0 – 30 miles of the NNR (including the local economy) (Table 3.2.1). There is low confidence in the figures calculated for GVA as they employ generalised and average data from other sources. If they are used to inform communications, they should be described as rough estimates.

Direct employment by the NNR supported £158,000 of GVA in the local economy and the same in the regional economy (figures calculated using salary ranges for pay bands) (Table 3.2.1). The NNR spent approximately £5,500 per year in the local economy (within 0 - 10 miles) and £11,000 per year in the regional economy (within 0 – 30 miles). The latter supported approximately 0.1 FTE of employment and GVA of £5,750.

In addition to a direct contribution, indirect and induced contributions arise from the expenditure of businesses in supply chains and from employees' spending their salaries. The estimates of indirect and induced contribution have a lower level of accuracy than the direct contribution because they are calculated using rough estimates of multipliers (Section 3.1).

In 2017, the NNR, shop and café supported employment of approximately 10 FTE in the local and regional economy, £266,000 of GVA in the local economy and £292,000 of GVA in the regional economy, through direct, indirect and induced effects (Table 3.2.1). Because data from other sources, some of which was for all sectors, were used for the analysis, the level of confidence in these estimates is low (a two out of ten chance of being correct). The contribution to the regional economy, which includes the local economy, is expected to be greater because it covers a larger area, encompassing more suppliers.

Visitors from more than 10 miles away spent an estimated £412,000 per year in the local economy that can be attributed to the NNR. This supported employment of approximately 6 FTE and GVA of £215,000 in the local economy through direct, indirect and induced effects (Table 3.2.1). Because these estimates use data from studies of other sites they should be viewed as illustrative. The contribution from visitor expenditure is additional to that from the NNR, shop and café provided above.

**Table 3.2.1 Estimates of the NNR's contribution to the local and regional economy**

Figures are for 2017. Estimates of gross value added (GVA) have been rounded to three significant figures. Employment is measured in terms of full time equivalents (FTEs). Totals may differ from the sum of data in the table due to rounding.

	Contribution to local economy (within 0 - 10 miles of NNR)		Contribution to regional economy (within 0 - 30 miles of NNR)	
	Employment supported (FTE)	GVA supported (£/yr)	Employment supported (FTE)	GVA supported (£/yr)
<b>Direct contribution from:</b>				
Direct employment by the NNR	5.5	158,000	5.5	158,000
Expenditure by the NNR	0.05	2,970	0.1	5,750
Shop and café on the site	2.5	61,100	2.5	61,100
<b>Total direct contribution</b>	<b>8.0</b>	<b>222,000</b>	<b>8.1</b>	<b>224,000</b>
<b>Direct plus indirect and induced contribution from:</b>				
Shapwick Heath NNR	<b>6.7</b>	<b>193,000</b>	<b>7.3</b>	<b>212,000</b>
Shop and café on the site	<b>3.0</b>	<b>73,400</b>	<b>3.3</b>	<b>79,500</b>
<b>Total direct plus indirect and induced contribution</b>	<b>9.7</b>	<b>266,000</b>	<b>10.5</b>	<b>292,000</b>
Visitor expenditure	6.3	215,000	See note (i)	See note (i)
<b>Total</b>	<b>15.9</b>	<b>481,000</b>	<b>10.5</b>	<b>292,000</b>

Note (i): the contribution of visitor expenditure to the regional economy was not calculated.

The results of this study provide an update to estimates for 2011/12 calculated for all NNRs managed by Natural England, which included Shapwick Heath as one of six case studies. That study estimated that Shapwick Heath NNR, other businesses on the site and visitor expenditure supported employment of 15 FTE and GVA of £393,000 in the local economy (within 10 miles) through direct, indirect and induced effects ICF GHK (2013). The contribution to employment is similar to that estimated for this study. The difference in estimates for GVA may arise from differences in activities and expenditure between the two periods and use of different sources of information for the analyses. Also, the ICF GHK study included the tenant farmer<sup>51</sup> (omitted from this study).

Estimates of the contribution to the local and regional economy can help inform discussions with local businesses, the Local Enterprise Partnership, and support applications for funding. Analysis such as that employed above can be applied at various scales. The contribution to the local and regional economy can be calculated for several NNRs (as demonstrated by ICF GHK (2013)) or for land management over a wide area if the necessary data on employment and expenditure are available (summarised in Appendix A). The advice of an economist is likely to be needed, to identify which

<sup>51</sup> The tenant farmer was estimated to support 0.5 FTE employment and £11,000 GVA in the local economy through direct, indirect and induced effects (ICF GHK 2013).



figures from the national accounts to use (they are updated regularly) and to advise on how to make any necessary adjustments for inflation, amongst other things.

# 4 Health benefits supported by the NNR

---

NNRs support health benefits for people who walk or undertake other forms of exercise when they visit. This chapter starts by explaining the method used in assessing the health benefits supported by Shapwick Heath NNR (Section 4.1). It then presents and discusses the results (Section 4.2).

## 4.1 Method

Two different approaches were used which focused on two different types of visitors, each of which undertakes a different kind of exercise on the NNR:

- adults who go for a walk on the NNR, and
- 'active' adults who exercise on the NNR. 'Active' adults report that they undertake exercise for 30 minutes or more 5 or more times per week.

Health benefits may be separated into:

- Health benefits that are supported by the NNR: benefits that would arise even if the NNR was not accessible because at least some people would walk or exercise somewhere else instead.
- Health benefits that are reliant on the NNR: benefits from walks or other exercise that would not have taken place if the NNR was not available for some reason. These are the health impacts of the NNR.

These two were estimated separately for adults. Data were not available to assess the impacts of exercise by children on the quality or length of life.

The calculations provide rough estimates for 2017 that employ average national data (unless specified otherwise). More precise estimates could be derived using local data.

### Health benefits for adults who walk on the NNR

The health benefits for all adults who go for a walk on the NNR were measured in terms of the resultant reduction in death rate. This was estimated using the World Health Organisation's Health Economic Assessment Tool (HEAT). Though HEAT can also be applied for cycling, the analysis here focuses on walking as data on cycling visits were not available for the NNR. The analysis underestimates the full health benefits of people visiting the NNR because it does not include mental health benefits, exercise other than walking, and visits by children.

HEAT can be used to assess the health benefits that arise from each walk taken on the NNR. That is because it assumes that each increase in physical activity is associated with additional health benefits. The health benefits of going for a walk are assumed to be additional to the benefits of other exercise that people undertake. The only data that are needed are the number of adults who go for a walk when they visit the NNR, the number of visits they make per year, and the distance they walk or the time they spend walking. These were estimated by NNR staff and are set out in

Table 4.1.1. It was estimated that there were 60,000 visits by adults to Shapwick Heath NNR per year of which 95% went for a walk during their visit. These visitors were estimated to walk on average two miles per visit and to visit the NNR twice a year. Using these data, there were an estimated 28,500 adult visitors who walked per year.

The health benefits were estimated by entering the average number of adult visitors who walk on the NNR per year and the average distance they walk per day (calculated as the average over a year) into HEAT (<http://www.heatwalkingcycling.org/#homepage>). For the analysis, the value of a prevented fatality in Department for Transport (2018) was used for the value of a statistical life. This figure (from UK government guidance) is more appropriate to use for UK applications than the default value employed in HEAT (which is estimated from an international review of studies (World Health Organisation 2014)).

**Table 4.1.1 Data employed in the estimation of health benefits for adults who walk on the NNR**

<b>Variable</b>	<b>Estimate</b>	<b>Source and assumptions</b>
Value of a life at 2016-17 prices	1,408,264	Source: Department for Transport (2018), which gives a value of £1,548,104 at 2010 values and prices. Value adjusted for inflation using HM Treasury GDP deflator (2018a).
Number of visits by adults per year	60,000	Estimated by NNR staff (from an estimate of 80,000 visits per year and an estimate that 75% of visits are by adults).
Percentage of adult visitors who go for a walk on the NNR (note that the walk does not need to be for 30 minutes or make them out of breath)	95%	Estimated by NNR staff.
Average distance the above visitors walk per visit (miles)	2	Estimated by NNR staff.
Average number of visits an adult makes per year to the NNR	2	Estimated by NNR staff.
Average number of adult visitors per year who walk	28,500	Calculated using the above data.
Average distance walked on the NNR per day by a visitor who walks	0.0110	Calculated using the above data. Note that the figure is low because the average is calculated over a year for the distance walked in two visits.
Number of adult visitors who go for a walk on NNR but would not walk if the NNR was not available	0	Estimated by NNR staff.

### **Health benefits specifically for 'active' adults who make 'active' visits**

The health benefits for 'active' adults who exercise on the NNR were estimated based on the approach developed by White and others (2016). The benefits were estimated in terms of the improvement in Quality Adjusted Life Years (QALYs) for 'active' visitors. QALYs are a quantitative measure of the state of health. They are used to assess the impact of health-related interventions on the length and quality of life (and are commonly used in the UK). One QALY equals a year lived in perfect health (NICE 2014). The analysis for this study employed the value for a QALY given in government guidance (HM Treasury 2018b). The guidance was published after White and others (2016), which employed a different value.

The assessment focussed on adults who are 'active', that is, who report that they undertake exercise for 30 minutes or more five or more times per week (White and others 2016). This provides a conservative estimate of the health benefits as it does not include people who exercise at a lower level. Exercise is considered here to be physical activity that is enough to raise the person's breathing rate. It may include sport, exercise, brisk walking or cycling for recreation or to get to and from places, but does not include housework or physical activity that may be part of the person's job (Natural England 2017). People aged over 16 are assumed to be adults for the purpose of this analysis (that is the definition of an adult employed by Natural England's Monitor of the Engagement with the Natural Environment (MENE) survey (2017) which was the source of data used in White and others (2016)).

Data employed in the analysis are set out in Table 4.1.2. NNR staff estimated that adults make 60,000 visits to Shapwick Heath NNR per year. In the absence of data for the NNR, the percentage of visits that were 'active' visits made by 'active' adults were estimated using average data for adults' visits to the natural environment in England. As such, it was assumed that 15% of visits made by

### **The Economic Benefits Supported by Shapwick Heath National Nature Reserve**

adults were 'active' visits by 'active' adults. In the absence of survey data, the NNR staff estimated that all 'active' visits by 'active' visitors would take place elsewhere if the NNR was not available for some reason. The analysis also employed an estimate of the number of QALYs associated with an active visit (calculated using data from White and others (2016)), and the value of a QALY recommended in government guidance.

**Table 4.1.2 Data employed in the estimation of health benefits for 'active' adults who make 'active' visits to the NNR**

Variable	Estimate	Source and assumptions
Number of visits by adults per year	60,000	Source: estimated by NNR staff (from an estimate of 80,000 visits per year and an estimate that 75% of visits are by adults).
% of visits that are by adults who report undertaking 30 mins or more exercise 5 days or more per week ('active visitors') & undertake some exercise in the natural environment	15%	In the absence of data for the NNR, an estimate from White and others (2016) was used (Tables 1 & 4, estimated using MENE data for 2009/10 to 2014/15). The estimate is an average for adults' visits in the natural environment in England. To estimate the total number of visits, people making 5 or more visits per week are assumed to make 5 visits.
Number of QALYs associated with each 'active' visit	0.0002	Source: derived using data from White and others (2016). This figure is based on the assumption that 30 mins of moderate to intense physical activity each week for 52 weeks of a year is associated with 0.010677 Quality Adjusted Life Years (QALYs) and that the relationship is cumulative and linear (Beale and others 2007 in White and others 2016).
Value of a QALY (£)	60,000	Estimate of willingness to pay for a QALY (HM Treasury 2018b).
Percentage of 'active' visits by 'active' visitors that would not be made if the NNR was not accessible.	0%	Estimated by NNR staff.

## 4.2 Results

Two different approaches were used to estimate the health benefits supported by the NNR. The health benefits were estimated for adults who go for a walk and for 'active' visits by 'active' individuals in 2017. Because both focus on the benefits to the individual of improved health, they should not be added to estimates of the value of recreational visits as the latter are likely to include part of the same health benefits.

### Health benefits for adults who go for a walk on the NNR

NNR staff estimated that each year, 28,500 adults go for a walk on Shapwick Heath NNR, making on average 2 visits per year, walking 2 miles on each visit. Using WHO's HEAT (see Section 4.1) this walking was estimated to prevent 0.1 premature deaths per year among people who walk on the NNR, which has an economic value of £179,000 per year (estimated using the value of a statistical life). These are health benefits that are supported by the NNR. The level of confidence in these estimates is low (a two out of ten chance of being correct) because accurate data were not available on visitors and their visits. The results do not estimate the full health benefits to people using the NNR as they do not include the mental health benefits, benefits to children who visit the NNR and to people who undertake exercise other than walking (such as cycling and running).

NNR staff estimated that, if the NNR was unavailable for some reason, people who go for a walk on the NNR would go for a walk somewhere else instead. Consequently, there are no health benefits from walking that are reliant on the NNR. However, it is likely that people who go for walks are reliant on using a wider area that includes the NNR.

To put these results in context, a study of people who walk on English coastal paths also employed WHO HEAT. It found that in 2017, an estimated 2.2m people walked on English coastal paths making a total of 29.2m trips. The exercise from this was estimated to result in 133 fewer premature deaths per year amongst people who walked on the paths (ICF and others 2019) with a value of £231 million per year. The estimates include walks that people would have taken elsewhere if the paths were not accessible for some reason.

### **Health benefits specifically for 'active' adults who make 'active' visits**

A smaller number of visits to Shapwick Heath NNR was by 'active' adult visitors who made 'active' visits. An 'active' adult visitor is someone who reports that they undertake exercise for 30 minutes or more five or more times per week. They make an 'active' visit if their visit involved raising their breathing rate for 30 minutes or more. NNR staff estimated that 'active' adults made 9,200 'active' visits to the NNR per year. This is the number of visits supported by the NNR (which includes visits that people would have made somewhere else if the NNR was not accessible for some reason).

The total health gain to 'active' visitors making 'active' visits was estimated to be 1.9 Quality Adjusted Life Years (QALYs) per year. This is a measure of the increase in the quantity and quality of people's lives from the exercise that active adults undertake on the NNR. The economic value of this was estimated to be £113,000 per year. This is the value of the health benefits supported by (but not reliant on) the NNR. The level of confidence in these estimates is low (a two out of ten chance of being correct) due to the low accuracy in the data used in the calculations. Note that these results are not estimates of the full health benefits of recreation on the NNR because they do not include the health benefits of visits that were not 'active', visits by adults who were not 'active', or visits by children.

The NNR staff estimated that all active visits by 'active' visitors would take place somewhere else if the NNR was not available. Consequently, there is not a health benefit for 'active' visitors that is reliant on the NNR. That is what would be expected in an area where there are alternative suitable sites for active visits. However, there are likely to be health benefits for 'active' visitors that are reliant on the wider area that Shapwick Heath is located in (though research would be needed to establish the scale).

To put the results in context, White and others (2016)<sup>52</sup> estimated that in England, 3.20 million 'active' adults make 'active' visits in natural environments (such as parks, woodland, beaches). These visits were estimated to be associated with a health gain of 109,164 QALYs per year.<sup>53</sup>

Estimates of health benefits can help inform communication with audiences that include National Health Service Trusts, local authorities, and local interest groups, and support the case for funding applications. If the necessary site-specific data (set out in Appendix A) are available, it is straightforward to estimate the health benefits that are supported by several NNRs, or at a landscape scale.

---

<sup>52</sup> The technique used here is based on the technique employed by White and others (2016).

<sup>53</sup> Because White and others (2016) use a different estimate for the economic value of a QALY, the estimates of economic value are not presented here.

# References

---

- AECOM. 2016. Evaluation of the social, economic and cultural ecosystem service impacts of the Cumbria Bog LIFE+ Project. Report for Natural England
- BEIS. 2017. Data tables 1 to 19: supporting the toolkit and the guidance. Table 3. URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/696677/Data\\_tables\\_1-19\\_supporting\\_the\\_toolkit\\_and\\_the\\_guidance\\_2017\\_180403.xlsx](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/696677/Data_tables_1-19_supporting_the_toolkit_and_the_guidance_2017_180403.xlsx) [Accessed 22 May 2020].
- BEJER, C., EMMETT, B.A., TIETEMA, A., SCHMIDT, I.K., PEÑUELAS, J., LÁNG, E.K., DUCE, P., DE ANGELIS, P., GORISSEN, A., ESTIARTE, M., DE DATO, G.D., SOWERBY, A., KRÖEL-DULAY, G., LELLEI-KOVÁCS, E., KULL, O., MAND, P., PETERSEN, H., GJELSTRUP, P., & SPANO, D. 2009. Carbon and nitrogen balances for six shrublands across Europe. *Global Biogeochemical Cycles* 23.
- CLARK, R. 2017. Is Corporate Natural Capital Accounting appropriate for monitoring nature reserves? An assessment for National Nature Reserves managed by Natural England. Natural England Research Reports, Number 072. URL: <http://publications.naturalengland.org.uk/file/4602824549203968> [Accessed 22 May 2020].
- DEFRA. 2007. An introductory guide to valuing ecosystem services. URL: <https://www.gov.uk/government/publications/an-introductory-guide-to-valuing-ecosystem-services> [Accessed 22 May 2020].
- DEPARTMENT FOR TRANSPORT. 2018. WebTAG data book. URL: <https://www.gov.uk/government/publications/tag-data-book> [Accessed 22 May 2020].
- EFTEC. 2016. Forest Enterprise England – Corporate Natural Capital Account. Report for Forest Enterprise England (unpublished).
- EFTEC. 2015. Beam Parklands Natural Capital Account. Final Report for the Greater London Authority. URL: [www.london.gov.uk/sites/default/files/beam\\_parklands\\_natural\\_capital\\_account\\_final\\_report\\_eftec\\_november\\_2015.pdf](http://www.london.gov.uk/sites/default/files/beam_parklands_natural_capital_account_final_report_eftec_november_2015.pdf) [Accessed 22 May 2020].
- EFTEC, JOHN SHEAFF & ASSOCIATES, & THE LONDON BOROUGH OF BARNET. 2017. London Borough of Barnet Corporate Natural Capital Account. URL: [barnet.moderngov.co.uk/documents/s40941/Appendix%20%20Natural%20Capital%20Account%20or%20Barnet.pdf](http://barnet.moderngov.co.uk/documents/s40941/Appendix%20%20Natural%20Capital%20Account%20or%20Barnet.pdf) [Accessed 22 May 2020].
- EFTEC, RSPB & PWC. 2015a. Developing corporate natural capital accounts. Final Report for the Natural Capital Committee. URL: [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/516968/ncc-research-cnca-final-report.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516968/ncc-research-cnca-final-report.pdf) [Accessed 22 May 2020].
- EFTEC, RSPB & PWC. 2015b. Developing corporate natural capital accounts. Guidelines. For the Natural Capital Committee. URL: [www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/516971/ncc-research-cnca-guidelines.pdf](http://www.gov.uk/government/uploads/system/uploads/attachment_data/file/516971/ncc-research-cnca-guidelines.pdf) [Accessed 22 May 2020].
- ENGLISH PARTNERHSIPS. 2008. Additionality Guide. Third edition. URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/191511/Additionality\\_Guide\\_0.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191511/Additionality_Guide_0.pdf) [Accessed 22 May 2020].
- EUROPEAN ENVIRONMENT AGENCY. 2013. Common International Classification of Ecosystem Services version 4.3. URL: <http://cices.eu/> [Accessed 22 May 2020].
- EVANS AND OTHERS. 2016. Interim report on project SP1210: Lowland peatland systems in England and Wales – evaluating greenhouse gas fluxes and carbon balances. Unpublished report for Defra.
- FOREST ENTERPRISE ENGLAND. 2016. Forest Enterprise England. Natural Capital Accounts 2015/16. Forestry Commission England. URL:

[https://www.forestryengland.uk/sites/default/files/documents/NATURAL%20CAPITAL%20ACCOUNT%202015\\_%202016.pdf](https://www.forestryengland.uk/sites/default/files/documents/NATURAL%20CAPITAL%20ACCOUNT%202015_%202016.pdf) [Accessed 22 May 2020].

FOREST ENTERPRISE ENGLAND. 2017. Forest Enterprise England. Natural Capital Account 2016/17. Forestry Commission England. URL: [https://www.forestryengland.uk/sites/default/files/documents/NATURAL%20CAPITAL%20ACCOUNT%202016\\_%202017.pdf](https://www.forestryengland.uk/sites/default/files/documents/NATURAL%20CAPITAL%20ACCOUNT%202016_%202017.pdf) [Accessed 22 May 2020].

FUJIWARA, D., OROYEMI, P. & MCKINNON, E. 2013. Wellbeing and civil society. Estimating the value of volunteering using subjective wellbeing data. Department for Work and Pensions, Working paper No 112. URL: [www.gov.uk/government/publications/wellbeing-and-civil-society-estimating-the-value-of-volunteering-using-subjective-wellbeing-data-wp112](http://www.gov.uk/government/publications/wellbeing-and-civil-society-estimating-the-value-of-volunteering-using-subjective-wellbeing-data-wp112) [Accessed 22 May 2020].

GHK. 2009. Economic Impact of HLF Projects. Volume 1 - Main Report. URL: <https://www.heritagefund.org.uk/sites/default/files/media/research/economicimpacthlfprojects2009.pdf> [Accessed 22 May 2020].

THE GUARDIAN. 2017. Joining a gym? Save pennies as you shed the pounds. URL: <https://www.theguardian.com/money/2017/jan/07/gym-membership-guide-to-cutting-costs> [Accessed 22 May 2020].

HM GOVERNMENT. 2011. One-In, One-Out (OIOO) Methodology. URL: [www.regulation.org.uk/library/2011\\_oioo\\_methodology.pdf](http://www.regulation.org.uk/library/2011_oioo_methodology.pdf) [Accessed 22 May 2020].

HM TREASURY. 2018a. GDP Deflators at market prices, and money GDP. March 2018. <https://www.gov.uk/government/statistics/gdp-deflators-at-market-prices-and-money-gdp-march-2018-quarterly-national-accounts> [Accessed 22 May 2020]

HM TREASURY. 2018b. The Green Book. Central Government Guidance on Appraisal & Evaluation. London: TSO. URL: <https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government> [Accessed 22 May 2020].

HOMES & COMMUNITIES AGENCY. 2014. Additionality Guide. Fourth Edition. URL: [https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/378177/additionality\\_guide\\_2014\\_full.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/378177/additionality_guide_2014_full.pdf) [Accessed 22 May 2020]

ICF GHK. 2013. The economic impact of Natural England's National Nature Reserves. Natural England Commissioned Report NECR131 <http://publications.naturalengland.org.uk/file/5835296918732800> [Accessed 22 May 2020]

ICF, SUSTRANS, CAVILL ASSOCIATES AND BLUE ISLAND CONSULTING. 2019. The economic and health impacts of walking on English coastal paths: A baseline study for future evaluation. Baseline Assessment Volume 2. A report produced for Natural England. URL: <http://publications.naturalengland.org.uk/publication/6476962745024512> [Accessed 22 May 2020]

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE. 2005. Guidance Notes for Lead Authors of the IPCC Fourth Assessment Report on Addressing Uncertainties. URL: <https://www.ipcc.ch/site/assets/uploads/2018/02/ar4-uncertaintyguidancenote-1.pdf> [Accessed 22 May 2020].

JANSSENS, I.A., FREIBAUER, A., SCHLAMADINGER, B., CEULEMANS, R., CIAIS, P., DOLMAN, A.J., HEIMANN, M., NABUURS, G.J., SMITH, P., VALENTINI, R. & SCHULZE, E.D. 2005. The carbon budget of terrestrial ecosystems at country-scale – a European case study. *Biogeosciences* 2, 15–26. Cited in Bullock, J.M. and others. 2011. Semi-natural grasslands, Chapter 6 in Bateman and others National Ecosystem Assessment.

LINSLEY, P. AND MCMURRAY, R. 2018. North York Moors National Park Authority Measuring Health and Well-being Impact. URL: <https://www.northyorkmoors.org.uk/about-us/how-the-authority-works/health-and-well-being> [Accessed 22 May 2020].

LUSARDI, J. 2014. Ecosystem Approach Quick Start Guide #2 Ecosystem Services. URL: <https://ecosystemsknowledge.net/resources/quickstart> [Accessed 22 May 2020].

MOLLOY, D, THOMAS, S., MORLING, P. 2011. RSPB reserves and local economies. URL: <https://www.rspb.org.uk/globalassets/downloads/documents/positions/economics/reserves-and-local-economies.pdf> [Accessed 22 May 2020]

NATURAL CAPITAL COMMITTEE. 2014. Towards a framework for defining and measuring changes in natural capital. Working paper 1. URL: [www.gov.uk/government/collections/natural-capital-committee-documents](http://www.gov.uk/government/collections/natural-capital-committee-documents) [Accessed 22 May 2020].

NATURAL ENGLAND. 2017. Monitor for Engagement in the Natural Environment (MENE). Headline Report for the 2015-16 survey. URL: <https://www.gov.uk/government/statistics/monitor-of-engagement-with-the-natural-environment-2015-to-2016> [Accessed 22 May 2020].

NATURAL ENGLAND. 2016. National Nature Reserve Management Standard. Internal document.

NATURAL ENGLAND AND TNS. 2017. Monitor of Engagement with the Natural Environment. The national survey on people and the natural environment. Technical Report to the 2009-16 surveys. Natural England Joint Report JP023. URL: <https://www.gov.uk/government/statistics/monitor-of-engagement-with-the-natural-environment-2015-to-2016> [Accessed 22 May 2020].

NICE (National Institute for Health and Care Excellence). 2014. Developing NICE guidelines. The manual. URL: <https://www.nice.org.uk/process/pmg20/chapter/introduction-and-overview> [Accessed 22 May 2020].

ONS (OFFICE OF NATIONAL STATISTICS). 2018a. Labour market statistics summary data tables. URL: <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/datasets/summaryoflabourmarketstatistics/current> [Accessed 22 May 2020].

ONS. 2018b. UK non-financial business economy (Annual Business Survey): Sections A to S. URL: <https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/datasets/uknonfinancialbusinesseconomyannualbusinesssurveysectionsas/current> [Accessed 22 May 2020].

ONS (2017a) Components of Household Expenditure 2017. URL: <https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/expenditure/datasets/componentsofhouseholdexpenditureuktablea1> [Accessed 22 May 2020].

ONS. 2017b. United Kingdom National Accounts: The Blue Book 2017. Industrial Analyses Tables 2.1 & 2.4. URL: <https://www.ons.gov.uk/economy/grossdomesticproductgdp/compendium/unitedkingdomnationalaccounts/bluebook/2017/uknationalaccountsbluebook2017> [Accessed 22 May 2020].

ONS. 2007. UK Standard Industrial Classification of Economic Activities 2007 (SIC 2007). URL: <https://www.ons.gov.uk/methodology/classificationsandstandards/ukstandardindustrialclassificationofeconomicactivities/uksic2007> [Accessed 22 May 2020].

PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY. 2007. Ecosystem services. Postnote No 281. URL: [researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-281](http://researchbriefings.parliament.uk/ResearchBriefing/Summary/POST-PN-281) [Accessed 22 May 2020].

ROGERSON, M., BARTON, J., BRAGG, R., PRETTY, J. 2017. The health and wellbeing impacts of volunteering with The Wildlife Trusts. Report for the Wildlife Trusts. URL: [https://www.wildlifetrusts.org/sites/default/files/2018-05/r3\\_the\\_health\\_and\\_wellbeing\\_impacts\\_of\\_volunteering\\_with\\_the\\_wildlife\\_trusts\\_-\\_university\\_of\\_essex\\_report\\_3\\_0.pdf](https://www.wildlifetrusts.org/sites/default/files/2018-05/r3_the_health_and_wellbeing_impacts_of_volunteering_with_the_wildlife_trusts_-_university_of_essex_report_3_0.pdf) [Accessed 22 May 2020].

RSPB 2017. Accounting for Nature: a natural capital account of the RSPB's estate in England. Report and Annexes. URL: <https://www.rspb.org.uk/our-work/our-positions-and-casework/our-positions/wildlife-and-the-economy/economic-case-for-nature/ecosystem-services/> [Accessed 22 May 2020].

SEN, A., HARWOOD, A.R., BATEMAN, I.J., MUNDAY, P., CROWE, A., BRANDER, L., RAYCHAUDHURI, J., LOVETT, A.A., FODEN, J., & PROVINS, A. 2014. Economic assessment of the recreational value of ecosystems: methodological development and national and local application. *Environmental and Resource Economics* 57 233-249.



- SUNDERLAND, T., WATERS, R.D., MARSH, D. V. K., HUDSON, C., AND LUSARDI, J. 2019. Accounting for National Nature Reserves: A natural capital account of the National Nature Reserves managed by Natural England. Natural England Research Report, Number 078. URL: <http://publications.naturalengland.org.uk/publication/4535403835293696> [Accessed 22 May 2020].
- UNITED NATIONS, EUROPEAN COMMISSION, FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT, WORLD BANK GROUP. 2014. System of Environmental-Economic Accounting 2012. Experimental Ecosystem Accounting. URL: <https://openknowledge.worldbank.org/handle/10986/23959> [Accessed 22 May 2020].
- WHITE, M.P., ELLIOTT, L.R., TAYLOR, T., WHEELER, B.W., SPENCER, A., BONE, A., DEPLEDGE, M.H., FLEMING, L.E. 2016. Recreational physical activity in natural environments and implications for health: A population based cross-sectional study in England. *Preventative Medicine* 91 383–388.
- WILLIS, K.G., GARROD, G. SCARPA, R., POWE, N., LOVETT, A., BATEMAN, I.J., HANLEY, N., & MACMILLAN, D.C. 2003. Social and environmental benefits of forestry phase 2: The social and environmental benefits of forests in Great Britain. Edinburgh: Report to Forestry Commission. URL: [https://www.academia.edu/571000/The\\_social\\_and\\_environmental\\_benefits\\_of\\_forests\\_in\\_Great Britain](https://www.academia.edu/571000/The_social_and_environmental_benefits_of_forests_in_Great_Britain) [Accessed 22 May 2020].
- WILSON, D., BLAIN, D., COUWENBERG, J., EVANS, C.D., MURDIYARSO, D., PAGE, S.E., RENOU-WILSON, F., RIELEY, J.O., SIRIN, A., STRACK, M., TUUTTILA, E.-S. 2016. Greenhouse gas emission factors associated with rewetting of organic soils. In special issue: Greenhouse gas fluxes in degraded and restored peatlands: global perspectives. *Mires and Peat* 17, 4.
- WORLD HEALTH ORGANISATION. 2014. Health economic assessment tools (HEAT) for walking and for cycling. Methodology and user guide, 2014 update. Economic assessment of transport infrastructure and policies. URL: <https://www.heatwalkingcycling.org/#homepage> [Accessed 22 May 2020].

# Appendices

## A Site-specific data requirements

This appendix sets out the site-specific data that are needed to carry out the analysis set out in this report. It includes suggestions of questions that might usefully be added to surveys to collect data that increase the accuracy of estimates. The appendix's aim is to support similar analyses for other sites.

### 1 Site-specific data used to estimate the value of ecosystem goods and services

The site-specific data that are needed to estimate the value of ecosystem goods and services provided by a site are summarised in Box A.1. These are also needed to develop a corporate natural capital account.

#### Box A.1 Site-specific data used to estimate the value of ecosystem goods and services

##### Essential data

- Identification of the main ecosystem goods and services provided by the site (those provided at a significant scale)
- For the main ecosystem goods and services that can be quantified, estimates are needed of the quantity per year. It is important that the quantities are in the same units as the economic values that are used for valuation. For example, the quantity of educational visits needs to be the number of people, not the number of groups. Likewise, for recreational visits. The amount of firewood sold needs to be in the units in which it is sold. See note below regarding benefits to volunteers.
- Areas of the broad habitat types (which are used to estimate the net carbon flux).
- For the main ecosystem goods and services that are sold, the revenue for them (eg sales of firewood and timber, educational visits by school pupils that are charged for).

Note regarding benefits to volunteers: it is likely to be easiest to estimate the value of the benefits based on the number of hours of input by volunteers, not least because these are the data that are most commonly recorded. If the hours are not recorded for the different skill categories, the value of the benefits for all volunteer input can be estimated using the average of the NLHF values for unskilled and skilled inputs (estimating an hourly value). This approach is adopted by RSPB (2017). Estimates of the benefits for regular volunteers require data on the number of regular volunteers (which may not be recorded) and there is not an established technique for estimating their value (Section 2.1).

### 2 Site-specific data used to develop the natural capital account

The site-specific data that are needed to develop a corporate natural capital account for a site are summarised in Box A.2.

#### Box A.2 Site specific data used to develop the natural capital account

##### Essential data for the first year in the account:

*Note: if the figures for these are expected to fluctuate in future, projections are needed. A period of 20 years may be used for the projections.*

*Adoption of a proportionate approach is recommended. Goods, services and costs that are not at significant levels are then omitted from the account.*

- Indicators of ecosystem quantity and quality (this assumes that the indicators have already been identified).
- The quantity of the main ecosystem services that can be quantified.
- Areas of the broad habitat types (which are used to estimate the net carbon flux).

- Revenue for each of the ecosystem goods and services that are provided at a significant scale and that others pay for (eg sales of firewood, educational visits by school pupils that are charged for).
- Any rent paid or received for land (though this may be omitted to protect confidential information).
- Number of days of inputs by volunteers (separated in to inputs that are unskilled, semi-skilled and professional).<sup>a</sup>
- Contributions in kind or money made by others (not Natural England), excluding volunteer time (valued at the market price).
- Estimates of costs other than staff costs and capital items.<sup>b</sup>
- Estimates of the number of staff (in full time equivalents) employed at each grade and the full salary costs for each grade (employing data from salary ranges for the relevant pay bands).<sup>c</sup>
- Estimates of expenditure on capital items.<sup>b</sup>

<sup>a</sup> These are used to estimate the 'cost' of volunteer inputs, using estimates from National Lottery Heritage Fund. The categories are as follows: unskilled inputs eg clearing a site (would be paid about £50/day if hired); skilled inputs e.g. erecting fences (would be paid about £150/day if hired); professional inputs eg ecological surveys (would be paid about £350/day if hired). Source: URL: <https://www.heritagefund.org.uk/discussions/how-calculate-volunteer-time> [Accessed 22 May 2020]

<sup>b</sup> Capital items include buildings, machinery, and equipment costing more than a threshold amount (eg £5,000).

<sup>c</sup> These are used to avoid disclosing confidential data on individuals' salaries.

### 3 Site-specific data used to estimate the contribution to the local and regional economy

The site-specific data needed to assess the contribution of a site to the local and regional economy are summarised in Box A.3. Some (but not all) of the data are provided in a corporate natural capital account. If there are other businesses on the site that are not covered by the account, the data needed to assess their contribution also need to be obtained.

#### Box A.3 Site specific data used to estimate the contribution to the local and regional economy

Essential data that are not in a natural capital account (can be rough estimates):

*Note that the analysis can focus just on the local economy, but the contribution is not likely to be significant if there are few suppliers within 10 miles.*

- Percentage of expenditure that is with businesses in the local economy (within 10 miles) and in the regional economy (eg within 30 miles). Even if they are located within the area, do not include expenditure in national businesses (that have stores or operations across England, such as Tesco, Travis Perkins) as they are not likely to contribute much to the local or regional economy. Estimate the percentage separately for capital items and for non-staff costs that exclude capital items.
- Data on the number of people and the total number of full time equivalents employed who work on the site.

Essential data that are in a natural capital account:

*Note: if the figures for these are expected to fluctuate in future years (aside from inflation), projections are needed for the natural capital account (eg over a period of 20 years). The equivalent annual value<sup>a</sup> of the projections, which is used in the account, is employed to calculate the contribution to the local and regional economy.*

- Estimates of costs excluding staff costs and capital items<sup>b</sup>.

- Estimates of full salary costs for each relevant staff grade (employing data from salary ranges for the relevant pay bands <sup>c</sup>).
- Estimates of expenditure per year on capital items <sup>b</sup>.

If large expenditures that result in significant contribution to the local or regional economy are likely, the accuracy of the analysis will be increased if the 'industry' that the money was spent on is identified. For a list of the 'industry' categories used for the analysis, see the one digit Standard Industrial Classification codes (ONS 2007) (eg agriculture, forestry and fishing; or construction).

Data that increase the accuracy but are not essential (which could be collected through surveys – see below):

*Note: in the absence of site-specific data, estimates from ICF GHK (2013) can be used.*

- Percentage of visits that are by people not living within 10 miles who do not stay overnight (day visitors)
- Percentage of visits that are by people not living within 10 miles who stay overnight.
- Amount spent per visit within 10 miles by day visitors who do not live within 10 miles.
- Amount spent per visit within 10 miles by overnight visitors who do not live within 10 miles.

Though it is not necessary to collect data on people's visits using surveys, suggested survey questions that could be used to increase the accuracy of estimates are provided below <sup>d</sup>:

Do you live in the local area (within 10 miles of here)?

If not, are you staying away from home overnight?

How much do you and your immediate party (e.g. family) expect to spend during your trip today?

Please provide only what you have actually/will actually spend today.

However, if your accommodation was paid in advance or in a lump sum for several nights, please provide an estimate for a single night.

And how much of that do you estimate will have been spent in the local area, that is, within approximately 10 miles of here?

How many people does this expenditure cover?

<sup>a</sup> Equivalent annual value = total present value /  $a_{t,r}$ , where  $a_{t,r}$  is the annuity factor (See footnote in Appendix B Section 2).

<sup>b</sup> Capital items include buildings, machinery, and equipment costing more than a threshold amount (eg £5,000).

<sup>c</sup> These are used to avoid disclosing confidential data on individual's salaries.

<sup>d</sup> Source: ICF and others (2019).

#### 4 Site-specific data used to estimate health benefits

The site-specific data that are needed to assess the health benefits supported by a site are summarised in Box A.4. Of these, only the number of visits per year are likely to be included in a natural capital account.

##### Box A.4 Site specific data used to estimate health benefits

###### Health benefits for people who go for a walk:

Essential data (can be rough estimates):

- Number of visits per year.
- Percentage (or number) of visits that are by adults.
- Percentage of visits by adults that involve going for a walk.

- Average distance walked (or time spent walking) per visit by adults who go for a walk.
- Average number of visits an adult makes per year

Data that will improve the accuracy, but are not essential:

- Number or percentage of visits that are 'active' visits by 'active' adults (can be estimated using a percentage from White and others (2016)).
- Percentage of 'active' visits by 'active' visitors that would not be made if the site was not accessible (can be assumed to be zero, to avoid over-estimating the benefits).
- Percentage of adult visitors who go for a walk but would not walk if the site was not available.

Though it is not necessary to collect data on people's visits using surveys, suggested survey questions that could be used to increase the accuracy of estimates are provided below <sup>a</sup>:

How many times have you visited this place in the past 12 months (including this visit)?

How long do you think you will spend walking here today? <sup>b</sup> (in hours / minutes)

In the past week, on how many days have you done a total of 30 minutes or more of physical activity that was enough to raise your breathing rate?

This may include sport, exercise, and brisk walking or cycling for recreation or to get to and from places, but should not include housework or physical activity that may be part of your job.

*(If the answer to the above is five or more):* In the past 12 months, how many times did you do that physical activity here (including this trip)?

(Record total number of visits over the year / average number of visits per month / week)

*(If the answer to the above is greater than zero):* If this place was not accessible for some reason, which of the following do you think you would have done instead?

Done the physical activity somewhere else

Not done the physical activity

Don't know

<sup>a</sup> Based on ICF and others (2019) and Natural England and TNS (2017).

<sup>b</sup> In the analysis of the data, this figure should be adjusted to accommodate breaks. ICF and others (2019) suggest assuming that on average, people walk for 50 minutes per hour and rest for the remaining 10 minutes. The Ramblers suggest that people walk at 4 kilometres per hour (<http://www.ramblers.org.uk/advice/navigation/calculating-walking-pace.aspx>)

## B Further details on the CNCA method used

This section provides further details on the method used in developing a corporate natural capital account for Shapwick Heath NNR. It covers: further comparison with financial accounts; key assumptions employed in this study; valuation of ecosystem services; estimation of costs; and the effects of net carbon flux.

### 1 Further comparison of CNCA with financial accounts

CNCA differs from financial accounts in the following ways:

- CNCA aims to provide understanding of the value of maintaining natural capital assets, indicating the value of goods and services to society as well as the organisation (reporting the two separately). In contrast, financial accounts record the productive assets available to a business, the means of financing them and the results of their use, assessed only in financial terms to the business.

- CNCA is forward looking. Each of the supporting schedules employs a set of projections. Estimated data are entered for each year over the long term future for the quantity and quality of natural capital assets, flow of goods and services, the value of those and costs. The projections are for delivery of a plan to achieve a long term goal. Financial accounts are different in that they report what happened in the previous accounting period and focus on the value of changes only over that period.

Both types of accounting assess the value of assets. CNCA estimates the value based on projected flows in future, whereas financial accounting uses the historical purchase price of capital items and applies depreciation over the life of the asset.

CNCA focuses on the operations of the organisation and does not usually incorporate information on upstream or downstream supply chain impacts<sup>54</sup> (Eftec and others 2015a). It is a relatively novel area of accounting, developed for the UK's Natural Capital Committee in 2015, and is not yet subject to agreed principles (so may be subject to change in future).

## 2 Key assumptions

This section summarises key assumptions that were employed.

The time period adopted for the account was in perpetuity. This was because, for the purposes of the study, it was assumed that Natural England has stewardship responsibility for the NNR in perpetuity. Forest Enterprise England's account (2016, 2017) employed the same time frame.

Data were entered in the account for the first twenty years. Using the standard approaches employed for CNCA (Eftec personal communication 2016), the remaining period was covered through the calculation of residual values.<sup>55</sup> Similarly, residual values were also employed in Forest Enterprise England's account (2016, 2017). In the account for the NNR, for monetary values (including costs) that occurred annually, the values recorded in year 20 were assumed to continue in a steady state in perpetuity. For monetary values that did not occur annually, equivalent annual values<sup>56</sup> were calculated and used to calculate residual values (based on the advice of Eftec (personal communication 2016)).

The residual value of net carbon flux was calculated based on the value in year 20. This produced a significant under-estimate as the per unit values in government guidance increase exponentially with time. However, as identified in the report, there is low confidence in the estimates of net carbon flux that were used and the estimate is partial (due to data gaps).

Payments of funding from the government (Grant in Aid) and other payments funded by society (eg EU LIFE+ and NLHF) were not included as receipts in the account. This is because the account focuses on costs, not sources of funding or income.

The Single Farm Payment received by the NNR was not included in the account. If it had been included, it would have had no net effect. This is because it would have been entered as a cost to society (it is funded by society) and a benefit to society (on the basis that its value is assumed to reflect the value to society of provision of ecosystem goods and services (suggested by Eftec (personal communication 2017)). It should not be added to the value of goods and services estimated in the account because that would include the value of goods and services twice (Eftec personal communication 2016). If it was entered, it would be in a separate section of the account in which the cost and benefit cancelled each other out (this is the approach adopted for similar payments in Forest Enterprise England's account (Eftec 2016)). Because inclusion of the Single

<sup>54</sup> In this regard, CNCA differs from some of the other frameworks for assessing environmental impacts, such as the Environmental Profit and Loss Account applied by Puma (part of the [Kering](https://www.kering.com/en/sustainability/environmental-profit-loss/) group (URL: <https://www.kering.com/en/sustainability/environmental-profit-loss/> [Accessed 22 May 2020]), which assesses environmental impacts along the organisation's entire value chain.

<sup>55</sup> *Residual value* =  $A/r$  where  $A$  is the value entered for year 20 and  $r$  is the discount rate.

<sup>56</sup> *Equivalent annual value* =  $\text{total present value} / a_{t,r}$  where  $a_{t,r}$  is the annuity factor with  $a_{t,r} = \left(\frac{1+r}{r}\right) \left[1 - \frac{1}{(1+r)^t}\right]$  where  $r$  is the discount rate and  $t$  is the time period (in years) used to calculate the total present value (HM Government 2011).

Farm Payment would not change the net natural capital asset value and did not add insight for this study, for simplicity, it was not included.

Other key assumptions:

- The account assumes that market prices and costs remain at 2017 levels and that provision of and demand for goods and services continue at 2017 levels unless specified otherwise. It assumes that all costs (to Natural England and others) are met.
- All monetary values per unit are the values in the first year of the projections unless changes in future values were anticipated for reasons other than inflation. These values were applied to all future years in the projections in the account.
- Where delivery of the goal employed in the account could be influenced by the actions of other organisations (such as appropriate management by landowners upstream to address diffuse pollution) the account assumes that the organisations undertake the necessary actions.

The focus of the account regarding climate change mitigation is on carbon, carbon dioxide and methane. Other greenhouse gases, such as nitrous oxide, were not included.

### **3 Valuation of ecosystem services**

This section provides further details on the estimation of: net carbon flux, recreational visits, educational visits and benefits to volunteers who volunteer regularly.

#### ***Estimation of net carbon flux***

The net carbon flux for the broad habitat types on the NNR was estimated by an expert in Natural England. Generalised values for broad habitat types that were best estimates were used because site-specific data were not available. Consequently, the level of confidence in the estimates is low (a two out of ten chance of being correct).<sup>57</sup> The data used to estimate the net carbon flux are presented in Table B.1.

Net carbon flux is defined here as the carbon uptake via net primary production by plants minus carbon losses in the form of carbon, carbon dioxide and methane via respiration by organisms (Natural England personal communication 2017). It represents the balance of positive and negative fluxes of both carbon dioxide and methane.<sup>58</sup> Net carbon sequestration is a negative flux.<sup>59</sup> Consequently, the quantity of net carbon sequestration is a negative figure. Conversely, net emissions of carbon dioxide and methane are a positive flux, so the quantity is a positive figure.

---

<sup>57</sup> Employing categories from the Intergovernmental Panel on Climate Change (2005).

<sup>58</sup> This is necessary as certain habitats that are net emitters of methane may be a net sink for carbon dioxide and vice versa (Natural England personal communication 2017).

<sup>59</sup> Where the net flux is negative, carbon uptake is greater than the carbon losses and the environment is a net carbon sink. The net removal and storage of carbon by the environment from the atmosphere is described as 'carbon sequestration'. In England, soils, peatlands capable of forming peat and woodlands provide significant carbon sequestration (the net carbon flux for wet woodland is not known) (Natural England personal communication 2017).

**Table B.1 Estimates of the net carbon flux for Shapwick Heath NNR**

Vegetation community	Area of habitat in 2017 (ha)	Net carbon flux (tonnes of CO <sub>2</sub> equivalent per year)		Notes (see beneath table) and source
		Per hectare per year	For the NNR per year	
Shallow lakes (mesotrophic)	40.59	6.86	278	Note 1. RSPB (2017)
Phragmites reedbeds S4, Phragmites-Peucedanum tall-herb fen S24, s26	181.20	-3.91	-708	Note 2. Evans and others (2016)
Juncus–Cirsium fen meadow M22, Molinia-Cirsium fen meadow M24	12.30	-6.05	-74	RSPB (2017)
Wet woodland W2 Salix-Betula-Phragmites woodland / W5 Alnus-Carex paniculata woodland, W1, W4, W5, W6	51.15	data not available		
Dry woodland W10	45.67	-10.71	-489	Note 3. RSPB (2017)
Wet heath m15, m16	4.54	-1.26	-6	Beier and others (2009)
Tussocky wet MG9	0.48	-6.05	-3	RSPB (2017)
Tussocky dry MG1	4.00	17.25	69	Wilson and others (2016)
Species rich - wet MG8	5.07	-6.05	-31	RSPB (2017)
Species rich dry MG5	14.21	17.25	245	Wilson and others (2016)
Semi- improved MG6, MG7	16.43	0.89	15	Janssen and others cited in NEA
<b>Total for the NNR (does not include wet woodland)</b>			<b>-704</b>	

Note 1: Median of range 6.07 to 7.65.

Note 2: Median of range -7.91 to + 0.1.

Note 3: Median of range -3.63 to -17.78.

### **Value of recreational visits**

Shapwick Heath NNR does not charge for admission for recreational visits. In the absence of an estimate specific to the site, the economic value of a recreational visit was estimated using the online Outdoor Recreation Valuation Tool (ORVal).<sup>60</sup> The number of recreational visits to the NNR was estimated using data for the NNR as this was likely to be more accurate than the estimates provided by ORVal (which estimates the number of visits based on where people live and the habitat, amongst other things, but not the unique features of a specific place).

<sup>60</sup> URL: //leap.exeter.ac.uk/orval/ [Accessed 22 May 2020]



The estimate of the value of a recreational visit provided by ORVal was £5.01. It is slightly higher than the average admission fee for an adult (£4.46 per visit) charged by a sample of Nature Reserves that charge for access<sup>61</sup> (no fee is charged for many sites):

- RSPB: Dearne Valley - Old Moor £5; Rainham Marshes £5; Strumpshaw Fen £3.50.
- Hampshire County Council: Titchfield Haven NNR £4.25.
- Norfolk Wildlife Trust: Cley Marshes £5.
- Yorkshire Wildlife Trust: Potteric Carr £4.

However, admission fees for nature reserves cannot be assumed to provide estimates of economic value, not least because admission fees are subsidised by some providers (to encourage people to visit) and the market may not be competitive (there are no admission fees for some sites).

Other studies have employed a variety of approaches for valuing recreational visits:

- In developing the natural capital account for parks and open spaces in the London Borough of Barnet, Eftec and others (2017) also employed estimates from ORVal.
- In Forest Enterprise England's account (2017), recreational visits were valued using data from a study estimating people's willingness to pay for recreational visits to woods and forests. In 2015/16, the value used was £2.17 per visit<sup>62</sup> (Forestry Commission personal communication 2017).
- The account for Beam Parklands (Eftec 2015) employed the estimated uplift in property values to estimate the value of ecosystem goods and services delivered to the local community (which include recreation, amenity, education and health benefits).
- For its account, RSPB (2017) used the findings of a meta-analysis (Sen and others 2014) to estimate the value of recreational visits.<sup>63</sup>

### ***Value of educational visits***

The fee charged by Shapwick Heath NNR for educational visits by schools (£1.77 per person) is 50% of the average fee charged by a sample of NNRs that charge for educational visits for school pupils (£3.55 per half day visit):<sup>64</sup>

- Derbyshire Wildlife Trust (WT) £4
- Durham WT £2
- RSPB £3.50-£4 (Primary)
- Staffordshire WT £3.50
- Warwickshire WT £4.50

However, these fees are likely to under-estimate the economic value of a visit. Providers may subsidise their charges for educational visits (to contribute to achieving educational aims) and the market may not be competitive (not least because no price is charged by some sites offering educational visits).

### ***Value of benefits to volunteers who volunteer regularly***

The value to volunteers of volunteering regularly was estimated based on the components of health, wellbeing and training benefits that can be easily valued. This employs the same approach as Linsley

<sup>61</sup> The admission fees are for non-members and do not reflect savings from family admissions. Data from 10 October 2017.

<sup>62</sup> Employing an estimate from Willis and others (2003) adjusted for inflation.

<sup>63</sup> Estimates of the value of a visit from the meta-analysis are £3.79 per visit to woodlands and forests, £2.07 per visit to freshwater and floodplains and £1.75 per visit to grasslands (at 2017 prices, adjusted for inflation using the HM Treasury GDP deflator (2018a)).

<sup>64</sup> Data from 10 October 2017.

and others (2018). Details of the values used are show in Table B.2. The total is likely to underestimate the value, as noted in Linsley and others (2018).

**Table B.2 Estimation of the benefits to volunteers of volunteering regularly**

<b>Benefit to regular volunteers<sup>a</sup></b>	<b>Source of information</b>	<b>Assumptions</b>	<b>£ per year</b>
Making new social contacts and friendships	Cost of attending camaraderie-oriented group offered by Age UK <sup>b</sup> (£5.00 per week) (estimate employed by Linsley and others (2018))	Regular volunteers benefit from opportunities to make social contacts and camaraderie. In the absence of a value for volunteers, the value is estimated using the fee charged for participation in camaraderie groups offered in Settle by Age UK (assumed to be similar to the cost of similar groups elsewhere in England).	260
Satisfaction from contributing to a worthwhile cause	Average value of households' charity donations (£3.00 per household per week) (Source: ONS (2017a)) (Estimate employed by Linsley and others (2018)).	In the absence of a value, the satisfaction regular volunteers gain from contributing their time to a worthwhile cause is estimated using the amount that households donate regularly to charity.	156
Training	Cost of attending a training course to learn a skill such as brush cutter training based on the following sample of costs: £130 + VAT (Blake Training), £145 + VAT (Hush Farms). <sup>c</sup>	In the absence of a value, the training gained by a regular volunteer is estimated based on the cost of training in use of brush cutters (common training for NNR volunteers). This is comparable to the cost of training in hedge laying that is employed by Linsley and others (2018).	165
Exercise	Estimate based on the following sample of costs of gym membership for budget operators (The Guardian 2017). Pure Gym: Manchester Spinningfields £264 / yr (£21.99 a month, plus £10 joining fee); Bristol Union Gate: £250 / yr (£19.99 a month plus £10 joining fee). The Gym: Manchester Ashton Old Road: £154 / yr (£11.99 a month plus £10 joining fee); Bristol: £204 / yr (£16.99 a month, no joining fee)	It is assumed that regular volunteers benefit from exercise that is comparable to that offered by membership of a gym run by a budget operator.	218
<b>Total</b>			<b>799</b>

<sup>a</sup> A regular volunteer is defined here as someone who volunteers at least once a month.

<sup>b</sup> Examples of Age UK charges for camaraderie clubs: <https://www.ageuk.org.uk/northcraven/activities-and-events/> [Accessed 11 Feb 2019]

<sup>c</sup> Source of costs of training courses: <http://www.blaketraining.co.uk/brushcutter-trimmer-maintenance-and-operation-iantra-awards-ita-for-experienced-novice-operator>. <http://www.hushfarms.co.uk/Brushcutter-Trim-mer-Training-c-10.asp> [Accessed 11 Feb 2019]

An alternative estimate based on the value of the work done by the volunteers was also provided. That estimate employed data on the amount of unskilled, skilled and professional inputs by volunteers per year and the value for each of these categories that is used by the National Lottery Heritage Fund (NLHF, Appendix B Section 4). The data on inputs and their value were taken from the natural capital account. This approach to estimating the value of benefits to volunteers is informed by the valuation of benefits to volunteers in other studies. The RSPB natural capital account (2017) employed the midpoint between (a) an estimate from Fujiwara and others (2013)<sup>65</sup> and (b) an average of the value of work done by volunteers (using NLHF data) to estimate the benefit to volunteers of volunteering. That provides a much higher estimate than that used here.

#### 4 Estimation of costs

Monetary values of inputs of volunteer time were estimated employing the values used by NLHF. The NLHF values are for three categories of volunteer input (Table B.3). These are rough estimates of costs if the inputs were being paid for. To enable use of these estimates, the NNR staff separated the amount of volunteer input into the three NLHF categories when they entered it into the account. In the account for nature reserves managed by the RSPB, the value of volunteer inputs was estimated using the NLHF figures. In Forest Enterprise England's 2016/17 account they were valued at £9.99 per hour (Forest Enterprise England personal communication 2017).

**Table B.3 Valuation of volunteer inputs**

Category of volunteer input	Value of input (£/day)
Unskilled (eg clearing a site)	50
Skilled (eg erection of good quality fences)	150
Professional (eg ecological survey by an expert)	350

Source: National Lottery Heritage Fund website URL: <https://www.heritagefund.org.uk/discussions/how-calculate-volunteer-time> [Accessed 22 May 2020]

Data on staff costs were supplied by Natural England. The total salary costs to Natural England used in the account are set out in Table B.4 and the assumptions are set out beneath the table.

**Table B.4 Total salary costs for Natural England staff**

Role	Total salary costs to Natural England / year	
	Basic (36 hrs / week)	Working 43 hrs / week
Reserve Warden, Support Adviser	£20,390	£24,355
Reserve Manager, Adviser	£26,620	£31,796
Senior Reserve Manager, Group Coordinator, Lead Adviser	£32,744	£39,111

Source of full salary costs for basic hours: Natural England pay tool (1 April 2016). Data include Natural England's National Insurance and pension contributions. The data for 2017 were not expected to be significantly different to these data for 2016.

The account assumes that for all staff involved in NNR work, the basic hours for their pay band is 36 hours / week and that they are paid the maximum salary for their pay band. This is because many NNR staff previously worked for English Nature and have worked for Natural England and legacy bodies for a long time. Unless specified otherwise, the account assumes that NNR staff work 43 hours / week. The full salary costs were calculated pro rata using full salary costs for 36 hours / week.

<sup>65</sup> Discussed in Section 2.1.

## 5 The effects of net carbon flux

The net carbon flux can make a significant contribution to gross and net asset values. This is illustrated by comparing estimates for Shapwick Heath NNR with estimates for East Dartmoor NNR from 2016 (Clark 2017) that were calculated using similar data sources and a similar approach. The goals that formed the basis of projections in the accounts were similar<sup>66</sup>. The two NNRs are both in south west England and have approximately the same number of recreational visits per year. Estimates of the gross asset value that exclude the net carbon flux are comparable for the two NNRs (Table B.5). The net asset value excluding the net carbon flux is higher for East Dartmoor (£0.377m compared with -£0.685m for Shapwick Heath NNR) because the present value of the costs is lower than for Shapwick Heath NNR<sup>67</sup>.

When the net carbon flux is included, it greatly affects the asset values. For East Dartmoor NNR, the present value of net carbon sequestration (£506m) is 98% of the gross asset value (£516m), whereas for Shapwick Heath NNR, the corresponding value (£2m) is just 18% of the gross asset value (£12m). The gross and net asset values including net carbon flux of Shapwick Heath NNR are much lower than East Dartmoor NNR due to differences in the habitats, which are inherent features of the sites. East Dartmoor NNR is estimated to sequester 180,000 t CO<sub>2</sub> equivalent per year (it has 235ha of woodland), whereas Shapwick Heath NNR is estimated to sequester 704 t CO<sub>2</sub> equivalent (partial estimate) (it has habitats that are expected to be net emitters of carbon dioxide and/or methane and just 46ha of woodland known to sequester carbon). Note that the level of confidence in these estimates is low.

**Table B.5 Gross and net asset values including and excluding net carbon flux**

National Nature Reserve	Shapwick Heath	East Dartmoor <sup>a</sup>
<b>Total gross asset value (£ millions):</b>		
including net carbon flux	12.035	515.835
excluding net carbon flux <sup>b</sup>	9.921	9.436
<b>Net carbon flux total present value (£ millions)<sup>b</sup></b>	2.114	506.399
<b>Woodland known to sequester carbon</b>	46 ha	235 ha
<b>Total present value of costs (£ millions)</b>	10.494	9.058
<b>Total net asset value (£ millions)</b>		
including net carbon flux	1.429	506.777
excluding net carbon flux	-0.685	0.377

<sup>a</sup> Account calculated employing data from 2016. Source: Clark (2017).

<sup>b</sup> Note that due to rounding errors the sum of gross asset value excluding net carbon flux and total present value of net carbon flux may not equal gross asset value including net carbon flux.

## C Contribution to the local and regional economy

This section provides further detail on the data used in assessing the contribution of Shapwick Heath NNR to the local and regional economy.

<sup>66</sup> The goal for the account for East Dartmoor NNR was to 'sustain high nature conservation value'.

<sup>67</sup> Costs are determined by the characteristics of the NNR, amongst other things.

**Table C.1 Calculation of gross value added (GVA) per full time equivalent (FTE) job for two relevant sectors**

Sector	Published data for 2016 <sup>a</sup>		Calculated using published data
	GVA at basic prices (£m)	Jobs ('000s)	GVA (£) per FTE (full time equivalent) job <sup>b</sup>
Retail sale of cultural and recreation goods (SIC G 47.6)	3,608	172	26,221
Food & beverage service activities (SIC I 56)	32,661	1,789	22,821

<sup>a</sup> Source: ONS (2018b)

<sup>b</sup> Based on an average of 32.1 hours worked per week by all workers in 2015 (ONS 2018a), assuming 1 FTE works 40 hours per week), 1 job = 0.8 FTE.

**Table C.2 Calculation of output per full time equivalent (FTE) job and GVA per £1 of output for the 'all industries' sector**

Sector	Published data for 2015 <sup>a</sup>			In 2017 (adjusted for inflation) <sup>b</sup>		Calculated for 2017 using published data	
	Total output at basic prices (£m)	GVA at basic prices (£m)	Jobs ('000s)	Total output at basic prices (£m)	GVA at basic prices (£m)	Output (£) per FTE job <sup>c</sup>	GVA per £1 of output (£)
All industries	3,220,900	1,684,937	34,511	3,291,751	1,722,001	116,662	0.52

<sup>a</sup> Source: ONS (2017b)

<sup>b</sup> Factor used to adjust 2015 figures for inflation: 1.02 (HM Treasury 2018a). No adjustment made to 2016 figures, as they are used here as figures for 2017.

<sup>c</sup> Based on an average of 32.1 hours worked per week by all workers in 2015 (ONS 2018a), assuming 1 FTE works 40 hours per week), 1 job = 0.8 FTE

**Table C.3 Visitor expenditure per full time equivalent (FTE) job and gross value added (GVA) per £1 of visitor expenditure**

	In 2013	In 2017 <sup>a</sup>
Visitor expenditure per FTE employed in the local economy (£)	63,000	65,760
GVA in local economy supported per £1 of visitor expenditure (£)	0.50	0.52

<sup>a</sup> Figures adjusted for inflation using a factor of 1.04 (HM Treasury 2018a).

Source: ICF GHK (2013) based on a review of impacts from local studies using the Cambridge and STEAM models.



**Natural England is here to secure a healthy natural environment for people to enjoy, where wildlife is protected and England's traditional landscapes are safeguarded for future generations.**

Should an alternative format of this publication be required, please contact our enquiries line for more information: 0300 060 3900 or email [enquiries@naturalengland.org.uk](mailto:enquiries@naturalengland.org.uk).

Catalogue Code:

[www.gov.uk/natural-england](http://www.gov.uk/natural-england)

This publication is published by Natural England under the Open Government Licence v3.0 for public sector information. You are encouraged to use, and reuse, information subject to certain conditions. For details of the licence visit [www.nationalarchives.gov.uk/doc/open-government-licence/version/3](http://www.nationalarchives.gov.uk/doc/open-government-licence/version/3).

Please note: Natural England photographs are only available for non-commercial purposes. For information regarding the use of maps or data visit [www.gov.uk/how-to-access-natural-englands-maps-and-data](http://www.gov.uk/how-to-access-natural-englands-maps-and-data).

© Natural England and other parties 2020