Scottish Natural Heritage
Research Report No. 1144

Testing a natural capital approach on SNH land

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RESEARCH REPORT

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RESEARCH REPORT

Summary

Testing a natural capital approach on SNH land

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Background

Scottish Natural Heritage (SNH) seeks to gain a better understanding of the stocks of natural capital on SNH land and the ecosystem services that they provide. Natural capital is the environmental resources (plants, animals, air, water, soils) that combine to yield a flow of benefits to people. Nature can be overlooked during decision making, often because its values, beyond traditional markets, are hard to quantify. Natural Capital Accounting extends traditional accounting to include non-market benefits provided by the environment.

The accounts are for land that is owned or primarily managed by SNH, most of which is National Nature Reserve (NNR), amounting to nearly 56,000 hectares or 0.7% of Scotland's land surface. Some lands under Nature Reserve Agreement with SNH are essentially managed by third parties and these have been excluded as the scope of the accounts has been to include only land for which SNH has the principal management responsibility.

SNH is developing accounts to:

- Demonstrate the value to people from nature, and from SNH land in particular;
- Inform future decisions about SNH land and its management to secure greater benefits for people and nature;
- Encourage others to apply a natural capital approach to increase investment in nature.

Main findings

This pilot natural capital account is the first to be produced for SNH land and as such reflects the baseline state of natural capital at the end of 2017. This work is experimental and there are gaps in the methodology and uncertainties in parts of the methods which require further work and are reflected in the robustness of the results.

Key findings from this study are:

- SNH's land generates an estimated £28m worth of benefits each year.
- The account covers 56,000 ha, made up of seven key habitat types; coastal, freshwater, mires/bogs/fens, grassland, shrub heathland, woodland, and montane.

- The account does not cover all benefits – the most valuable benefits that are monetised are tourism and recreation, and climate regulation.
- Sites are of high quality for biodiversity – almost all are designated.
- Over time, these benefits have an estimated asset value (present value) of £780m over 60-years
- Although partial, the estimated asset value is eight times larger than the estimated present value of the costs expended on managing the assets (also over 60-years), demonstrating value for money on investment in these sites.

Other important aspects of the development of the account include:

- Benefits quantified are: food, recreation and tourism, education and volunteering, climate regulation (greenhouse gas flux), renewable energy production, air quality, human health and well-being. Biodiversity was not quantified in monetary terms but assessed through a natural capital indicator score for the seven key habitat types.
- Woodlands on SNH land provide net positive carbon sequestration valued at £2.2m per year. Better data is required on the peatland habitats within SNH's land before their carbon impacts can be accurately assessed.
- Educational visits are an important part of SNH site use and fulfil a vital SNH objective in connecting people with nature, over 11,000 educational visits are made every year with 4,600 volunteer days with an estimated value of £421,000 per year.
- Biodiversity value itself is not valued in monetary terms but is measured through a series of ecological indices. These indices mirror some of those calculated for the whole of Scotland in the Scottish Natural Capital Asset Index. This enables comparison of the condition of key habitats managed by SNH (52% favourable and 20% recovering) with their average condition across the rest of Scotland (53% favourable, and 12% recovering).
- The account was developed with readily available data and GIS analysis within SNH and can be repeated over time.
- Some elements of the account could be improved in accuracy (for example, carbon sequestration in various land types and measures of visitor numbers), whilst some benefits that were not included could be considered for inclusion in future accounts (e.g. water quality, mental health benefits and flood risk mitigation).

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Glossary

Accounts	The organisation of information in structured formats that aid management decision making and reporting.
Biodiversity	The variability among living organisms from all sources, including terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part. Biodiversity includes diversity within species, between species, and between ecosystems (Convention on Biological Diversity, Article 2).
Discounting	The technique of applying a discount rate to convert future monetary amounts to their equivalent value in today's terms, based on the opportunity for capital resources to earn a return elsewhere.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. Ecosystems may be identified at different spatial scales and are commonly nested and overlapping. Consequently, for accounting purposes, ecosystem assets are defined through the delineation of specific and mutually exclusive spatial areas.
Ecosystem accounting	An integrated approach to the assessment of the environment through the measurement of ecosystems, and measurement of the flows of services from ecosystems into economic and other human activity.
Ecosystem services	The benefits provided by ecosystems and the biological diversity contained within them to society and human activities.
Maintenance cost account	The costed schedule of current and future maintenance activities for sustaining natural capital assets.
Monetary flow account	Records the value of the expected flow of goods and services from natural capital assets. This includes both value derived by the organisation from natural capital assets ('private value') and wider societal benefits ('external value') from natural capital.
Natural capital	The elements of nature that directly and indirectly produce value or benefits to people, including ecosystems, species, fresh-water, land, minerals, the air and oceans, as well as natural processes and functions.
Natural capital asset register	An inventory that holds details of the reporting entity's natural capital asset stocks, including their conditions, as measured by their extent, quality and other relevant factors.
Natural capital balance sheet	A reporting statement that presents the value of the natural capital (assets) and the ongoing costs of maintaining natural capital (liabilities) at a specific point in time (the reporting date).
Net asset value	The value of natural capital assets net of non-natural capital production costs.
Net Present Value	NPV is calculated as the difference between present value benefits (PVB) and present value costs (PVC). A positive NPV indicates that benefits outweigh costs; a negative NPV vice versa.

Physical flow account	Records the expected flow of goods and services which are dependent on the natural capital asset stocks. The purpose of the physical flow account is to identify and quantify the flow of goods and services provided by a natural capital accounting unit, or an aggregation of accounting units.
Present Value	Sum of discounted values (of costs or benefits) over the appraisal period.
SNH land	For the purpose of this report, SNH land is defined as land that SNH owns, leases or holds the primary management responsibility under Nature Reserve Agreements (NRAs).

1. INTRODUCTION

This report sets out the methodology and data used to produce the pilot natural capital account for SNH land holdings, and sites substantially managed by SNH (see scope definition in Glossary). It also highlights the major elements to be developed to complete the accounts. A workbook accompanies this report, which includes the data and calculations underpinning the accounts.

This methodology uses both monetary valuation and non-monetary measures to monitor the extent, condition and benefits of natural capital. This approach has been adopted to enable a broad range of measures to be utilised within the account, allowing a wider perspective of value to be reflected in the account.

1.1 Objectives

The overall objective for this work is to test the applicability of natural capital accounts for the management of National Nature Reserves and other lands that are owned and/or managed by SNH. This project will act as a pilot study to enable planning of subsequent development of natural capital accounting methods, and management strategies, for all SNH land. The aims of this project are to:

- Test the feasibility of developing natural capital accounts as part of taking a natural capital approach to SNH land, and as a way of demonstrating the value of the natural environment to people from SNH land;
- Provide evidence for decisions on future action, policy and management on the costs and benefits of activities on SNH land, incorporating ecosystem service flows where possible;
- Illustrate the value of SNH land for people in more quantifiable terms and improve understanding of the relationship between natural capital condition and the level of benefit provided; and
- Through this understanding, help secure greater benefits for people from SNH's management of land, alongside management for nature.

To apply this approach in land management, consistent information is needed on natural capital assets, the flows of services and benefits they support, and the costs of managing them. Organising this information has parallels to, and therefore can borrow approaches from, financial accounting. The resulting natural capital account can be an additional monitoring and evaluation tool for decision-makers in organisations such as SNH.

It is important to note that monetary valuation is useful to generate economic evidence to inform decisions, especially those that require the scarce resources of time and money. However, there are many benefits that are very difficult to assign monetary values to, or are considered invaluable, and these should be equally considered during decision making processes.

This introduction (Section 1) concludes with some background on natural capital accounting. The following Sections of this report contain:

Section 2	The methodology used to construct the natural capital account and a description of the supporting documents: the asset register, and physical flows and monetary flows
Section 3	An overview of the asset register for SNH
Section 4	The physical and monetary flows of benefits
Section 5	The maintenance costs for the natural capital assets
Section 6	The construction and interpretation of the natural capital accounts, and

Section 7 Recommended next steps in the development of the natural capital accounting approach for SNH

1.2 Background on natural capital accounting

A key feature of 'natural capital accounting' (as distinct from other forms of environmental accounting) is that it links the flow of ecosystem services and spending on maintenance to the stock of natural capital. The approaches used in accounts for an organisation are similar to national level ecosystem accounts and natural capital accounts, but those approaches tend to exclude costs of maintenance. At the organisation level, the natural capital accounting approach used has developed from the initial framework eftec and partners prepared for the Natural Capital Committee (NCC) in 2015: Corporate Natural Capital Accounting (CNCA)[1].

The framework shown in Table 1.1 organises internal and external information at site, project or organisational levels (depending on the scope of the account).

Table 1.1. Stages of Natural Capital Accounting and Key Questions Answered

	Answer these key questions…	…to generate these natural capital accounting outputs
1	What natural capital assets are owned, managed, or depended on?	**Natural Capital Asset Register:** Registry of all natural capital assets owned/ managed or depended upon.
2	What flows of benefits do the assets produce?	**A statement of physical flows:** Benefits, both for the organisation and for wider society, in biophysical metrics.
3	What is the value of the benefits and to whom do they accrue?	**A monetary flow statement:** Benefits in monetary terms: data from markets (and financial accounts of the business) and the literature, and where monetary data are lacking, in other indicators and qualitative narratives.
4	What does it cost to maintain the natural capital assets?	**A schedule of maintenance costs:** Relevant activities and their costs.
5	What is the net impact of the organisation on natural capital?	**A natural capital balance sheet:** Sum of natural capital benefits over time minus the cost of maintaining the natural capital assets in a condition that generates the benefits.

The particular features of this project, which shape the exact approach and format for presenting the account include:

- Developing a system of accounts that meets the particular needs of SNH's estate, (mainly NNRs) which involves a focus on measuring biodiversity benefits;
- Providing a range of measures (monetary and non-monetary) that adequately capture the benefits of conserving nature alongside the wider benefits to society (e.g. recreation, carbon sequestration, food production, etc.), and
- Create an overall assessment of natural capital at estate level, which can be developed at a finer level of resolution (i.e. at site level) in future enhancements to the accounts.

[1] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/516971/ncc-research-cnca-guidelines.pdf

2. METHOD

2.1 Accounting boundary and scope

2.1.1 Spatial scope

The purpose of this methodology is to create and test a consistent natural capital accounting approach that can be applied to SNH land – defined for this study as land that SNH owns, leases or holds the primary management responsibility under Nature Reserve Agreements (NRAs). Under NRA, SNH can play a variety of management roles. In some cases, SNH takes a minimal role (e.g. across a large part of Abernethy Forest NNR), and in others may be more actively involved. For the purposes of the natural capital accounts the scope of benefits and costs should be consistent (i.e. they relate to the same natural capital assets, so that all the costs necessary for realising the benefits should be included in the account). It was not feasible within the scope of this study to collect the costs of natural capital management of lands managed by third parties under NRA, and these sites have been excluded. The final list of NRA sites for inclusion within the account was agreed on a case by case basis with the Operations Manager for Nature Reserves (see Appendix 1: List of Sites).

The scope of the account includes:

- Any land under an NRA and over which SNH plays the major role of management.
- Other land holdings with a substantial natural capital element (e.g. Castlehill peatland site on Islay, and grounds at Battleby).

As this is the first natural capital account produced for SNH, it evaluates the baseline status of natural capital only. Typical natural capital accounting practice is to compare the reporting year with the baseline year in order to track changes in natural capital status and value. Establishing such a system of ongoing reporting is not part of this project's purpose, but this is considered in the recommendations of the report (see section 7.2).

The purpose of this project is to test the application of natural capital accounting in order to learn lessons about the aspects of this approach that can help demonstrate, and better manage, the value of SNH land. Options for future development include regular updates to the account, with elements being refreshed as major changes or revisions become available (e.g. visitor survey data).

2.1.2 Temporal scope

In consultation with the SNH steering group, the project baseline year was selected as 2017. Evidence and data that are as close as possible to this date were used to establish the baseline status. For example, annual financial data are typically available for the financial year, hence data for April 2017 to March 2018 were used as a basis for estimating the financial elements of the accounts.

The forecasting timeframe was set at 60 years, which is considered to be sufficient to reflect strategic management objectives of SNH, and to be in line with recommendations in the HMT Green Book Guidance (2018). However, longer time scales could be appropriate to assess certain issues (e.g. climate change, or where long term restoration is required).

2.2 Method

The methodology builds upon the corporate natural capital accounting approach developed by eftec, RSPB and PWC (2015) and the adaptation of this approach in the 'biodiversity net

gain natural capital account method' developed by eftec and Forest Trends in 2017[2]. This latter development expanded the presentation of results to include biodiversity in non-monetary terms.

The scope of benefits covered in the account is listed in Table 2.1.

Table 2.1. Summary of benefits and rationale for inclusion

Benefit	Basis for Inclusion
Food	Modest number of sheep and cattle grazed on SNH land. Includes venison income from deer management.
Recreation and tourism	Significant visit numbers and welfare benefit derived from recreation. Include estimates for a contribution to nature-based tourism in Scotland.
Education and involvement	Educational visits are an important part of SNH site use. Volunteer effort is a significant contribution to natural capital management benefitting both SNH and volunteers.
Carbon sequestration	Carbon sequestration is significant in woodland habitats. Avoiding carbon loss is important for peatland.
Energy	Renewable energy (wind and hydro) is generated at several sites. Solar energy was considered but later excluded as all installations are on built capital.
Air Quality	Certain habitat types can have significant air filtration benefits.
Health and well-being	Sites can support active lifestyles and so avoid costs of ill-health.
Biodiversity	Provision of wildlife and important habitat is a major benefit of SNH land – whilst not valued in monetary terms this study has created an SNH-relevant NC index that appropriately captures the state of biodiversity within sites.

The baseline natural capital balance sheet reports the natural capital benefits and maintenance costs over 60 years expressed as present value in the accounting year (2017/18). In doing so it provides a baseline to compare to future assessments as the level of future costs and benefits is explicitly considered (and not necessarily assumed to be fixed or static).

[2] See: http://bbop.forest-trends.org/pages/cnca_infographic and https://www.forest-trends.org/bbop_pubs/bng-cnca/

3. NATURAL CAPITAL ASSET REGISTER

This section summarises the structure of the asset register of the SNH land. The asset register has been structured to use the European Nature Information System (EUNIS) as this is the main habitat/ land-use classification used within SNH.

Table 3.1 shows the total area of SNH land analysed, categorised by EUNIS level 1 land cover type. This land analysis covers 55,622 ha.

Table 3.1. Sites by EUNIS Land Cover Type

EUNIS Land Type	Area (ha)	%
Heathland, scrub and tundra	19,655	35%
Marine habitats	8,599	15%
Montane habitats	6,428	12%
Woodland, forest and other wooded land	6,284	11%
Mires, bogs and fens	6,103	11%
Inland surface waters	2,612	5%
Grasslands and land dominated by forbs, mosses or lichens	2,508	5%
Inland unvegetated or sparsely vegetated habitats	1,640	3%
Coastal habitats	1,176	2%
Habitat complexes	310	<1%
Constructed, industrial and other artificial habitats	250	<1%
Cultivated agricultural, horticultural and domestic	57	<1%
Total	**55,622**	**100%**

3.1 Natural capital condition

In addition to documenting the extent of natural capital, the asset register records important measures of natural asset condition. This includes:

- The status of SNH land as indicated by condition of features of overlapping SSSIs (Table 3.2);
- The condition of significant water bodies that intersect sites, measured by Water Framework Directive (WFD) status (see Table 3.3), and capturing reasons for not attaining good status, and
- Carbon stocks in peatland.

The condition of land by area is shown in Table 3.2.

Table 3.2. Condition of SSSI features on SNH land[3]

Status	Area (ha)	%
Favourable Maintained	31,538	59%
Favourable Recovering	2,450	5%
Favourable Declining	4,839	9%
Unfavourable Recovering	5,912	11%
Unfavourable No change	5,265	10%
Unfavourable Declining	2,812	5%
Not yet assessed	727	1%
Total	**53,543**	**100%**

[3] SNH land as defined in the Glossary

Note, in the absence of definitive measures of habitats on SNH land, the method used a proxy measure based on available information on the condition of overlapping SSSI features: SSSI condition is assessed by feature rather than by area. The method divided the area of each parcel of land equally by the number of features measured and attributed site area in proportion to the condition status of the measured features; i.e. if there were 8 features measured and 3 were at 'Favourable maintained', then 3/8^{ths} (or 37.5%) of the land area was attributed to this status.

The data used include SSSI biological features on SNH land. There are 307 biological features that cover individual habitat, habitat assemblage, individual species, and species assemblage. The data includes features in favourable or unfavourable conditions regardless of whether there is an onsite remedy.

Water Framework Directive (WFD) water bodies that intersect SNH's sites were analysed by overall condition and are summarised in Table 3.3. All identified waterbodies were rivers and the length of intersection with SNH land is given in Table 3.3.

Table 3.3. Water Framework Directive Water Bodies intersecting SNH's landholdings

Water body status	Count	Percentage	Length (km)	Percentage
High	1	3%	3.8	4%
Good	13	39%	62.7	61%
Moderate	13	39%	19.1	19%
Poor	6	18%	17.6	17%
Total	**33**	**100%**	**103.1**	**100%**

Whilst the overall status of any water body cannot be wholly attributed to SNH management action, this remains a useful measure of natural capital condition.

Information has been provided by the SNH GIS team on peatland area and volume, which in turn has been used to estimate the total mass of carbon stored in peat soils. Area of peatland is relatively reliably measured, whilst peat depth is more difficult to ascertain. The following figures are based on best estimates[4] of peat depth by site from a variety of sources including, the James Hutton Institute (JHI) peat depth dataset, SNH's carbon and peatland map and ad-hoc site surveys. 17,700ha of peat soils have been identified across 32 sites. This analysis produced an estimate of 54 $MtCO_2e$ stored in these soils.

The asset register captures a range of important measures of natural capital condition. It is common practice for this register to use a variety of measures of condition without necessarily reporting them. Over time some measures may become more or less important and these can be included or removed from periodic reports as deemed necessary. In the context of this study, the development of the biodiversity index has been chosen as the main focus for determining the most salient elements of natural capital status to report at the overall account level (see section 4.8).

[4] Described in SNH document "GIG analysis methodology – job no 91460".

4. BENEFIT ASSESSMENT

The physical flow account records the expected flow of goods and services provided by the accounting units (i.e. habitats) identified in the asset register. Typically, these flows are measured in annual terms in physical quantity metrics (e.g. agricultural output, tonnes of carbon dioxide equivalent sequestered, number of visitors).

The monetary flow account estimates the value of the expected flow of benefits (goods and services) that are captured in the physical flow account. In the CNCA framework these values include both private value that flows to SNH, and the value accruing to the rest of society. Both must be measured to capture the full value of natural capital, and in SNH's case the majority of benefits are public in nature.

A variety of ecosystem services and the associated benefits derived from natural capital were considered for inclusion within the account. The approach has been to use the Common International Classification of Ecosystem Services (CICES) as the basis for identifying and aggregating benefit categories to use for economic valuation.

Some benefits may not be measured and valued either because the value is deemed not material to the accounts (e.g. timber sales), the work required to obtain the necessary data is not feasible within the project timescales (e.g. flood risk benefits), or they cannot be assessed reliably with current valuation methods (e.g. biodiversity).

This section describes the selected approach to evaluating the flow and value of each of the major goods and services in turn.

4.1 Food

As the scale of this benefit is moderate (tens of £k per year), a simple approach to assessing physical output has been used, based upon a steady state annual output of livestock type, and venison from deer culled. SNH provided figures for the total heads of livestock (sheep and cattle) grazed on each site. The quantity of deer culled was 930[5] in 2017.

The monetary value of each was estimated as follows:

- Sheep - were valued at a gross margin of £28 per head of sheep and represents the lower end of the return estimated from Nix (2019) for grazing on uplands. Based on 1,600 sheep grazing, this gives a monetary estimate of £45k per year. This margin is based on market prices for upland lambs and allows for additional feed costs (non-grazing), veterinary costs and a level of re-stocking.
- Cattle - due to the wide variety of methods for realising income from cattle, the approach taken to valuation was to assess the service that SNH land provides in support of grazing cattle. From Nix (2019) a lower end fee of £2 per head per week was used. 300 cattle grazed on SNH land, giving an overall value of £30k per year for this service. As SNH receives only a small income from grazing rights, for simplicity, all of this benefit was attributed to third party graziers.
- Venison - was estimated based on the average income to SNH over the last two financial years (source 2016/17 and 2017/18 financial accounts). Average venison income was £48k per year from around 930 deer of all types and ages. Note that the costs of deer management have been treated as a maintenance cost as it is an important element of habitat management.

[5] Source SNH. (419 stags/bucks, 371 hinds/does, 140 calves).

This gives a total annual estimate for the provision of food as £123k per year, although this is expected to fall to £106k per year when sheep are withdrawn from Cairnsmore. Venison income flows to SNH, all other income is assumed to flow to tenant farmers, giving a 60-year PV of £1.3m to SNH and £1.6m to tenant farmers.

4.2 Recreation and tourism

SNH land contains extensive recreational assets, including sites of international interest which boost the tourist economy.

The most recent published estimate of annual visits to SNH land was the 2016 estimate of 600,000 visits (NNR report 2016) which was based on survey results from 2014/15. There is reasonable evidence to suppose that this figure has increased since 2014/15: based on count information from four major sites[6], visit numbers increased by 25% over the three years from 2014/15 to 2017/18. These are popular sites and hence have been the focus of recent visit counts however expert judgement from the NNR management team suggests that other sites have experienced similar increases. This suggests that 750,000 visits may be a better estimate for the current level of visits and has been used as the baseline value for these accounts.

In addition to the reappraisal of the current level of visits, the account assumes that visits will continue to increase into the future in line with Scottish population growth estimates over the period 2018-40 (source: National Records of Scotland 2017[7]).

The value of benefits from recreation are assessed in different ways, as shown in Figure 4.1.

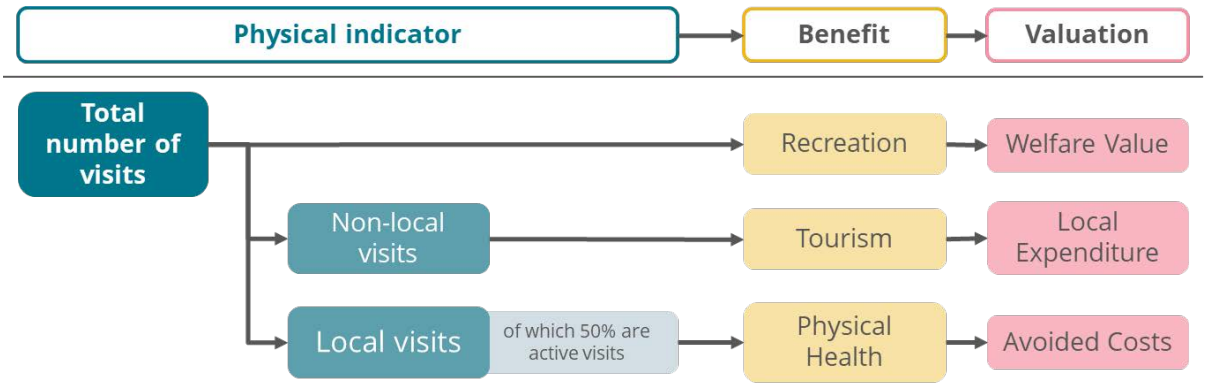

Figure 4.1. Flow chart of methodology for recreation, tourism and physical health benefits.

Note: local is as defined in SNH NNR visitor survey.

Recreational value is the benefit a visitor derives from visiting a site. Recreational visits were valued at a composite unit value per visit, which represents the diversity and character of SNH land and the profile of visits made to SNH land. For example, Sen *et al* (2014)[8] provide estimates for the value of visits to: mountains and moorlands (£5.64), woodlands (£3.74) and

[6] Beinn Eighe visitor centre, Muir of Dinnet, Creag Meagaidh, and Noss ferry data.
[7] https://www.nrscotland.gov.uk/statistics-and-data/statistics/statistics-by-theme/population/population-projections/population-projections-scotland/2016-based/list-of-figures
[8] 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(2), 233-249.

marine/coastal sites (£4.44) (all inflated to 2017 values). A weighted average value for the type of site visited (£4.62) provides a simple estimate for the overall recreational value of SNH land (£3.47m/year).

Tourism was valued by estimating the level of spend that non-locals make in the local economies around SNH land that they visit. Tourism is defined as a trip involving an overnight stay away from home. From the visitor satisfaction survey, 40% of visitors reported that they were from outside Scotland and were on holiday or visiting family and friends. This, as a proportion of all visits, was used to estimate a lower bound for the number of tourist visits attributable to NNRs. An upper bound was to assume that all non-local visits (64% from the same survey) were tourists. This produced an estimated range of 300-480 thousand visits per year[9]. Assuming each visit involved a one-night stay at £72 per head of spend in local economy[10], this gives an estimated monetary value in the range of £21.7m to £34.7m per year, with the lower value being used in the account.

Health benefits are described in Section 4.7.

4.3 Education and volunteering

Educational visits are an important part of SNH site use and fulfil a vital SNH objective in connecting people with nature. Similarly, volunteer effort makes a significant contribution to natural capital management, whilst benefitting volunteers' sense of well-being.

SNH recorded 11,700 educational visits to NNRs in 2017/18. These visits were valued using the cost-based valuation of Mourato *et al*. from the UKNEA (2010), inflated to £25.91 per visit in 2017 terms. This yielded an overall estimate of £303k per year for educational visits in 2017/18.

Volunteers' contribution (4,600 days in 2017/18, source SNH) has two value elements. Firstly, as a benefit to the volunteers themselves from the well-being they derive from working on SNH land; this may be valued based on the travel cost method or may be connected to physical health benefits. This has been estimated based on the number of Quality Adjusted Life Years (QALYs) that volunteering activity brings to participants. From the analysis of volunteer days, it was estimated that 2,833 days were active days and that this was equivalent to 0.58 QALYs using the method from White *et al.* (2016).

Secondly, the benefit that SNH obtains from the useful work done, was recognised both in the private value to SNH (work done for free), and as an external third party cost necessary for maintaining natural capital (i.e. it has zero impact on the SNH bottom line of the account). Labour value was estimated at a representative labour rate using a range from £75/day for basic skilled work (at minimum wage rate) to around £150/day for more highly skilled work[11].

From an analysis of the type of work performed (shown in Table 4.1) it was estimated that 22% of the work was of higher skill (the sum of management 13%, monitoring 2%, specialist 3% and surveying activity 4%), and the rest was assumed to be lower skill. This produced an estimate of £421k/year for the value of volunteer effort.

[9] Tourist visits may last for several days, but it is reasonable to assume that the day spent visiting the NNR was primarily for the purpose of visiting the NNR, given the remoteness of most sites.
[10] GB Tourism Survey, 2015. https://www.visitbritain.org/sites/default/files/vb-corporate/Documents-Library/documents/England-documents/gb_tourist_report_2015.pdf
[11] Assumes around £25/hour for specialist non-expert work for volunteers (or £150 per day), which is a typical rate for graduate ecologists (2018).

Table 4.1. Analysis of Volunteer Days (2017/18)

Activity Type	No. Days	%
Maintenance	2,242	48
Management	592	13
Monitoring	104	2
Other	1,393	30
Specialist	145	3
Surveys	183	4
Grand Total	**4,659**	**100%**

4.4 Carbon storage and GHG sequestration and emissions

Both carbon storage and GHG sequestration/emissions were estimated for woodland and peatland areas, which are the main habitat types that sequester and store carbon in both soils and vegetation. In addition, net GHG flow was estimated for saltmarsh (sequestration) and emissions from livestock.

Assumptions on sequestration rates were made based on the habitat areas reported in the asset register, and in the case of livestock on average emissions per head of livestock by type (cattle or sheep). Recognised sequestration factors were used to estimate volumes of GHG flow and were valued using the BEIS (2018) guidance on valuing non-traded carbon (at the central forecast rate).

Carbon storage

The total mass of carbon stored in peat soils in SNH land holding was estimated from an analysis of peat soil area and depth by the GIS team (GIG 91460, unpublished report)[12]. The mass of carbon stored in all soils was estimated at 14.9 million tonnes (or 54 million tonnes of CO_2e).

For 2015, Forestry Statistics (2018) reported that UK woodland (3.17 Mha) stored 2,715 MtCO_2e in soils, with an additional 1,066 MtCO_2e in biomass, dead wood and litter. Assuming pro rata woodland storage, SNH woodland stores 5.4 MtCO_2e in soils with an additional 2.1 MtCO_2e in biomass, dead wood and litter. This is a rough first order estimate of woodland carbon stock, and it is recommended that SNH undertake a more detailed assessment of woodland carbon stocks.

GHG sequestration and emissions

The woodland extent of 6,284ha can sequester 34ktCO_2e/year based on a simple average sequestration rate per hectare from ONS (2017) ecosystem accounts and Forestry Commission (2017)[13]. This simple estimate was used to develop this initial account, it is recommended that SNH should consider undertaking a more refined analysis of sequestration by woodland type to obtain a more accurate estimate.

Following BEIS (2018) guidance on valuing non-traded carbon at £65 per tonne of CO_2e per year (in 2017), the economic value of carbon sequestration in these landholdings is estimated to be around £2.2 million in 2017.

[12] The estimate was based on a synthesis of best available peat depth estimates on a site by site basis. Sources included, the SNH carbon and peatland map (2016), JHI soil peat depth dataset and ad hoc depth survey results by site.

[13] 17m tCO_2e sequestered in UK (ONS 2017) divided by 3.17m ha of woodland (FC 2017), gives a UK average of 5.4 tCO_2e per ha.

For peatland there is a lot of uncertainty about emission factors and sequestration rates, and evidence from Scotland shows a wide range of values[14]. Whilst near natural and pristine peat bog may sequester carbon, this can be offset by methane emissions which have a strong global warming potential. Overall, degraded peat will be more likely to be a net source of GHG emissions rather than a sink. Although knowledge gaps remain, a useful summary of how greenhouse gas flux varies with peatland condition can be obtained from the Centre for Ecology and Hydrology (CEH) report, Evans *at al*. (2017). Selected greenhouse gas flows in tCO_2e/ha/year are shown in Table 4.2

Table 4.2. Selected greenhouse gas emission and sequestration rates for various classes of peatland (Evans et al., 2017)

Peat condition	Drainage	Total tCO_2e/ha
Near natural fen	Undrained	-0.61
Near natural bog	Undrained	0.01
Rewetted bog	Rewetted	0.81
Heather dominated modified bog	Undrained	2.08
Eroded modified bog	Undrained	3.55
Eroded modified bog	Drained	4.85
Extracted industrial	Drained	13.84

Figures are net GHG flows for all gases (CO_2, methane and nitrous oxide) expressed in tCO_2e, sequestration figures are negative, emissions positive.

Within the timescales of this project it has not been possible to assess the condition of peat within SNH managed land by the categories identified in Table 4.2. From SNH data on SSSI condition of mire, bog and fen habitat features, 45% is in favourable condition, 20% is unfavourable and 35% is in a currently unknown state of recovery. It would be reasonable to assume that the area in favourable condition (45%) is near natural and so is roughly sequestration neutral. The area in unfavourable condition (20%) could be assumed to be drying, and so emitting in range of 2.08 – 4.85 tCO_2e/ha. The major unknown is the condition of the remaining 35% of peatland habitats for which the necessary data is unavailable, although the condition of these features has previously been assessed as recovering.

A range of possible emission rates can be assessed through evaluating best, medium and worst-case scenarios for emissions (Table 4.2). In the best-case scenario it is assumed that only the known unfavourable peatland is emitting GHG at a rate equivalent to the condition of 'Heather dominated modified bog undrained'. In the worst case it is assumed that land that is not favourable is emitting at a rate equal to that for 'Eroded modified bog drained'. In the mid-case scenario it is assumed that the area of land that was not in favourable condition is emitting at the same rate as 'Heather dominated modified bog un-drained'. This provides a range of 7,400 to 46,400 tCO_2e per year.

[14] Artz *et al*. 2013. Potential Abatement from Peatland Restoration, climate exchange. https://www.climatexchange.org.uk/media/1616/potential_abatement_from_peatland_restoration.pdf

Table 4.3. Indicative range of GHG emissions for SNH peatland

Assumed Condition	Rate tCO_2e/ ha	Best Case Area%	Best Case tCO_2e	Mid Case Area%	Mid Case tCO_2e	Worst Case Area%	Worst Case tCO_2e
Near natural bog	0.01	80	-	45	-	45	-
Heather dominated modified undrained	2.08	20	7,400	55	20,250	-	
Eroded modified bog drained	4.85	-				55	46,400
Total		**100**	**7,400**	**100**	**20,250**	**100**	**46,400**

The mid-case scenario has been used in the account. A more accurate figure would need more detailed condition assessments, and given the wide range of possible GHG flows it is recommended that SNH undertakes a suitable study to quantify the likely flows.

This analysis has also excluded the peatland at Castlehill on Islay (404ha.), for which no information on peat condition or extraction was available. This land has been made available by SNH to the local whisky distilleries to avoid peat extraction on more sensitive sites. The purpose of this land is to provide peat to an important local industry and help protect sites that are outside the scope of this study. As this information was lacking this element of the land is excluded from the account but should be considered for inclusion in future accounts if possible.

Saltmarsh can sequester significant quantities of carbon, typically at a rate of 8 tCO_2e per hectare per year[15]. SNH land contains 651ha of saltmarsh, providing an estimated 5,229 tCO_2e sequestration per year.

Livestock also produce emissions, and these have been estimated and included alongside greenhouse gas sequestration benefits of woodland and saltmarsh. Average emission factors have been calculated per head of cattle and sheep for Scotland[16], and include enteric fermentation emissions of methane plus emissions associated with manure produced. Current livestock levels are estimated to produce over 800 tCO_2e per year.

In summary therefore, and noting the large uncertainties particularly around estimates of peatland emissions, combining the positive values (sequestration) of woodland (34,000tCO_2e/year) and saltmarsh (5,200tCO_2e/year) with the negative values (emissions) from peatland (20,250CO_2e/year) and livestock (800tCO_2e/year), gives a net positive (sequestration) amount of around 18,150tCO_2e/year.

4.5 Energy

Natural capital may be used to generate renewable energy, by installing generating assets (e.g. wind turbines or solar panels) on land and utilising the kinetic energy of water flow (e.g. through hydro-electric turbines) or wind. The two major sources of renewable energy located on natural assets were wind and hydro power schemes. All solar energy generation (both PV and solar thermal) was from energy generating assets located on built capital (buildings) rather than on natural capital, and hence were excluded from this analysis. There was some

[15] Natural England, 2012. Carbon storage by habitat: Review of the evidence of the impacts of management decisions and condition of carbon stores and sources. http://publications.naturalengland.org.uk/publication/1412347

[16] Greenhouse Gas Inventories for England, Scotland, Wales and Northern Ireland: 1990-2017 http://naei.beis.gov.uk/reports/reports?section_id=3

biomass generation from SNH land, but this was small and consequently excluded from the analysis too.

Peat is extracted from the Castlehill site on Islay and used by the local whisky distilleries to avoid damage to more sensitive sites, however data on the volumes extracted was not available and has been omitted from the account. Consideration should be given to evaluating this level of peat usage and possibly including in future accounts.

Based on three years of meter reading data provided by SNH, an average of 110,000 kWh/year of energy was produced by the hydro scheme at Creag Meagaidh, and 17,500 kWh/year from the wind turbines at St Cyrus and Forvie. Valued at an average grid rate of 12p/kWh, this output gives an overall value of £15k per year.

4.6 Air quality

Air quality benefits arise from the ability of different types of vegetation to absorb pollutants from the air. The economic value of this service is estimated as the reduced exposure of people to those pollutants, and the resulting healthcare cost savings. Jones *et al*. (2017) modelled this service for the UK national accounts and produced a wide range of values depending on different levels of air pollution, types and extent of vegetation and density of human population. From this modelling, indicative annual values have been obtained for woodland habitats in different local authority areas (eftec and CEH, 2019[17]).

The main air quality benefit is derived from woodland (6,284ha). From GIS information, the area of woodland was estimated by site and by local authority area. This was used to evaluate air quality benefits by site and resulted in an overall benefit of £73k per year.

4.7 Health and well-being

A physical measure of health benefit may be based on the number of active lifestyles supported by exercise on SNH land. This benefit can be valued at an assumed avoided health cost per active lifestyle supported[18]. Health benefits can also be assessed through an estimate of the number of additional QALYs provided by exercise in the natural environment, however, care must be taken to avoid double counting with recreational values as this assessment includes the welfare value of recreation in its valuation (which was included in section 4.2). Consequently, for this study, an estimate was made of the number of active visits made to SNH managed sites, and these were valued at an average avoided health cost per visit[19].

From the visitor satisfaction survey[20], it was estimated that 36% of visits were made by local people making a short trip to the site from home, and hence more likely to use the location for regular exercise. Of these visits it was assumed that 50% were active visits (involving 30 minutes or more of meaningful physical activity)[21], giving a total of 135,000 active visits per year. These active visits were valued at £337.5k per year.

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[17] Pollution Removal by Vegetation, https://shiny-apps.ceh.ac.uk/pollutionremoval/

[18] Department of Health, 2004. At least five a week: Evidence on the impact of physical activity and its relationship to health. http://webarchive.nationalarchives.gov.uk/20130107105354/http://dh.gov.uk/prod_consum_dh/groups/dh_digitalassets/@dh/@en/documents/digitalasset/dh_4080981.pdf

[19] Taking the average saving in health costs per active lifestyle (£650 per year) and dividing by the number of active visits needed per year (260 visits, giving an average of £2.50 per active visit).

[20] Scottish Natural Heritage ongoing visitor satisfaction surveys (SNH unpublished data).

[21] 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. *Preventive Medicine*, 91, 383-388.

4.8 Biodiversity

The monetary valuation of wildlife and habitat is complex and, in many contexts, contentious. Consequently, and in discussion with the project steering group, it was decided to adopt a non-monetary approach to quantifying and tracking the status of biodiversity on SNH land. The main aim in assessing this benefit was to create an SNH-relevant natural capital index from a relevant subset of indicators from the Scotland's Natural Capital Asset Index (NCAI) that are capable of disaggregation to site level. The NCAI is a 'composite index which tracks changes in the capacity of Scotland's terrestrial ecosystems to provide benefits to people'[22].

Many elements of Scotland's NCAI relate to biodiversity, but only some of their elements are capable of disaggregation to SNH site level. Appendix 2 describes which components of the NCAI are relevant and capable of measurement at SNH site level, and finally highlights those items for which data were reasonably gatherable within the timescales and constraints of this pilot study.

The main portions of the NCAI that could be developed were the status conditions of seven habitats that were sufficiently represented within SNH's landholding. Appendix 4 illustrates how the habitat condition data can be used to follow the NCAI weighting approach.

The base data was taken from the Site Condition Monitoring (SCM) system. The data used cover the condition of biological features on Site of Special Scientific Interest (SSSI), Special Area of Conservation (SAC) and Ramsar designations. Over 200 habitat-related features are included for 31 SNH sites and 141 features were attributed to a habitat type (64 features that could not be attributed to a single/particular habitat type were excluded from the natural capital indicator). Features directly related to species were not included as they could not be directly attributed to a habitat type, and therefore do not accurately represent the condition of the habitat.

The SCM classification used is 'assessed favourable', which measures features in terms of three categories; favourable, recovering and unfavourable (see Table 4.4). The NCAI also uses 'assessed favourable' to monitor habitat conditions in Scotland. To keep in line with the NCAI, the classification 'assessed favourable' was used to measure the condition of SNH land.

Table 4.5 Classification used in NCAI

Assessed Condition	NCAI "Assessed Favourable" category
Favourable Maintained Favourable Recoverable Favourable Declining	Favourable
Unfavourable Recovering	Recovering
Unfavourable Maintained Unfavourable Declining	Unfavourable
Lost	Lost

[22] SNH, https://www.nature.scot/professional-advice/planning-and-development/valuing-our-environment/natural-capital-asset-index

It is worth noting that the Official Statistics Publication for Scotland uses a different classification, 'summary condition' which measures features by favourable, unfavourable recovering due to management and unfavourable[23]. As the NCAI data has been used, this account has used the definition from NCAI.

Table 4.6 presents the condition of features by habitat type. This data is used in the construction of the overall biodiversity index (see Appendix 4: Biodiversity Index).

Table 4.6. SNH Habitat Features by condition

Habitat	Number of Features			% of features in favourable condition
	Favourable	Recovering	Unfavourable	
Coastal	19	4	3	73%
Freshwater	15	2	1	83%
Mires/bogs/fens	18	14	8	45%
Grassland	2	1	0	67%
Shrub heathland	5	2	11	28%
Woodland	8	4	13	32%
Montane	6	1	4	55%
Total	**73**	**28**	**40**	**52%**

Table 4.7 shows the percentage of features in favourable condition for seven habitats on SNH land. For comparison, the final column also shows the overall percentage of favourable features for all designated sites in Scotland.

Table 4.7. Analysis of SNH site habitat features by condition and habitat type

Habitat	SNH %			Scotland NCAI %		
	Fav	Rec	Unfav	Fav	Rec	Unfav
Coastal	73%	15%	12%	76%	7%	17%
Freshwater	83%	11%	6%	72%	3%	25%
Mires/bogs/fens	45%	35%	20%	54%	17%	30%
Grassland	67%	33%	0%	43%	16%	41%
Shrub heathland	28%	11%	61%	34%	11%	55%
Woodland	32%	16%	52%	37%	16%	47%
Montane	55%	9%	36%	36%	19%	44%
Overall	**52%**	**20%**	**28%**	**53%**	**12%**	**35%**

This analysis indicates that the condition of designated features of SNH land is broadly in line with that for the whole of Scotland, but with greater prospects of achieving favourable condition (ie the 20% vs 12% recovering features). SNH montane and grassland habitats show a higher percentage of favourable status, but the number of features in these categories is small so it would be premature to draw any definitive conclusions from this result.

[23] Note that the Official Statistics Publication for Scotland uses the 'summary condition' classification to measure the condition of Scotland's biological *and* geological features on SSSI, SAC, Special Protection Area (SPA), and Ramsar. https://www.nature.scot/sites/default/files/2019-05/Official%20Statistics%20-%20Protected%20sites%20-%20proportion%20in%20favourable%20condition%202019.pdf

4.9 Benefits not included in this assessment

Further benefits that were considered of potential relevance for assessment by this initial account, but ultimately not covered, were:

Workforce productivity: The SNH office at Battleby in Perthshire is surrounded by 18 ha of deciduous woodland. There is evidence (eftec & CRESR, 2013) that proximity to natural green space improves the productivity and health of workers. However, there was a lack of evidence in this case to support Battleby having better workforce performance due to its natural grounds, hence this benefit has not been included in the natural capital account. Appendix 3 outlines the approached used.

Water quality: The condition of water bodies can be measured and valued through Water Framework Directive data, but the areas of water in the account boundary are a small part of some very large water bodies. Therefore, it is hard to relate the available data to the areas of water covered in the account. WFD status has been captured as a measure of condition within the asset register.

Flood Risk Mitigation: The report on Stirling Carse[24] was investigated to assess whether this benefit could be evaluated for the Flanders Moss NNR. Unfortunately, the modelling for this type of assessment is complex and it is difficult to estimate the contribution that the SNH land can make to an overall reduction in flood risk.

Landscape benefits to property: Values to surrounding properties as a result of proximity to natural capital are a way of assessing benefits to residents. However, any premium reflected in property values will arise from all surrounding natural assets, not just those on SNH land, so it is hard to attribute value to the assets within the account. Furthermore, care is needed to avoid double-counting when summing individual benefits and benefits to property in the account. For these reasons no value of landscape has been estimated for this study.

[24] Ewan Group plc. 2006. Flanders Moss National Nature Reserve: review of hydrological monitoring strategy. Scottish Natural Heritage Commissioned Report No.168 (ROAME No. F03LG05).

5. MAINTENANCE COSTS

Maintenance costs are associated with the activities required to maintain natural capital in its productive and healthy condition in the long run. These costs are used to estimate the liability side of the balance sheet, reflecting the ongoing need to provide the resources necessary to sustain the benefits (asset) side of the balance sheet.

Within the natural capital balance sheet, the cost of natural capital maintenance activities that arise from legal obligations should be reported separately from other maintenance liabilities. This distinction is not easy to apply in the analysis of maintenance activity. It may be reasonable to take the view that maintaining NNRs is a legal obligation; then all costs other than the costs of supporting visitors are legal obligations. This is a rather simplistic assumption but has been used in segregating the maintenance costs in the account.

Maintenance costs have been estimated from extracts from SNH accounts as follows (Table 5.1). It should be noted that no depreciation schedule for fixed assets associated with NNRs was available, hence an allowance of maintenance and replenishment of fixed assets is missing from the natural capital maintenance account. However, discussion with the SNH management team suggests that most the cost of maintaining fixed assets is covered in annual expenditure below and the level of capital replacement should be low.

Table 5.1. Maintenance costs – Sources and basis of estimates

Cost	Method	Data Source
Staff costs	Days of SNH staff effort recorded by NNR site and by grade of staff. Days effort valued at SNH day rate by staff grade (A-H). These day rates include all employment costs plus an overhead allowance to cover SNH overhead costs. Figures taken from 2017/18.	Spreadsheet of days by site provided by Operations Manager (Nature Reserve Activity). Staff day rates supplied by finance function.
Non-staff costs	Analysis of non-staff costs by site and cost type. Analysis by use of site code and activity code. Data averaged over the five financial years 2013/14 to 2017/18, to provide a more robust estimate of long run spend.	Spreadsheet of costs provided by Operations Manager (Nature Reserve Activity)
Volunteer effort	Volunteer effort was valued at an appropriate daily rate for skilled and un-skilled work as described in section 4.3.	Volunteer days by site and activity provided by SNH Operations Manager (Nature Reserve Activity)

In the absence of any better information on capital maintenance costs, the current level of activity and cost is assumed to be sufficient to maintain the condition of all sites in the long term. However, given that the status of some features is still unfavourable (no change – as in section 4.8), it could be argued that levels of spend may need to reviewed for some sites.

The results of the analysis of spend by site is shown in Table 5.2 and these are gross costs exclusive of any income (e.g. venison sales, sporting rights, energy feed-in tariffs or ferry income, etc.). Overall annual costs of £3.1m were split 40% staff and 60% non-staff costs.

Table 5.2. Spend by top ten sites

Site	Annual Cost (£)	Percentage of Total
Rum	372,488	12.1%
Isle of May	294,668	9.5%
Creag Meagaidh	270,150	8.7%
Beinn Eighe	240,798	7.8%
Flanders Moss	190,715	6.2%
Cairnsmore of Fleet	169,858	5.5%
Forvie	132,978	4.3%
Loch Leven	121,105	3.9%
Caerlaverock	115,969	3.8%
Muir of Dinnet	91,713	3.0%
NNR General (not site specific)	332,047	10.7%
All other sites	756,336	24.5%
Total	**3,088,824**	**100%**

SNH expenditure to maintain the land totalled £3.1m per year. The top ten sites ranked by expenditure account for nearly 65% of all spend. These represented the larger sites, but also island sites tended to incur higher costs due to extra transport expenditure (e.g. Rum and Isle of May). Of the 47 sites analysed, 29 incurred expenditure of £10k or more per year. The analysis of spend by site enables the schedule of maintenance costs to be readily amended for the acquisition of new sites, or the declassification/disposal of existing sites.

In addition to the analysis of spend by site, non-staff spend can be analysed by management objective. Whilst the proportion of spend across these objectives has varied significantly over the last five years (financial years 2013/14 to 2017/18), and the analysis does not include staff time, the five-year average gives a broad indication of the relative scale of each (Table 5.3). These objectives can be analysed to a lower level of detail (e.g. managing nature by habitat type), but as a result it is hard to draw any conclusions.

Table 5.3. Proportion of cost by Management Objective

Objective	Activity	% of Total
Management Agreement	Administering agreements	12.0%
Managing for Nature	Management of habitats and wildlife	12.3%
Managing for People	Promotion of sites and provision of visitor facilities	18.3%
Property Maintenance	Maintenance of property infrastructure	57.4%

Managing infrastructure is the largest element of expenditure (57%). Natural capital maintenance should only include costs that are essential to the maintenance of natural assets, and it is assumed that this infrastructure is essential for maintaining the sites. Some of this expenditure may be associated with supporting visitors, but this is included because it helps manage potential visitor pressure on wildlife, and visitor benefits are included in the account. Direct costs of 'Managing for nature' are low (12.3%). Finally, 'Managing for People' (18.3%) is to some degree discretionary, as the level of promotion and provision of visitor services being largely a matter of policy. It has been assumed that this proportion of all expenditure is not a natural capital legal obligation, but is still necessary in order to manage people on site and prevent unwanted damage to sites.

The present value of this level of spend over 60 years is £81m.

In addition to SNH spend, volunteer effort was estimated at £421k per year, representing £11m when discounted over a 60 year timeframe. The evaluation of this element is described in section 4.3 and represents a fair labour rate for the work done by volunteers.

6. NATURAL CAPITAL ASSET VALUES

Figure 6.1 presents a summary of the natural capital benefits (in monetary and non-monetary terms) alongside the costs of maintaining SNH land. The figure also provides an indication of the level of confidence in the results by line item.

Natural Capital Stock		Physical Measures of Ecosystem benefits			Monetary Measures		
						PV 60 years (£k)	
Natural Capital Status Indicators		Physical Indicator	Measure	Units	2017 value £k/yr	Without population growth	With population growth
		S1. Food					
		Number of sheep on SNH land	1,600	Head of sheep	45	783	783
		Number of cattle on SNH land	300	Head of cattle	30	790	790
		Number of culled venison on SNH land	930	Head of deer	48	1,259	1,259
		S2. Energy					
		Energy produced from hydropower	110,000	kWh/year	13	346	346
		Energy produced from wind power	17,500	kWh/year	2	55	55
S8. Biodiversity (% Favourable)		**S3. Climate Regulation**					
Coastal site condition	73%	Total woodland carbon sequestration	33,702	tCO_2e/yr	2,191	131,992	131,992
Freshwater site condition	83%	Total saltmarsh carbon sequestration	5,229	tCO_2e/yr	340	20,480	20,480
Mires/bogs/fens site condition	45%	Peatland GHG emissions	(20,251)	tCO_2e/yr	(1,316)	(79,312)	(79,312)
Grassland site condition	67%	Livestock GHG emissions	(817)	tCO_2e/yr	(53)	(2,893)	(2,893)
Shrub heathland site condition	28%	**S4. Air quality filtration**					
Woodland site condition	32%	Total woodland extent	6,284	Hectares	73	1,776	1,776
Montane site condition	55%	**S5. Physical health**					
Total (all habitats)	52%	Active visits	135,000	Visits/year	338	13,642	14,175
Weighted index	**45%**	QALYs	28	QALYs/year	1,663	67,229	69,855
		S6. Recreation and tourism					
		Visits to SNH land	750,000	visits/year	3,465	91,390	94,614
		Tourist visits	300,000	visits/year	21,673	571,634	571,634
		S7. Education and volunteering					
		Number of educational visits	11,700	visits/year	303	7,950	7,950
		Number of volunteer days	4,600	volunteer days/yr	421	11,038	11,038
		QALYS increase for volunteers	1	QALY	35	913	913
		Adjustments					
		Removal of QALYs double count			(1,663)	(67,229)	(69,855)
		Water quality					
		Mental health benefits					
		Flood risk mitigation					
		Total Monetary Benefits			**27,607**	**771,843**	**775,600**
		Maintenance Costs					
		SNH management costs			(3,089)	(81,015)	(81,537)
		Volunteer effort			(421)	(11,038)	(11,038)
		Total Costs			(3,510)	(92,053)	(92,575)
Net Natural Capital					**24,097**	**679,790**	**683,024**

Level of Confidence	Description of confidence
High	We have made some assumptions and estimates but are confident that the data is accurate and can support decisions.
Medium	Value is moderately accurate but does not represent the full measure of services value
Low	Results that may be inaccurate by more than an order of magnitude. Evidence is partial and significant assumptions are made that require further research.
Not Included	Item not included in this account. Robust method yet to be developed for this item.

Figure 6.1 Summary of flows of benefits and costs

Note: tourist visits (300,000) are included within all visits to SNH land, however the monetary benefit is the additional spend that tourists bring to the local economy and is therefore additive to the monetary benefits.

Benefits considered to potentially be significant, but that have not been evaluated include: water quality, mental health benefits and flood risk mitigation. These may be included in future accounts.

Key features of the presentation on natural capital information include:

- Information is presented under three headings; natural capital stock, physical measures of ecosystem service levels, and monetary valuations of benefits.
- The natural capital stock is measured in this case by indicators of habitat condition (see section 4.8 and Appendix 4)
- Physical flows are presented in various physical units of output as described in sections 4.1 to 4.8)
- Monetary flows are expressed as annual values in the baseline year (2017), and as 60-year discounted present values, both with and without population growth. Note that only recreational/tourism benefits vary with population growth.
- Maintenance costs are presented as annual value in 2017 and as 60-year discounted present values, both with and without population growth.
- Confidence levels are colour coded as described in the legend at the bottom of the figure. An explanation of the process used to assess confidence levels is given in Appendix 5: Confidence Level Assessment.

This information can also be presented in a balance sheet format which highlights the split between benefits to the public (the majority) and benefits to SNH (see Figure 6.2). This presents the expected present value of these annual figures over the 60-year forecast period. The extended balance sheet also includes non-monetary metrics for the status of designated sites features reflecting habitat condition (see section 4.8).

At December 2017	**Monetary Values**			Non-Monetary - Features at Favourable	Non-Monetary Index (2017 base)
	Value to SNH (PV £m)	**Value to Public (PV £m)**	**Total Value (PV £m)**		
Benefits					
Food	1.3	1.6	2.8		
Energy	0.4	-	0.4		
Carbon sequestration		70.3	70.3		
Air quality		1.8	1.8		
Physical health		14.2	14.2		
Recreation & Tourism		666.2	666.2		
Education & Volunteering	11.0	8.9	19.9		
Wildlife	-	-	-	52%	100.0
Gross Asset Value	12.7	762.9	775.6		
Maintenance Costs					
SNH Management	(81.5)	-	(81.5)		
Volunteer effort	-	(11.0)	(11.0)		
Total Maintenance Costs	(81.5)	(11.0)	(92.6)		
Net Natural Capital	**(68.8)**	**751.9**	**683.0**		

Figure 6.2. Natural capital balance sheet (extended)

Key features of this presentational format that are useful include:

- **It highlights the split of public/private benefits and costs**. In this case very large benefits flow to the general public (e.g. recreation, tourism, carbon sequestration, education and physical health benefits), whilst smaller benefits flow to SNH as an

entity (benefits from volunteer effort, food and renewable energy generation). Clearly the costs largely fall upon SNH, whilst the benefits are mainly public in nature.

- **It illustrates the extent to which benefits can be expressed in monetary or non-monetary terms**. Although many benefits can be stated in monetary terms, the primary rationale for NNR land is the preservation of natural habitats and wildlife which cannot be adequately expressed in monetary terms.

Changes over the forecast period

The physical quantity and monetary value of benefits over time will be influenced by pressures on the natural capital assets, changes in beneficiaries (such as population change) and wider society, and other factors (e.g. climate change). Factors that will be considered include:

- Population growth of 3% for Scotland over the period 2016-2026 will see the Scottish population increase to 5.58 million people, and on to 5.7m (or 5%) by 2041 (National Records of Scotland, 2018). Recreational visits and tourism benefits have been increased in line with this projected population growth for Scotland (by 5% to 2041 and stable thereafter). This leads to £3.2m greater present value of recreational benefits and £20.2m more in tourist spend when discounted over 60 years. Maintenance costs for providing for visitors will need to increase correspondingly to cope with the growth in visitor numbers. Consequently, the "managing for people" element of the natural capital maintenance costs has been increased in line with this population growth projection.
- Climate change presents risks such as: increased flood risk, pressures on biodiversity and impacts on water quantity and quality. Given the broad range of potential scenarios and impacts it is not possible to forecast likely changes to ecosystem service flows or benefit levels for this natural capital account.

The risks from Climate Change to notifiable biological and geological features in Scotland has been assessed by Brooker *et al*. (2014). This assessment is therefore relevant to the features on SNH land. However, the methods used are likely to be developed further and applying them to the sites within the account would require a complex analysis. This is because many sites have multiple features, and features may face different levels of risks at different sites (for example due to differences in current conditions, connectivity and/or exposure to future climate change). Nevertheless, it should be recognised that climate change poses a major challenge to nature conservation and adds uncertainty to the assessment of long-term costs and benefits from SNH land assessed in this report.

Other changes in the flow and value of benefits may be driven by changes in policy. For example, air quality benefits will reduce in value over time due to reduction in emissions at source. This has been built into the valuation model for air quality.

Table 6.1 summarises the assumptions used to reflect these factors in the PV calculations. It should be noted that these assumptions are conservative – they do not account for changes later in the 60-year time frame, in particular potential consequences of climate change.

Table 6.1. Trends in benefit flows and values over time for natural capital

Benefit	Physical Flows	Monetary Value
Food	No change, but could link to predicted reduction in extent of grazing	No change in unit value
Air quality	Expected changes over time are already incorporated into the modelling from which the results are drawn	
Recreation	Number of visits increases proportionally with population growth	May change in unit value per visit with income level but held constant in this analysis.
Health	Number of active visits increases with population growth	No change in unit value
Carbon sequestration	No change over time	Value of carbon emissions increases over time in line with BEIS (2018)

7. CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

The natural capital account demonstrates that the land managed by SNH represents a net cost to SNH, but that value to the public is around eight times greater than the costs. Whilst some benefit valuations are subject to some degree of uncertainty, and some others have not been evaluated in monetary terms (e.g. biodiversity), it is clear that the benefits are many times greater than the costs and provide confidence in the value for money of investment in SNH land. This presentation is a useful vehicle for highlighting the value provided by SNH to the general public.

This pilot study has also shown that it is possible to organise data within an account with good coverage of key benefits, and that this can be done with reasonable effort (a handful of people working intermittently over 2-3months) at both site (51 sites) and SNH level. Many elements of the account will change on an infrequent basis, hence future updates may be produced with less effort by refreshing only the elements that have materially changed.

The initial account piloted here supports a deeper understanding of the natural capital approach and provides a sound basis from which to prioritise efforts for further development of this approach. Continued measurement of natural capital condition, maintenance activities, ecosystem service levels and benefits will increase knowledge of the relationship between natural capital health and beneficial outcomes. For example, better knowledge of peatland condition and the consequent GHG flows may inform more focused interventions to improve peatland condition.

Finally, this study highlights the range of purposes and uses of a natural capital account, namely to:

- inform the public about the value and health of SNH's natural capital and to provide external accountability for SNH's management of its land,
- provide a framework to monitor natural capital asset deterioration, and so enable corrective action to be taken sooner, and
- develop a greater understanding of the relationship between management activity, natural capital health and the benefits that natural capital provides, so potentially improving decisions around the allocation of resources.

7.2 Recommendations

This study has used two different formats for presentation of natural capital information:

i. a summary of natural capital assets, physical flows and benefits; and
ii. an extended natural capital balance sheet.

The summary format aids a view of the elements of natural capital: asset extent/condition, ecosystem flows and benefit values. The balance sheet format highlights value flows to SNH and external beneficiaries, as well as presenting non-monetary indicators of habitat condition. Accounting is the presentation of information in useful formats that aid decision making, and it is reasonable to utilise different formats to inform different types of decisions and reporting purposes. Given the evolving nature of knowledge around natural capital and environmental science, it is important that accounting formats develop in response to emerging knowledge and changing social needs***. There is an opportunity for SNH to update the accounts in the framework provided by this study, giving consistent measurement of indicators and values over time. In doing so it is recommended that***

SNH continue to test and develop the presentation of natural capital information and regularly review the usefulness of the information presented.

Other recommendations include:

- More work is needed to understand the level of spend on natural capital required to maintain its current condition. Furthermore, given that more than 20% of designated features are in unfavourable condition, it is possible that a review is required of what level of spend to improve the condition of all features to a favourable condition. It is recommended that as a long-term management aim, SNH seek to develop an evidence trail on the level of maintenance activity and natural asset condition to understand what is required to sustain benefit flows in the long run.
- In this study the non-monetary indicators produced were restricted to those items that could be readily assessed within the timescales and resources of the project, (namely habitat condition only). There may be other elements of natural capital that may be important to capture in non-monetary terms. This may include: Water Framework Directive status, carbon storage in selected habitats, or the status of target natural features/species that are not designated. These items should be carefully selected, based on recognition of the value and usefulness of incorporating these elements into the non-monetary index. ***It is recommended that SNH review natural capital indicators that are not adequately represented in the accounts and update the non-monetary index accordingly***. This should be reviewed periodically.
- The evaluation of natural capital in this assignment highlighted the following gaps in information which should be priorities for future development and monitoring:
    - Recreational visits are not regularly measured. Given the significant value of this benefit, it would be helpful to have more robust and regular estimates of visitor numbers, at least by the major sites. This would not just help to evaluate benefit levels but would also assist in planning the level of provision to make for visitors.
    - Research on the link between biodiversity and visitor motivations to visit sites is also worth further investigation. Understanding what attracts visitors will help connect management actions to visitor benefits and inform enhancement of visitor experience and numbers in future.
    - The greenhouse gas flux of peatland is not known to a reasonable degree of accuracy. Given the extent of peat soils and the potential for carbon loss it is important that overall state of peatland is adequately measured and monitored. Carbon stocks in all land types, but especially woodland and peatland as high carbon stores, should be assessed on a more accurate basis.
    - A measure of climate resilience could be included in the account as scientific knowledge improves.
    - The differences in workforce absence rates between Battleby and other large SNH offices could be further investigated by breaking down data across the age structure of employees.
- The information used in these accounts will change at different rates over time, and not all elements will need refreshing for each publication of a new set of accounts. Based on this study, advice on update data (both frequency and level of detail) is summarised in Table 7.1.

Table 7.1. Advice for SNH on updating data

Benefit	**Update**
Food	Given the low value and infrequent changes to grazing levels, this benefit may be reassessed if there are major changes in grazing practice only. Periodic revaluations for market prices may be necessary.
Recreation and tourism	Given the magnitude of these benefits it is helpful to re-estimate these regularly (at least bi-annually).
Education and involvement	Regular updates to the level of educational visits and volunteers are desirable as these are significant measures of engagement.
GHG sequestration	GHG flows and carbon storage needs to be refined for all land types. Carbon sequestration will vary very little over time in woodland habitats so may be updated every 5 years or so. Monitoring for carbon loss is important for peatland and should be assessed every two years.
Energy	Update only if there is a change in number of renewable schemes. Possible refresh for energy prices.
Air Quality	Pollution absorption will alter with pollution levels. Revise as new updates to the air quality model are made.
Health and well-being	As part of recreation, monitoring the number of people who use SNH land to support active lifestyles will provide more accurate estimates of avoided health costs.
Biodiversity	Update on similar cycle to condition monitoring.
Costs	
Maintenance costs	Costs at NNR level are readily available and likely to change by year so should be reviewed annually.

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APPENDIX 1: LIST OF SITES COMPRISING SNH LAND (AS AT 2017)

Site	**Rationale for inclusion -** Nature [or Type] of SNH land	Area (ha)
Abernethy	Designated site	275.2
Achanarras Quarry	Designated site	39.8
Ariundle Oakwood	Designated site	70.4
Battleby	Grounds for main office	15.2
Beinn Eighe	Designated site	4,358.1
Ben Lui	Designated site	953.3
Ben Wyvis	Designated site	2,307.5
Blawhorn Moss	Designated site	108.8
Braehead Moss	Designated site	84.2
Caerlaverock	Designated site	7,296.9
Cairnsmore of Fleet	Designated site	2,581.7
Castlehill, Islay	Site used to supply peat to local distilleries	404.1
Claish Moss	Designated site	569.7
Clyde Valley Woodlands	Designated site	29.4
Corrie Fee	Designated site	165.9
Cragbank Wood	Designated site	8.8
Craigellachie	Designated site	257.5
Creag Meagaidh	Designated site	4,010.7
Dunnet Forest	Land leased out	105.1
Flanders Moss	Designated site	821.7
Forvie	Designated site	986.6
Glasdrum Wood	Designated site	169.2
Glen Nant	Designated site	56.3
Glen Roy	Designated site	1,478.5
Glen Tanar	Designated site	4,186.8
Glencripesdale	Designated site	608.6
Hermaness	Designated site	968.3
Invereshie and Inshriach	Designated site	3,112.7
Isle of May	Designated site	52.9
Jock's Gill Wood	Designated site	16.8
Keen of Hamar	Designated site	45.5
Kirkconnell Flow	Designated site	158.6
Knockan Crag	Designated site	20.8
Loch Druidibeg	Designated site	1,045.5
Loch Fleet	Designated site	288.1
Loch Leven	Designated site	1,584.3
Loch Lomond	Designated site	227.7
Loch Maree Islands	Designated site	213.5
Moine Mhor	Designated site	486.6
Monach Islands	Designated site	572.4
Muir of Dinnet	Designated site	1,166.2
Noss	Designated site	341.3
Rannoch Moor	Designated site	1,509.4
Rhynie Chert	Designated site	8.4
Rum	Designated site	10,619.8
Silver Flowe	Designated site	190.6
St Cyrus	Designated site	88.7
Sunart	Non-operational site	0.8
Taynish	Designated site	337.6
Tentsmuir	Designated site	596.6
Whitlaw Mosses	Designated site	18.6

APPENDIX 2: POTENTIAL USE OF SCOTTISH NCAI FOR DEVELOPING A SITE BASED MEASURE OF BIODIVERSITY CONDITION

This document sets out the indicators used in the SNH's Natural Capital Asset Index (NCAI) and assesses which elements may be used as the basis for an index which appropriately captures the condition of biodiversity at NNR site level.

The indicators have been split into the following categories:

- Table A2.1: Indicators that are **not relevant** for SNH land
- Table A2.2: Indicators that are **relevant**, but **cannot** be disaggregated for SNH land
- Table A2.3: Indicators that are **relevant**, and **can** be disaggregated for SNH land

Finally, those items from Table 3 for which data were readily available are listed. These items were used as the basis for developing a natural capital index for biodiversity to present alongside the monetary elements shown in the natural capital balance sheet.

Table A2.1 Indicators that are not relevant for SNH land

#	Indicator	Reason
1	Adult red grouse density	Better to use upland bird index
2	Agri-environment area	Not relevant with end of grazing
3	Area of certified forest	Only for commercial forest, so not on SNH land.
4	Area of grass cut for hay	Not on SNH land
5	Bare fallow/set-aside area	Not on SNH land
6	Butterflies – generalists	Currently under review as has been discontinued – there is species specific data available online
7	Cereal yield	Not on SNH land
10	Farmland bird index	No farmland on SNH land
11	Fertiliser use (inverse)	No farmland on SNH land
14	Greenspace - place for children to play	Relates to urban population, no urban areas on SNH land
15	Greenspace - provides a space to relax	Relates to urban population, no urban areas on SNH land
16	Greenspace - 'strongly agree' quality reduced in last five years (inverse)	Relates to urban population, no urban areas on SNH land
17	Greenspace -attractive green areas	Relates to urban population, no urban areas on SNH land
21	Number of livestock units	No farmland on SNH land
23	Pesticide use (inverse)	No farmland on SNH land
24	Pollution: orthophosphate at safe level	WFD is a suitable indicator
26	Raw water quality: nitrates in rivers at safe level	WFD is a suitable indicator
27	River water quality (% unpolluted sites)	WFD is a suitable indicator

31	Urban birds	No urban areas on SNH land
32	Use of marked coastal paths	Covered by visitor data
33	Visual influence of built development (inverse)	Contentious, so not available

Table A2.2 Indicators that are relevant, but cannot be disaggregated for SNH land

#	Indicator	Actions
35	Wild salmon and grilse - rod and line	Not at site level, relates to river systems/ regions.

Table A2.3 Indicators that are relevant, and can be disaggregated for SNH land

#	Indicator	Actions determining use in account (April 2019)
9	Coastal Site Condition (favourable condition)	Indicators **are** relevant but **cannot** be disaggregated for SNH land
8	Coastal bathing water quality (guideline and mandatory)	
12	Freshwater Site Condition (favourable condition)	Used in condition index
13	Grassland Site Condition (favourable condition)	
18	Mires/bogs/fens Site Condition (favourable condition)	
19	Montane Site Condition (favourable condition)	
28	Temperate shrub heathland Site Condition (favourable condition)	
37	Woodland Site Condition (favourable condition)	
20	Net annual change in carbon in woodlands	Data used in carbon sequestration benefit
22	Outdoor visits per week (one or more)	Data used in recreation benefit
34	Water Framework Directive - good or better ecological status	Data used in asset register
29	Total number of different bird species counted	Data not used
30	Upland bird index	Data not used
36	Wintering waterbird index	Data not used
37	Woodland bird index	Data not used
25	Raw water abstractions (inverse)	Relevant on Rum and at Craig Meagaidh, but small overall.

Within the constraints of this pilot study, the data for bird indices (items, 29, 30, 39 and 37) was too complex to gather at site level. Outdoor visits (item 22) overlaps with the recreational benefit measure and Water Framework Directive status (item 34) has been captured within the natural capital asset register but overall status is not fairly attributable to SNH management of NNR land. Therefore, these elements have been excluded from the development of an index. The only items that could be included within this pilot assessment were the status conditions of various habitats (items 9, 12, 13, 18, 19, 28, 37):

- Coastal Site Condition (favourable condition)
- Freshwater Site Condition (favourable condition)
- Mires/bogs/fens Site Condition (favourable condition)
- Grassland Site Condition (favourable condition)
- Temperate shrub heathland Site Condition (favourable condition)
- Woodland Site Condition (favourable condition)
- Montane Site Condition (favourable condition)

APPENDIX 3: WORKFORCE PRODUCTIVITY

Natural capital can play a valuable role in helping people become healthier and happier by being surrounded by green infrastructure. This benefit can manifest in several ways:

- They have a better quality of life[25]
- Healthier and happier people work more productively[26] and
- They also have less need for medical intervention, saving the public medical expenditure.

Ideally productivity improvements should be measured in terms that capture both the quality and quantity of work produced and provide evidence that the difference in productivity is reasonably attributable to the factor concerned (in this case enhanced natural capital at the Battleby site). Measures which capture differences in quantity and quality of work produced are often complex and cannot be reasonably assessed within the scope of this study.

As a proxy for productivity improvement, consideration was given to the possibility of evaluating this benefit by the number of sick days avoided through a better working environment at Battleby. The days lost per person at Battleby was compared with the three other sites that are comparable (employing over 30 staff); Clydebank, Edinburgh and Inverness. In principle, any improvement could be given a monetary value based on the value of fewer work-days lost.

Analysis of work-place absence rates, comparing Battleby and the other three large SNH office sites, looked for differences between overall absence rates, rates of short term absences (10 days or less), and long-term absences (11+ days). There is a difference in the average number of days lost to absence per head count, with a lower mean at Battleby compared Inverness and Edinburgh, but with Clydebank having the lowest absence.

Table A3.1. Headcount and days lost per head count for four SNH offices

Office	Headcount	Days lost per head count
Battleby	105	4.70
Inverness	207	6.79
Edinburgh	61	5.10
Clydebank	43	3.62

However, tests on the data show this difference is not statistically significant and hence cannot support the hypothesis there is a difference in absence rate at the Battleby site that is attributable to the natural capital of its grounds. The following tests were used to assess the statistical difference:

- **t test** was used to compare means between two samples. The t test showed that the difference between the offices and between short term absences (1-10 days) and long-term absences (11+ days) within each office are not statistically significant results
- **Kruskal-Wallis** test determines if two samples are related, without assuming they are normally distributed. The results showed the differences between the offices are not statistically significant.

Therefore, due to lack of evidence to support Battleby having better workforce performance due to its natural grounds, this benefit has not been included in the natural capital account.

[25] Constanza *et al.,* 2007. Quality of life: An approach integrating opportunities, human needs, and subjective well-being. *Ecological Economics*, 61, 267-276.
[26] eftec, & Sheffield Hallam University Centre of Regional Economic and Social Research, 2013. Green Infrastructure as a catalyst for economic growth: a review.

APPENDIX 4: BIODIVERSITY INDEX

This appendix is an extension to Section 4.8 and outlines how SNH's site condition monitoring data can be used in line with the NCAI's weighting method.

The approach used in Scotland's Natural Capital Asset Index (NCAI) can shed a different light on the % of features in favourable condition by allowing for weightings for habitat area and the relative value assigned for the ecosystem services provided by each habitat type. The index uses the data on features in favourable condition to show the capacity of the habitats to provide benefits to people, through the provision of ecosystem services.

Utilising the existing weighting factors from the NCAI, an indicative weighting for the seven habitat condition indicators is shown in Table A4.1.

By using the relative weighting of ecosystem services and the area of habitat type, the overall potential of the habitat to provide ecosystem services falls from 50% to 42.7%. This indicates that the higher proportions of favourable condition features are in smaller areas and in habitat types that support relatively less valuable ecosystem services.

Table A4.1. Indicative well-being weightings for habitat indicators.

Habitat indicator	Base Score % Favourable (A)	NCAI weighting factors (B)	Overall Revised Score (% favourable, AxB)
Coastal site condition	73%	5.5%	4.0%
Freshwater site condition	83%	14.0%	11.6%
Mires/bogs/fens site condition	45%	11.8%	5.3%
Grassland site condition	67%	5.3%	3.5%
Shrub heathland site condition	28%	37.1%	10.3%
Woodland site condition	32%	18.1%	5.8%
Montane site condition	55%	8.2%	4.5%
Total (all habitats)	**52%**	**100.0%**	**45.1%**

Clearly these weightings will change as more indicators are added to the index, however the table illustrates the general effect that larger areas will have more impact on the index (e.g. temperate shrub and heathland, as the largest habitat area contributes 37.1% to the overall index value).

This is an initial development of a habitat-based condition indicator, and it will require further refinement and expansion to meet the needs of SNH in the future. For this first natural capital account, we have used two measures of the percentage of sites in favourable condition for the seven habitat types - a simple total for all habitats and a weighted average based on the NCAI weighting methodology, see Table. A4.2.

Table A4.2. Proposed Habitat Indicators for Initial Natural Capital Account

Habitat indicator	**Base Score % Favourable (A)**
Coastal site condition	73%
Freshwater site condition	83%
Mires/bogs/fens site condition	45%
Grassland site condition	67%
Shrub heathland site condition	28%
Woodland site condition	32%
Montane site condition	55%
Total (all habitats)	**52%**
Weighted index (% Favourable)	**45%**

These indicators, based on SSSI condition data, give an adequate representation of the overall state of biodiversity for the account. However, in future consideration should be given to including items that are insufficiently covered in these indicators. These may include:

- Water quality
- Target species not captured by designated features
- Carbon storage in select habitats (e.g. saltmarsh, peatland)

APPENDIX 5: CONFIDENCE LEVEL ASSESSMENT

This appendix provides the justification for assigning confidence scores in Figure 6.1.

Benefit	Indicator	Justification
S1. Food	Number of sheep on SNH land	Data used is from SNH records.
	Number of cattle on SNH land	Data used is from SNH records.
	Number of culled venison on SNH land	Data used is from SNH records.
S2. Energy	Energy produced from hydropower	Data used is from SNH records.
	Energy produced from wind power	Data used is from SNH records.
S3. Climate Regulation	Total woodland carbon sequestration	Average UK woodland sequestration rate applied. Distribution of tree species and age have not been taken into account. BEIS Central non-traded cost of carbon estimates have been used with a range of -50%, +100%.
	Total saltmarsh carbon sequestration	Average UK saltmarsh sequestration rate applied. Central non-traded cost of carbon estimates have been used with a range of -50%, +100%.
	Peatland GHG emissions	35% of peatland area Condition is not known.The remainder is subject to a broad range of emissions estimates.
	Livestock GHG emissions	Average UK emissions used for cattle and sheep. This methodology is still being developed and estimates are highly variable with diet and management approach.
S4. Air quality filtration	Total woodland extent	Averages are applied at local authority level and may vary significantly by site.
S5. Physical health	Active visits	Exact number of visits to SNH is unknown. More regular surveys would improve confidence levels.
	QALYs	Uncertainty surrounding methodology to estimate the number of QALYs per visits.
S6. Recreation and tourism	Visits to SNH land	Exact number of visits to SNH is unknown. More regular surveys would improve confidence levels.
	Tourist visits	Exact number of visits to SNH is unknown. More regular surveys would improve confidence levels.
S7. Education and volunteering	Number of educational visits	Data used is from SNH records.
	Number of volunteer days	Data used is from SNH records.
	QALYS increase for volunteers	Uncertainty surrounding methodology to estimate the number of QALYs per visits.
S8. Biodiversity	% in favourable condition	Data used is from SNH records.

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