Farming in Hampshire:

National Pilot - Test and trialling a local governance of Environmental Land Management

ELM Convenor Advisory Board, Sponsored by Defra

Document 7 of 7

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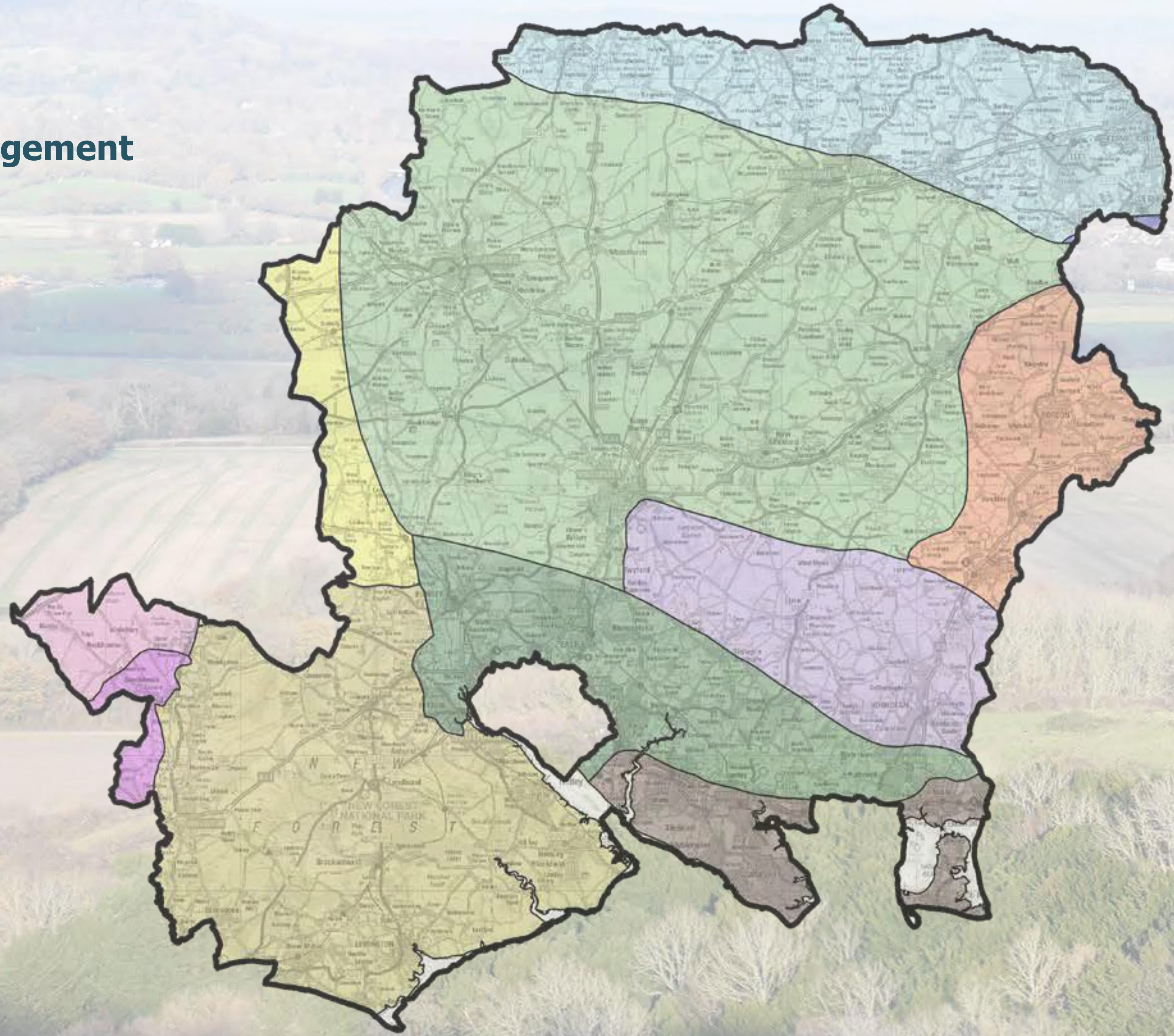
Natural Capital Technical Report

by eftec and Environment Systems



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Disclaimer

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Abbreviations and Acronyms

Abbreviation or acronym	Definition
BD	Biodiversity
BNG	Biodiversity Net Gain
BU	Biodiversity Unit
CO_2	Carbon dioxide
CS	Countryside Stewardship
CSR	Corporate Social Responsibility
DESNZ	Department for Energy Security and Net Zero
ELM	Environmental Land Management
FYM	Farmyard Manure
GFI	Green Finance Institute
GHG	Greenhouse Gases
ha	Hectares
HD	Hampshire Downs
$ktCO_2e$	Kilo (or thousand) tonnes of carbon dioxide equivalent
LNRP	Local Nature Recovery Plans
LNRS	Local Nature Recovery Strategy
$MtCO_2e$	Million tonnes of carbon dioxide equivalent
NBI	Nature Based Investing
NBS	Nature Based Solutions
NCA	Natural Character Area
NEVO	Natural Environment Valuation Online
NF	New Forest
NN	Nutrient Neutrality
NO_3	Nitrate
PES	Payments for Ecosystem Services
PIU	Pending Issuance Unit
PM	Particulate Matter
SD	South Downs
SFI	Sustainable Farming Incentive

SHL	South Hampshire Lowlands
SRI	Sustainable Food Supply Chain Initiative
SSSI	Special Sites of Scientific Interest
SuDS	Sustainable Drainage Systems
tC	Tonnes of carbon
tC/ha	Tonnes of carbon per hectare (to a specified soil depth)
tCO_2e	Tonnes of carbon dioxide equivalent
tCO_2e/year	Flow of tonnes of carbon dioxide equivalent per year
T&T	Test and Trial
TBH	Thames Basin Heaths
WCaG	Woodland Carbon Guarantee
WCC	Woodland Carbon Code
WCU	Woodland Carbon Unit
WG	Wealden Greensand

1. Introduction

This section presents the objectives of the project, the wider context within which this work took place and the elements of the context that was incorporated into the multidisciplinary approach and the structure of this report. Note that this report accompanies the main report that contains the non-technical summary, lessons and National Character Area (NCA) specific findings to the Board (Document 4 of the suite of documents from the project).

1.1 Objectives

As part of the Environment Land Management Scheme (ELMS) Hampshire Convenor Advisory Board Test & Trial (T&T), eftec & Environment Systems were commissioned to **provide a baseline natural capital assessment for the six largest National *Character Areas*** (NCAs) in Hampshire. The six NCAs are shown in Figure 1.1.

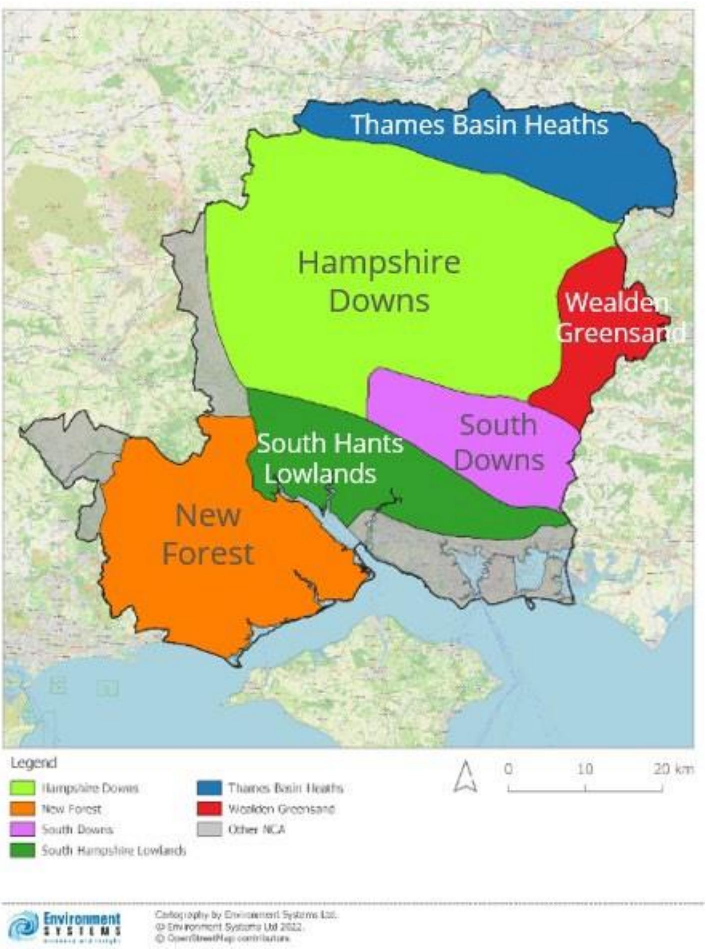

Figure 1.1 National Character Areas in Hampshire within the Scope of the Natural Capital Assessment

In addition, we were contracted to:

- Develop suitable business frameworks for each of the six main NCAs;
- Provide an indication of the potential scale and funding sources for natural capital benefits associated with land use change and land management change, and

Our work is designed to support our client, the Convenor Board, in its priority setting and decision making. The main results of this project are presented as document 4 of the suite of documents for this project "Test and Trialling a local governance of Environmental Land Management". This reportshould be read in conjunction with that report. In addition, our outputs:

- Helped inform the consultation process held with farmers/land managers in March 2024;
- Provide a repository of baseline information to support local initiatives in setting priorities and identifying appropriate land management changes;
- Support the development of a delivery vehicle for easy access to information and to support decisions (with the involvement of Land App), and
- Provide key lessons from this T&T for the benefit of Defra and the wider community.

1.2 Land management and decision making context

In this section we present our understanding of the wider context for our work. We went through this exercise to ensure we have the right scope and detail covered in the baseline natural capital account and we communicate the insights from accounting in a way that's relevant for the context.

The ELM Convenor Advisory Board for Hampshire was set up to test whether a body of this type can assess the different needs of all relevant stakeholders of land use and management in the county and develop an overarching plan that improves economic, environmental, and social outcomes for all concerned.

Such strategic planning across multiple national character areas and land uses requires the use of a multidisciplinary approach, which is what we adopted. This helps the Board ensure that any one objective is not prioritised at the unacceptable expense of others. Key aims and constraints that will need to be addressed in Hampshire:

- Identify and prioritise land use and management changes that can ***halt and reverse biodiversity loss and environmental degradation***, and where necessary adapt to important pressures such as climate change;
- **Support climate regulation**, through improved carbon sequestration, farming emissions reduction;
- **Promote viable and profitable income** to farmers land managers and natural resource managers, and
- **Enable access to the natural environment,** promoting health and well-being to all.

We understand that the Board needs to assess land use and management opportunities that can meet the above objectives, and ecologically, economically and financially feasible and has the acceptability of private and public funders ('buyers') and land owners / farmers (sellers) and the wider society. The interactions are shown in Figure 1.2.

Figure 1.2: Drivers Influencing Changes to Land Use and Land Management

Changes in land use and land management practice will only be achieved if they meet multiple feasibility criteria, namely:

- Ecological feasibility – is the change possible and advantageous given the natural assets concerned?
- Economic feasibility – do the economic benefits of the change outweigh the actual and opportunity costs?
- Policy feasibility – is the change aligned to different policy objectives?
- Financial feasibility – is someone (private or public sector) prepared to pay for/fund the change?
- Acceptability – is the change desirable/acceptable to the landowners/farmers, managers and the wider stakeholders and society?

These criteria have been addressed in our approach (see section 2.1) which explains how these have been considered in drawing up the range of feasible opportunities for the county.

The policy agenda has different levels of detail from, the UK level (e.g. 25 Year Environment Plan) to county specific policies and the priorities for a given NCA, down to individual farmer / landowners. These affect both strategic decisions about land use and more granular decisions about land management. Policies and priorities may be set at national, county and NCA level, but individual landowners will make decisions that make sense for them.

1.3 This Report

This technical report provides detailed explanation of the methods and data used to produce the outputs presented in the main report to the Convenor Board, (Document 4, Natural Capital Baseline and Opportunities). The remainder of this document is structured as follows:

- Section 2 explains our method and process for evaluating and assessing the natural capital baseline, risk and opportunities;
- Section 3 explains and describes the key results of the baseline assessment;
- Section 4 provides explanations of how the opportunities for improvement were identified, assessed and evaluated;
- Section 5 provides an overview of the potential for funding investment in natural assets, and
- Section 6 provides a summary of lessons learned and key recommendations.

2. Method

This section describes our methodology and how the approach interacts with other activities within the overall Advisory Board T&T project.

2.1 Our Approach

Our approach is to use the natural capital thinking and accounting principles to address the challenges described in Section 1.2 and to ensure that various feasibility requirements are incorporated both in our benefit assessments and in the way they are interpreted to support decision making.

Figure 2.1 shows the five key questions that need to be answered, and the process, inputs and outputs involved in answering them as well with what type of information is needed, who will provide this input, outputs that can be expected and actions for ground truthing and delivery.

	What assets do we have?	What do they do for us?	What are the opportunities for improvement?	What will be the outcomes?	What financing streams are available?
Process	Produce Baseline Asset Register	Baseline Benefits (Physical and £ value)	Land use change Land management change	Changes in benefit profile	Who will pay for each?
Inputs	Land data and maps *(by Environment Systems and eftec)*	Physical measurement and economic valuation assumptions *(by eftec)*	Ecological feasibility (*by Environment Systems*) Stakeholder acceptability *(by terra firma)*	Economic feasibility – benefits gained and foregone *(by eftec and Environment Systems)*	Financial feasibility *(by Ian Callaghan, eftec, Land App & the Board)*
Outputs	Baseline Natural Capital Benefit Assessment		Opportunity Mapping	Updated benefit assessments	Financial opportunities
	Development of Strategic Business Planning Framework				
Ground truthing & Delivery	Testing with Hampshire Biodiversity Information Centre (HBIC)		Consultation: demonstrating opportunities on Land App		Future expansion to include private revenue opportunities in "Delivery vehicle"

Figure 2.1: The multidisciplinary approach to the project

The process described above interacts with several other workstreams and organisations throughout the trial. Four key workstreams/activities that have been coordinated over the project are:

- Input from the Board and selected experts has been vital in determining both the scale of opportunity and what may be feasible/acceptable;
- The policy review work (from terra firma) was an important input to develop the most appropriate structure and content for the Business Plan Framework;
- Development of the delivery pilot tool (Land App), and subsequent feedback from the farmer/land manager consultation in March 2024, provided some important feedback on what information helps land managers make decisions on opportunities for improvement, and
- Finally, the existing and potential future opportunities for financing have informed the priorities and opportunity assessments.

The approach, NCA level results and strategic plans can be updated with more feedback from the Board, or individual landowners / managers given more time to work with the evidence gathered here. The approach can also be adapted to monitor flow of money and environmental benefits for any public funding / private finance deals that can be made.

2.2 Natural Capital Benefits

Having a consistent definition and classification of benefits nature provides is vital to the relevance and understandability of the outputs of this baseline assessment. Table 2.1 shows the classification used in the 25 Year Environment Plan (now Environmental Improvement Plan).

Table 2.1: Classification and Description of Natural Capital Benefits Covered in this Assessment (negative impacts from land use in red)

Benefit (25 YEP Basis) [1]	Description	Quantity	Value £
Using resources from nature more sustainably and efficiently	Arable Production	Included	Included
	Livestock (beef & sheep) production	Included	Included
	Dairy Production	Included	Included
	Timber and wood fuel production	Included	Included
Mitigating & adapting to climate change	Woodland carbon sequestration	Included	Included
	Hedgerow carbon sequestration	Included	Included
	Soil carbon sequestration [2]	Included	Included
	Wetland carbon sequestration	Included	Included
	Saltmarsh carbon sequestration	Included	Included
	Dis-benefits agricultural GHG emissions	Included	Included
Clean air	Air pollutant Removal (woodland)	Included	Included
	Agricultural air pollution emissions	Note 3	Note 3
Clean & plentiful water	Public water supply (PWS)	Included	Included
	Water quality (Natural environment)	Included	Non-monetary
	Reducing agricultural diffuse pollution	Included	Included
Enhanced beauty, heritage and engagement with the natural environment	Recreational value	Included	Included
	Physical health benefits of exercise	Included	Included
	Aesthetic, educational, volunteering values	Note 4	Note 4
Thriving plants and wildlife	Area of priority woodland habitat	Included	Non-monetary
	Area of priority natural grassland	Included	Non-monetary
	Area of wetland habitat	Included	Non-monetary
	Area of field margins	Included	Non-monetary
Enhancing biosecurity	Diversity of seed stock and livestock	Note 5	Note 5
	Species abundance	Note 5	Note 5
Reduced risk of harm from environmental hazards	Natural flood risk mitigation [3]	Note 6	Note 6

Notes (1) Other 25 YEP objectives that are not as related to land management are; managing exposure to chemicals (although pesticides fit), and minimising waste; (2) Soil carbon sequestration is difficult to forecast with confidence. Our approach is to provide an indication of a reasonable maximum potential for further carbon capture in soil by each NCA, however the realisation of this potential is difficult to predict. (3) Data on actual agricultural emissions at local level has not been possible to source within the scope of this project. (4) These benefits can be significant, and an important for especially public funding to maintain the landscape character. (5) These are key benefits, however the wide range of species covered are not possible to aggregate into an overall measure for this project. (6) Quantifying the location specific benefits of reducing flood risk through natural flood mitigation was not included in the scope of this project.

2.3 Identifying Opportunities

The baseline natural capital assessment quantifies the business as usual assumptions for land use and land management practice. The Board wants to know what scale and value of improvement is possible and how that will play out in terms of the profile of benefits and beneficiaries.

We could not assess the costs and benefits of all possible opportunities identified in all six NCA. However, we have developed strategic opportunities that;

- Align with the objectives for each NCA;
- Identify realistic land use and land management change that meets these objectives, and
- Are most likely to be material in terms of making a significant change at NCA level.

2.4 Quality Assessment

The inputs and outputs have been quality assured by the following activities:

- The workbook which calculates the baseline values, and the value of opportunities, has been audited by an eftec staff member not involved with the project;
- Feedback from the Board members and other experts has been vital in sanity check our values and proposed opportunities;
- The reports provided for the consultation also provided a test of the usefulness of our reports.

In addition, access to and useability of the results were tested through engagement with landowners / managers (Document “ELMS Convenor Final Report Mar-May 24 Document 5 (Workstream 4).pdf”). The test shows that;

- It is important to make different data to be readily available and in formats that are interoperable. This will help landowners/managers to identify the data that’s relevant to Hampshire, the NCA they are in and their own land, and use the data from this work with other data they have access to, and
- Link input data and outputs to actions that landowners/managers can judge for themselves - as to whether the implied actions to deliver potential opportunities are things they would like to do.

3. Baseline Results

Here we present the baseline natural capital benefit assessment, covering the baseline extent and condition of assets, the benefits they produce, an assessment of disbenefits (environmental costs), maps of risks to assets, and finally an assessment of opportunities for improvement.

The Asset Register presented in Section 3.1 is the answer to the question 'what assets do we have?' in Figure 2.1. The Physical Flows presented in Section 3.2 and the Monetary Benefits presented in Section 3.3, answer the question 'What do they do for us?', and include the negative impacts from economic activity that have been possible to capture in this project. The risk and opportunity assessments in Section 3.4, starts to answer the question about the opportunities for improvement, again in Figure 2.1.

3.1 Natural Capital Asset Register

The baseline land cover has been established by collating several data sets to give the most accurate assessment of land cover (Figure 3.1) and Table 3.1.

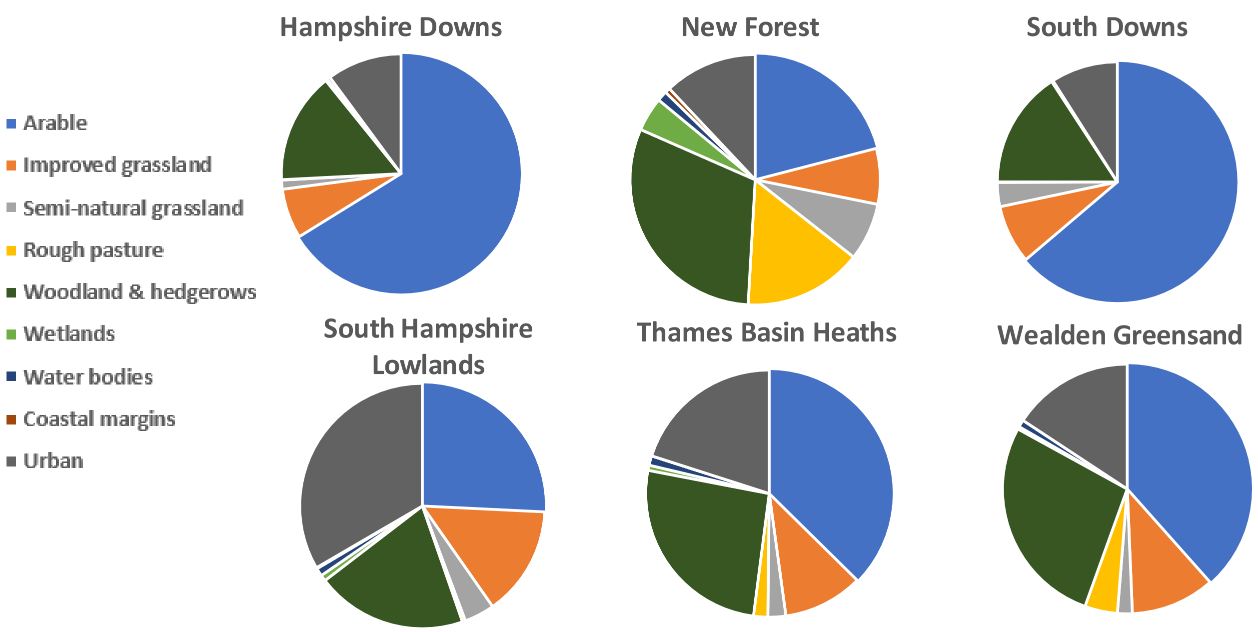

Figure 3.1: Proportion of land cover by each NCA

This shows that some NCAs have similar land cover proportions (Hampshire Downs and South Downs, both being heavily arable), whilst some are unique (the New Forest has a very diverse mix of land cover, and the South Hampshire Lowlands has a very high urban area).

Table 3.1: Natural capital asset register – land cover

	Hampshire Downs	New Forest	South Downs	South Hampshire Lowlands	Thames Basin Heaths	Wealden Greensand	Total
Arable	93,519	14,056	18,705	9,939	15,641	7,954	**159,814**
Improved grassland	9,514	4,822	2,313	5,602	4,379	2,260	**28,890**
Semi-natural grassland	1,737	4,987	952	1,544	979	398	**10,597**
Rough pasture	75	10,261	20	158	779	877	**12,171**
Woodland & hedgerows	21,157	20,556	4,623	7,682	10,871	5,688	**70,576**
Wetlands	388	2,962	9	309	283	69	**4,020**
Water bodies	594	878	52	405	518	195	**2,641**
Coastal margins	3	453	0	57	2	0	**516**
Urban	14,311	8,062	2,642	12,882	8,395	3,259	**49,552**
Other - sea	0	161	0	11	0	0	**172**
Grand total	**141,299**	**67,197**	**29,317**	**38,590**	**41,846**	**20,700**	**338,949**

In addition, Asset Register includes maps of important stocks such as soil carbon (Figure 3.2) and natural asset condition such as water quality assessed by the Water Framework Directive (WFD) status (Figure 3.3). **A full list of maps and their links is given in Appendix 1** and links are provided for each NCA. Maps include the following:

- Biodiversity stock
- Biodiversity hotspots
- SSSI Condition
- WFD Condition
- Woodland Ecological Connectivity Network
- Wetland Ecological Connectivity Network
- Grassland Ecological Connectivity Network
- Heathland Ecological Connectivity Network
- Carbon stock
- Vegetation carbon stock
- Water quality regulation stock
- Surface water regulation stock
- Agricultural production stock
- Drought mitigation stock

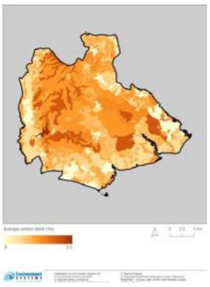
[Link to large scale map]

Figure 3.2: Soil carbon stock map – New Forest NCA

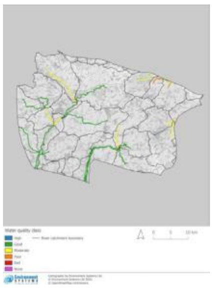
[Link to large scale map]

Figure 3.3: Water Framework Directive Status by waterbody, Hampshire Downs NCA

Maps have been produced to mark out areas best suited for ecological connectivity for grassland habitats, woodland habitats (example in Figure 3.4), wetland and heathland. These networks build on existing core site sand stepping stones to highlight those areas that provided the highest level of connectivity for that habitat.

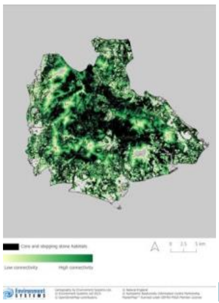
[Link to large scale map]

Figure 3.4: Woodland Ecological Connectivity Network (New Forest)

3.2 Quantifying natural capital benefits

Physical benefits presented here answer the question 'what do natural asset do for us?' (in Figure 2.1). Table 3.1 presents the benefits (from Table 2.1 above) and the data gathered to show their provision in the baseline in each of the six NCAs. The units for each benefit are different and specific to the measurement of that benefit. Some benefits require further calculation and assumptions to estimate (e.g. timber, physical activity).

Table 3.2: Physical flows of benefits by National Character Area (multiple units)

	Hampshire Downs	New Forest	South Downs	South Hampshire Lowlands	Thames Basin Heaths	Wealden Greensand
Arable production ('000 tonnes/yr)	424	28	73	22	43	28
Milk (millions litres/yr)	33	20	9	12	9	5
Beef (tonnes/yr)	1,099	677	293	418	284	185
Lamb (tonnes/yr)	485	85	132	58	130	85
Timber production ('000 m^3/year)	17	32	4	8	22	9
Solar energy ('000 MWh/yr)	159	25	4	100	17	21
Carbon sequestration ('000 tCO_2e/year)	117	119	26	44	60	32
Air quality regulation (tonnes PM2.5 removal/yr)	119	112	27	45	65	35
Recreation (million visits/yr)	11	11	5	10	9	2
Physical health (active visits millions/yr)	6	6	2	5	4	1

3.3 Natural Capital Benefit Assessment in monetary terms

We have assessed nine key benefits (also detailed in the Excel[TM] file eftec Results for Convenor 280524.xlsx sent with this report), and the disbenefit (negative impacts) of GHG emissions from agriculture. The tables of numerical results can be found in that file, here we present the topline results in each NCA in terms of total benefits percentage distribution of benefits (Figure 3.5) and £ per hectare of benefits (to Figure 3.6).

This baseline assessment is useful to inform the pattern of benefits provided by each NCA, and to indicate key services and natural assets that should be preserved and sustained in the long term. However, in addition to a baseline view, it also important to assess risks to these benefits, and opportunities for improvement, either through land use change, or through a change in land management practice. This aspect is addressed in the next section.

Figure 3.5 highlights that some benefits are very spatially specific. For example, recreation, physical health and air quality are a very high proportion of total benefits in the South Hampshire Lowlands, reflecting the proximity of natural assets to high urban populations. In comparison, these benefits are a lower proportion in the Hampshire Downs (but still around 40% of total benefits).

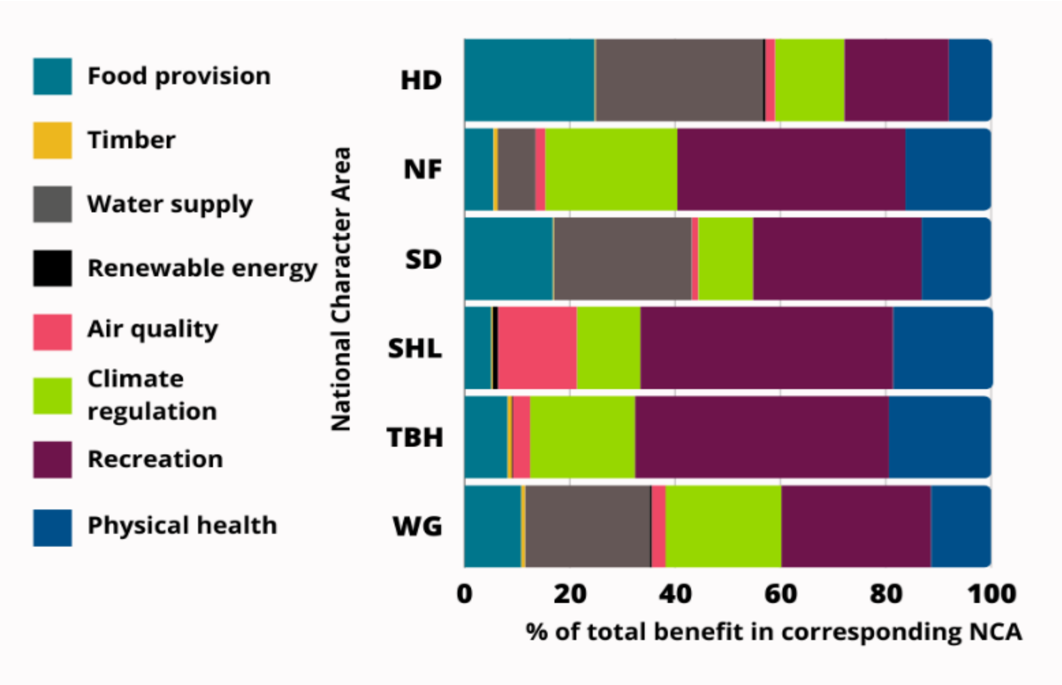

Figure 3.5: Each benefit as the proportion of total annual benefits by NCA

HD = Hampshire Downs, NF = New Forest, SD = South Downs, SHL = South Hampshire Lowlands, TBH = Thames basin Heaths, WG = Wealden Greensand

Plotting the benefits generated per hectare of land (Figure 3.6) also serves to emphasise differences across these NCAs. The recreational, physical health and air quality benefit values per hectare are particularly high in the South Hampshire lowlands, highlighting the importance of natural assets to the urban population. The New Forest has a more even distribution of benefits, demonstrating the character of its multi-benefit landscape (important for carbon sequestration and recreation and well-being). This figure also shows how food production is a more prominent feature of the Hampshire Downs compared to the other NCAs.

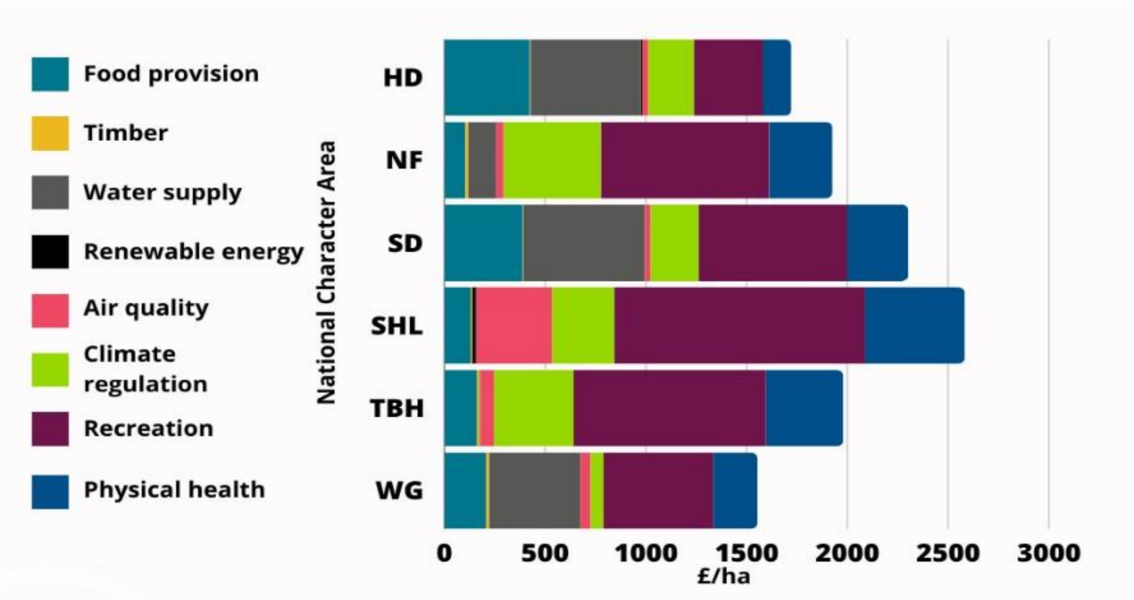

Figure 3.6: Annual benefit values (£ per hectare) by NCA

HD = Hampshire Downs, NF = New Forest, SD = South Downs, SHL = South Hampshire Lowlands, TBH = Thames basin Heaths, WG = Wealden Greensand

Disbenefits

The main environmental costs that we have quantified include:

- **GHG emissions from agriculture**. There is a wide range in the GHG footprint of food production, with large differences between the lowest impact producers and the highest. For example, winter wheat can range[1] from 0.12 to 0.93 tCO_2e per tonne of crop produced, with a mean of 0.34 tCO_2e/t. Likewise, the footprint of milk[2] can vary from 0.8 $kgCO_2e$/litre to 2.1 kgCO2e/litre, with a mean of 1.2. Similar ranges apply to beef and lamb production. The low, mean and high estimates in Table 3.3 are based on these extremes and the medium is based on the mean estimates. These emissions are valued at the UK government central non-traded carbon value (2024).
- **Diffuse water pollution from agriculture**. Nutrients and pesticides are pollutants to the water environment, but nitrate pollution is the most significant cost in the Hampshire Downs. This can be measured in terms of the expected costs of water treatment to remove, nitrate (as in Table 3.3). However, the cost to the the wider natural environment can be far higher.

Costs that we have not been able to quantify include:

- **Soil erosion and loss of soil organic carbon**. It has been estimated[3] that there are losses of over £1,000 million for England and Wales due to loss of soil. Specific losses for Hampshire require more data to provide an estimate for the soil profile of the specific NCAs in this project. Losses are likely

[1] CHAP & AHDB, (2022). Benchmarking emissions for UK agriculture and horticulture.
URL: https://chap-solutions.co.uk/projects/benchmarking-emissions-for-uk-agriculture-and-horticulture/

[2] Livestock production footprints are taken from AHDB at: https://ahdb.org.uk/knowledge-library/carbon-footprints-food-and-farming

[3] Graves et al (2015), The total costs of soil degradation in England and Wales, Ecological Economics 119 (2015) 399–411.

to be significant, especially for intensive arable farming practices.

- **Cumulative biodiversity losses are very significant**. For example, the England farmland bird index shows a 60% decline since 1970, with specialist species showing a 70% decline[4]. It is impossible to adequately express this loss in monetary terms, but is probably the most significant loss arising from land use and land management practice over the last 50 years.

The values in Table 3.3 give a very broad spread of the assessment of the cost of environmental impacts in Hampshire and given the significant items that could not be evaluated in monetary terms, represent a minimum view of the harmful effects of current land use. For context the medium impacts at £126 million are greater than the gross margin of foo production in the county and are comparable to the value of water abstracted for public water supply.

Table 3.3: Environmental costs of impacts that could be quantified in monetary terms, £ million/year

Disbenefit	Low	Medium	High
Arable GHG emissions	(39.5)	(61.1)	(135.0)
Livestock GHG emissions	(27.7)	(54.8)	(106.7)
Nitrate removal costs	(5.0)	(10.1)	(12.8)
Total	**(72.2)**	**(126.1)**	**(254.5)**

3.4 Risk and Opportunity maps

3.4.1 Risks

Maps which provide a view of risks to natural assets are:

- Soil erosion risk (for example see Figure 3.8)
- Agricultural production currently limited by drought (see Figure 3.7)
- Agricultural production limited by drought in 2080 (see maps by NCA in Appendix 1.)

Climate change is a major pressure for all natural systems, and many areas of Hampshire are already limited by drought (Figure 3.7). This situation will only worsen with future climate change (see modelled for 2080).

[4] https://www.gov.uk/government/statistics/england-biodiversity-indicators/5-farmland-species

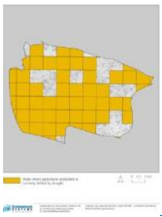
[Link to large scale map]

Figure 3.7: Areas where agricultural production is currently limited by drought. Hampshire Downs

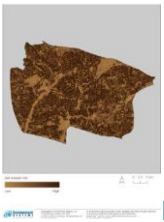
[Link to large scale map]

Figure 3.8: Soil Erosion Risk: Hampshire Downs

3.4.2 Opportunity mapping

Maps (for links by each NCA see Appendix 1) which highlight the main opportunities to improve the condition of natural assets and the benefits they provide include opportunities to:

- Potentially gain soil carbon;
- Enhance biodiversity;
- Reduce soil erosion risk;
- Improve surface water quality with habitat opportunities, and
- Improve groundwater quality.

These maps show the locations where the relevant benefits can be most improved. Of these maps, the soil carbon gain maps were used to assess the potential area and scale of possible future sequestration in soil for each NCA (in tonnes of carbon, see Section 4 for details). The opportunity maps to enhance ecological connectivity were used to quantify the potential area of habitat creation/restoration by habitat type and for each NCA (see detail of assessment in Section 4) .

Soil carbon stocks have been assessed with data that includes soil samples that capture minimum, mean and maximum soil carbon content by soil type (there are around 50 soil types in the classification used for Hampshire). The soil opportunity indicates the quantity of additional soil carbon that could be captured if the minimum and average soils where to reach the maximum level (Figure 3.9). Areas with no/low potential include urban areas and existing woodland.

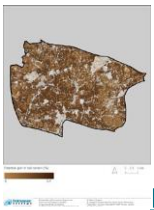
[Link to large scale map]

Figure 3.9: Potential Gain in Soil Carbon: Hampshire Downs NCA

4. Opportunity Evaluation

In setting appropriate priorities, the Board needs to consider the multiple aims for land use in the county, namely, to:

- **Provide a viable income/livelihood for farmers** and other land managers;
- **Avoid and eliminate negative environmental impacts**, chiefly GHG emissions and diffuse water pollution;
- **Assist meeting national climate targets (Net Zero**) by increasing carbon sequestration wherever possible;
- **Reverse biodiversity losses**, in particular enhancing/protecting those habitats which are rare and native to various parts of Hampshire (e.g., chalk streams, species rich grassland, New Forest etc.), and
- **Maintain and improve access to the countryside** for health and wellbeing.

We have produced a list of locally specific priorities for each NCA (below) for the Board to consider for adoption. In developing the suggested schedule of priorities by NCA we have taken into account:

- **Policy landscape** – National and local policies as compiled by terra firma in support of the project (including National Parks Management plans and NCA priorities);
- **Ecological evidence** – from the existing (baseline) state of natural capital (both extent and condition) as assessed in the baseline assessment, and from the opportunity mapping assessment carried out in support of this project;
- **Economic evidence** – The benefits provided by natural assets in existing condition and use;
- **Financing feasibility** – considering a high level assessment of the potential for funding (see below).
- **Stakeholder feedback** from the consultation process has been useful, but not at a level of response to provide any firm general indications as to which improvements are either preferred or are unacceptable.
- **The emerging LNRS under development**. Hampshire is working towards its Local Nature Recovery Plans (LNRPs) and will complete them towards the end of 2024. To date the LNRP's have prioritised stakeholder input, gathered through extensive consultations, to identify key conservation needs in the county, this stage of the process is due to complete in early summer 2024. This bottom-up approach contrasts with the ELMs test and trial for Hampshire, which has taken a strategic approach to focus on reducing key countywide environmental risks and issues, considering where using nature based solutions will optimise appropriate environmental outcomes. Because this project has been undertaken with a board, comprising a wide range of stakeholders, the priorities are most likely to be extremely complementary. Certainly, when the LNRP is published at the end of the year, the priorities that are identified in common will be ones that will lead to the most successful outcomes to reduce environmental risks and issues and build resilient biodiversity

Considering all these factors, general priorities align to those listed in each NCA summaries **(see Document 4; "Natural Capital Baseline and Opportunities").**

4.1 Potential scale of opportunities for improvement

Quantifying the scale of opportunities can be challenging, due to a range of factors including, uncertainty in the science, lack of data at a local level and uncertainty around the extent and effectiveness of take up of improvement opportunities amongst land managers. All these factors apply to varying degrees for each of the opportunities evaluated, ***hence the values quoted should be treated as approximate indications of the range of value of improvements that could be made***.

The uptake of these opportunities depends upon alignment with landowner and stakeholder interests as well as the economic incentives associated with these opportunities. Our analysis (Table 4.1) puts some potential scale and value on the benefits of improvement opportunities that are possible within Hampshire. These opportunities have been assessed as ecologically feasible, within the scope for the potential extent for financing feasibility being considered in Section 5.

It should be appreciated that many different actions can realise these opportunities. For example, water quality can be improved by reducing fertiliser applications, or by use of nature-based solutions to remove nutrients. Furthermore, some actions can deliver multiple opportunities. For example, certain regenerative farming methods can sequester carbon in soil, help reduce GHG emissions through lower fertiliser inputs and help improve water quality.

Table 4.1: Scale of potential opportunities across Hampshire

Opportunity	Quantification of Physical Benefit	Potential Value Indication £'m/year
Farm GHG emissions reduction	90 ktCO_2e/year	£4-25 million/year
Soil carbon sequestration	20 to 40 MtCO_2e (over 50 years)	£110-220 million/yr (for 50 years)
Priority woodland creation (3,400 ha)	2.4 MtCO_2e (over 70 yrs)	£2-9 million/yr for 70 yrs
Other woodland creation (3,900 ha)	2.7 MtCO_2e (over 70 yrs)	£2-10 million/yr for 70 yrs
Priority grassland creation	3,000 ha	Note 1
Priority heathland creation	2,000 ha	Note 1
Priority wetland creation	6,500 ha	Note 1
BNG units (arising from development)	196 BUs (over 10 yrs)	£0.4-1.2 million/yr For ten years
Hedgerow creation	77 ktCO_2e Over 30 years	£0.1-0.7 million/yr for 30 years
Water quality improvement - nutrient reduction measures	8,000 tonnes Nitrate removed/year	£5-13 million /year
Total		**c. £120-280 million/year**

Note 1: The creation of habitat in these priority areas provides very significant benefits for biodiversity. Quantifying this benefit in monetary terms is very difficult and not adequately captured in monetary terms. Consequently, no value is attributed to the benefits of these habitats here.

The middle column quantifies the main benefit arising from the opportunity (although there may be many other benefits that are less easy to quantify). The final column provides an indication of the range of value for the benefit identified on an average annual basis (in 2024 prices). The extent to which this benefit value may be realised as an income stream will vary by benefit and by circumstances but is considered in Section 5.

The table includes priority habitat creation, meaning that which provides a connecting benefit with an existing ecological network, or within designated sites (such as a SSSI). The scope for additional habitat creation (outside the connecting ecological network, and outside any designate site), is a further opportunity and is presented in Table 4.4.

There are other opportunities that have been considered but that are not simple to quantify or estimate, such as:

- The benefits of supply chain accreditation and support are many and varied (such as, direct investment or security of market), and may overlap with and support the benefits of nature sensitive and regenerative agriculture. Consequently, these are not explicitly evaluated here, but could be very significant, and deliver additional income.
- Provision of more public access (e.g., permissive footpaths, bridleways etc) can deliver significant additional recreation and public well-being benefits if sited in the right location (i.e., sufficiently close to centres of population). Anticipating the scale and location of such additional provision is difficult to forecast, hence no value has been estimated for this opportunity.

The evaluation of each item is described in the remainder of this section.

4.2 Opportunity to reduce GHG emissions from agriculture

A very broad range of actions can reduce GHG emissions from farming. Sustainable, nature-based, and regenerative agriculture techniques bring multiple benefits, in addition to GHG reduction, (such as avoiding soil erosion, resilience to climate change and underpinning the general health of biodiversity) and can be applied to all farmland within each NCA. However, the potential to reduce GHG emissions of farming, and sequestration of carbon in soil (see Section 4.3) are the two benefits that are most readily quantified in monetary terms, and hence present more opportunity for private finance. In contrast to sustainable agriculture which aims to eliminate harm to soil fertility and structure, carbon storage and biodiversity, regenerative agriculture takes this further and enhances these qualities so that farming practices have a positive environmental effect on agricultural land (LaCanne and Lundgren, 2018, Burgess et al., 2019). By building the "system", or resource base it utilises, productivity, farm communities and environmental management are all improved (General Mills, 2018).

Table 4.2: Potential Reductions in Agricultural GHG emissions, per year

National Character Areas	Physical quantity of improvement		Maximum indicative value £'m/year		
	Maximum Opportunity for Potential GHG reduction (tCO_2e/year)	Opportunity at 50% of potential (tCO_2e/year)	Social Cost of Carbon at 2024 central non-traded value, £273/tCO_2e)	Indicative value £'m/year (at 2024 low non-traded Value £136/tCO_2e)	Indicative value £'m/year at voluntary market value £50 /tCO_2e
Hampshire Downs	92,351	46,175	12.6	6.3	2.3
New Forest	25,038	12,519	3.4	1.7	0.6
South Downs	19,604	9,802	2.7	1.3	0.5
South Hampshire Lowlands	18,335	9,167	2.5	1.2	0.5
Thames Basin Heaths	15,638	7,819	2.1	1.1	0.4
Wealden Greensand	10,387	5,193	1.4	0.7	0.3
Total	**181,353**	**90,677**	**24.7**	**12.3**	**4.5**

There is significant variation in GHG emissions per unit of agricultural output (see Appendix A2.1.8 for details). If agricultural GHG footprint in Hampshire is assumed to be similar to the UK average, then the difference between the average and the lowest represents the maximum potential opportunity for emissions reduction. Not all of this potential may be realised so assuming 50% potential gives an indication of the annual realisable savings that could be achieved across the county (see Table 4.2).

The economic value of carbon sequestered, or GHG emissions avoided, is subject to a high degree of uncertainty and hence we quote a reasonable range of values here to illustrate the possible range of value. The Department for Energy Security and Net Zero (DESNZ) provides a range of non-traded carbon values to reflect the 'social cost of carbon'[5]. The central non-traded value for 2024 is £273 per tCO_2e and is subject to high and low estimates of =/- 50%. Over time as the task of achieving net zero becomes progressively more complex and expensive, it is expected that the social cost of carbon will rise. The final column shows the likely income if the saved carbon was possible to trade in the current voluntary carbon markets. The voluntary carbon prices are around £25-50 per tCO_2e, well below the social cost of carbon. However, it is expected that this price will rise towards the non-traded values as the drive to achieve net zero becomes more urgent. Given the range of £136 to £273/tCO_2e the potential value of reducing GHG emissions is in the region of £12 to £25 million per year. At the best current voluntary market prices this is around £4.5 million per year (if this carbon reduction is admissible as carbon credit) but can be expected to rise overtime as meeting net zero targets become progressively harder.

4.3 Opportunity to increase soil carbon sequestration

The science of soil is extremely complex, and there is a lack of topical data on soil carbon stocks in the UK (see Appendix A2.1.7 for details on the soil opportunity assessment we performed). Furthermore, each soil type has very different characteristics, in terms of capacity to sequester and store carbon, and the soil management practices required to sustain and improve carbon sequestration. The use of the land is also a key determinant in what can be achieved. All this makes the task of estimating the opportunity for further carbon sequestration very challenging. That said, there is sufficient evidence to indicate the main land management practices that can reduce soil carbon loss and are likely to achieve further carbon sequestration.

There is very large potential to increase soil carbon stocks, as evidenced by the wide range of stocks for any given soil type and land use combination. For example, the Defra T&T pilot at Cholderton and Snoddington (eftec, (2021)), showed that soil stocks in an extensive arable/livestock farm under organic management had more than twice the carbon stock of a neighbouring intensive arable farm on the same soil type. Soil data gathered from NatMap (see Appendix A2.1.7 for details) indicated that for the 49 different soil types in Hampshire, the difference between the mean soil stock and the highest was an average of 215 tC/ha. This is an indicative maximum potential (i.e. if the average was increased to the maximum observed for that soil type), and may not be realised due to land use constraints and many other factors.

[5] Greenhouse gas emissions values ("carbon values") are used across government for valuing impacts on GHG emissions resulting from policy interventions. They represent a monetary value that society places on one tonne of carbon dioxide equivalent (£/tCO2e).

Arable soils typically have a relatively low Soil Organic Carbon (SOC) content (27-88 tC/ha, see Natural England Report, Gregg et al (2021)) due to a wide range of management practices, such as high nitrogen application, excessive tillage, leaving soil bare and risks from soil erosion. Consequently, the balance of evidence suggests that in the UK arable soils are depleting in carbon stocks. Conversely this can be reversed by a a range of measures, (use of farmyard manures, minimal or no tillage, use of cover crops and herbal leys, etc.).

Improved grassland soils have a higher carbon content than arable land at around 72 – 204 tC/ha (Gregg et al (2021)). There is believed to be a carbon saturation equilibrium in some mineral-based habitats such as grasslands (Anderson, 2024), but this is likely to vary with soil type, and it can take 100 years to reach this equilibrium. For example, neutral grasslands restored to high diversity with red clover or other deep-rooted legumes can sequester as much carbon as many other habitats (Anderson, 2024), but relies on low grazing and no artificial fertilisation. Anderson also states, "Grassland carbon sequestration potential is too often ignored in favour of tree planting yet has the potential to play a vital role in capturing and storing carbon", but acknowledges that the range of uncertainty is a possible reason as to why this hasn't been taken up for widely. Improved grasslands can increase carbon content by use of; reduced nitrogen inputs in highly intensive leys, grass-legume mixtures rather than short-term leys, permanent grasslands rather than leys and grazing management rather than cut and grazed or cut only.

Arable and improved grassland comprise around 55% of the land area, but soils on other land types (e.g., woodland 20% and urban 15%) can sequester carbon too. Old and established woodland can carry on sequestering carbon in soil for hundreds of years, but at a low rate. Urban gardens and parks have sequestration potential too, but this is also likely to be low and difficult to measure and forecast. Consequently, we have not included an estimate of the potential for soil sequestration in these land cover types, but this benefit should be encouraged for these land use types.

Given that arable and improved grassland have the greatest potential for improvement in soil carbon content, and that these comprise the majority of land use in the county, these are the main land types we have included in our opportunity estimate. As the difference between the highest carbon stocks and the lowest in around 30 to 60 tC/ha, (roughly equivalent to 1 to 2% SOC) then we have taken this as a range of ambitious but achievable target for improvement across all agricultural land in each NCA (see Appendix A2.1.7 for detail of assumptions).

Applied to these land use types, this would give a total sequestration range of 20 to 40 million tonnes of CO_2e (Table 4.3). The timescales for achieving this are also highly uncertain, but the literature typically talks about timeframes of 50 to 100 years, (although poor soils can improve rapidly in the early years of soil improvement measures). The rate of sequestration will depend on many factors, ranging from the take up of measures by land managers to sequester carbon, to the responsiveness of soils to those measures. Soil ecology is highly complex and hence it is difficult to predict. We have taken 50 years as a reasonable timeframe, so an average annual sequestration rate could be in the region of 400 to 800 ktCO_2e per year and require sequestration in soil of 0.6 to 1.2 tC/ha per year. The lower rate is typically considered reasonable (see Sustainable Soils Assoc[6]), but the higher rate of 1.2 tC/ha is ambitious hence reflects the upper bounds of what could be achieved. ***Hence, Table 4.3 should be taken as a rough order of magnitude indication of sequestration potential and the value of that sequestration***.

Table 4.3: Potential for Soil Carbon Sequestration by NCA

National Character Areas	Area of Opportunity (ha)	% of Land	Sequestration Potential		Maximum indicative annual value (£'m/year)		
			50 - year potential range ($MtCO_2e$)	Annual potential ($ktCO_2e$/year)	Social Cost of Carbon at 2024 central non-traded value, £273/tCO_2e)	Indicative value £'m/year (at 2024 low non-traded Value £136/tCO_2e)	Indicative value £'m/year at voluntary market value £50 /tCO_2e
Hampshire Downs	102,289	72%	11.3 - 22.5	225 - 450	123	61	23
New Forest	19,754	29%	2.2 - 4.3	44 - 87	24	12	4
South Downs	21,178	72%	2.3 – 4.7	47 – 93	25	13	5
South Hampshire Lowlands	15,434	40%	1.7 – 3.4	34 – 68	19	9	3
Thames Basin Heaths	19,825	47%	2.2 – 4.4	44 - 87	24	12	4
Wealden Greensand	10,167	49%	1.1 – 2.2	23 - 45	12	6	2
Total	**188,647**	**56%**	**20.8 – 41.5**	**417 - 830**	**227**	**113**	**42**

Table 4.3 illustrates that over half the potential to sequester soil carbon occurs in the Hampshire Downs, reflecting the large area of arable and grazing land in that NCA. In contrast, the lowest potential for sequestration is in the New Forest, reflecting the predominance of established heath and woodland with lower potential for further soil carbon sequestration.

Applying the same range of carbon values as in Table 4.2. the maximum potential value of sequestering carbon in soil is in the region of £113 to 227 million per year (2024 values) making it by far the largest opportunity that we could quantify in monetary terms. At the best current voluntary market prices, this is around £42 million per year but can be expected to rise overtime as meeting net zero targets become progressively harder.

[6] See: https://sustainablesoils.org/soil-carbon-code/economic-and-policy-context

4.4 Opportunities for priority habitat creation and BNG credits

The areas for priority habitat creation (woodland, grassland, wetland and heathland) by each NCA are shown in Table 4.1. The full benefits of creating these habitats are difficult to adequately evaluate in monetary terms so have not been presented in those terms here. The exception is woodland and hedgerow creation which does provide a carbon sequestration benefit which is relatively easy to evaluate, and this has been present in Table 4.1 as reflecting part of the creation value. The benefits have been calculated based on typical sequestration rates for woodland creation (c 700 tCO_2e over a 70 year period) and evaluated using the same range of value assumptions pet tCO_2e as described for soil carbon sequestration above. This does only partly capture the value of woodland creation, which provides significant benefits for biodiversity.

The BNG market has been established recently (effective since the beginning of 2024) and may or may not double count with the opportunities for priority habitat creation listed above. Indeed, there is some hope that significant BNG market credits may fund some of the priority habitat needed in the county. However this will depend upon the specifics of each individual development deal, and many offset schemes may be outside the priority network (in which case they would be additional to the priority areas listed). The area of BNG offset demand by NCA has been estimated from work eftec has conducted for another project and presented here as an indication of the potential scale of development schemes over a ten-year period. Forecasting beyond this ten-year time horizon is more difficult to predict and hence not included. The level of offsite BUs demanded (196 over ten years, or nearly 20 per year on average) has also been evaluated, ***but is subject to a high degree of uncertainty***, as this can vary depending upon the scale and rate of development, the extent to which this occurs on greenfield sites and the extent to which developers can meet biodiversity obligations on-site. Recent deals suggest that BUs can be purchased for around £20,000 to £60,000 per unit and this range gives the annual values (£0.4-1.2 million/year) presented in Table 4.1.

In addition, there are opportunities for further habitat creation measures for woodland (especially multifunctional woodland for a variety of purposes), grassland, heathland, wetland and farm margins. These are areas for which habitat creation would be suitable and beneficial, but which are outside the core network or priority zones. This area is around 45,000 ha or 13% of the total NCA area. In particular, woodland creation can be beneficial over a very broad area and should only be avoided if land is better suited to other habitat or on deep peat.

Hedgerow Creation

Table 4.1 includes the creation of priority hedgerows that connect to existing hedgerows and the woodland network. The benefit of carbon sequestration is presented in Table 4.1 and evaluated using the same range of carbon values as used for GHG emissions reductions, soil carbon sequestration and woodland creation.

Table 4.4: Additional Habitat Creation Opportunities

	Area (ha) of Opportunity by NCA						Total Area (ha)
Opportunity	**Hampshire Downs**	**New Forest**	**South Downs**	**South Hants Lowlands**	**Thames Basin Heaths**	**Wealden Greensand**	
Woodland creation	14	19	8	1	-	-	**41**
Grassland creation	9,878	966	3,004	1,555	1,709	1,320	**18,432**
Heathland creation	260	1,307	41	4,966	4,952	2,839	**14,364**
Wetland creation	1,726	3,277	33	245	455	19	**5,756**
Farm Margins	3148	685	641	879	920	194	**6,466**
Total	**15,026**	**6,253**	**3,727**	**7,645**	**8,036**	**4,371**	**45,059**
% of NCA	11%	9%	13%	20%	19%	21%	**13%**

4.5 Opportunities to improve water quality

As discussed in the baseline assessment, the adverse impacts of diffuse nitrate pollution on water quality are significant. The main priority for public water supply is to reduce sources of pollution to aquifers, and surface waters, by reducing excess nitrate applications on land. The groundwater bodies that are in poor chemical condition, and hence are priority areas for reductions, are in the Hampshire Downs, Wealden Greensands, South Downs and in the Avon aquifer to the west of the New Forest. Although there is believed to be relatively lower abstraction in the South Hampshire Lowlands and Thames Basin Heaths, there may still be benefits to the wider water environment from nitrate reductions in these NCAs.

No nutrient balance information for Hampshire was available, hence it has not been possible to calculate a location specific quantity of nitrate reduction required by each NCA, to meet drinking water standards or to underpin improvements to WFD chemical status. However, as an indication of the rough order of magnitude of reductions that may be required and the potential savings in water treatment costs, the figures based on national average assumptions suggest that up to £13 million in costs may be avoided annually (Table 4.5). For detail see Appendix A2.1.9)

Table 4.5: Indication of Scale of Potential Nitrate Reductions by NCA

	Nitrate reduction estimate (tNO_3/year)			Possible saving of water treatment costs (£million /year)		
Relevant National Character Areas	**Low**	**Mid**	**High**	**Possible Cost Saving £m/year (low)**	**Possible Cost Saving £m/year (medium)**	**Possible Cost Saving £m/year (high)**
Hampshire Downs	2,300	6,600	8,200	3.0	8.3	10.4
South Downs	400	1,200	250	1.0	1.5	1.9
New Forest	800	300	1,500	0.3	0.3	0.5
Total	**3,500**	**8,100**	**9,950**	**4.3**	**10.2**	**12.8**

5. Financial feasibility

In this section we explore the financial feasibility (one of the key feasibility tests referred to in Section 2) for funding some of the opportunities identified in the previous section. This is a strategic overview of finance opportunities that are potentially relevant for the kind of natural capital benefits and opportunities for improvement that are covered above. This is not a one-to-one matching of those opportunities with specific finance sources.

It is important to recognise that not all the economic value of any particular benefit may be realised in market transactions. For example, the value range of the public benefits of carbon sequestration based on social cost of carbon from the DESNZ is from £138 to £415 per tCO_2e (in 2024), but current voluntary market transactions for carbon sequestration are in the range £25-50 per tCO_2e.

This section starts with a market overview then explores the main private financing markets (carbon, biodiversity, nutrient neutrality etc), and ends with direct funding and an overview of ELM funding.

5.1 Market overview

Interest in the potential for financial opportunities arising from natural assets present in Hampshire is part of a global picture, where growing concern over the damaging effects of climate change and ecosystem degradation have led to a matching interest in the potential to use assets in the affected systems themselves to help fund their restoration and ongoing protection.

Although this report covers a local project, it is probably worthwhile noting the state of the global market for investment in nature (See Box 5.1).

Box 5.1: The state of the global market

According to a **2023 report by PWC**[7], around half of global GDP of $58 trillion is either moderately or wholly dependent on nature. Despite the massive importance of nature for economies, however, the report notes a current ‘investment gap’ of some $700 billion p.a. in the funding required to protect the natural environment globally. Of the $134 billion that is being spent (of the $845 billion p.a. needed), moreover, $114 billion (85%) is coming from public funds. These numbers emphasise the huge need for private funding to cover the investment gap in nature protection, but at the same time the low level of private finance presently being mobilised at a global level.

What is more, private investment is highly concentrated in a few sectors of the nature-based investing (NBI) market. The same PWC report, studying 80 NBI vehicles, found that some 47% of their capital was invested in either forestry or sustainable agriculture, and a further 22% in marine-based projects. Another 18% had a “general nature focus”, but only 5% was invested in more specialist sub-sectors such as wildlife protection (2%) and habitats restoration (3%). These, of course, are the sectors that involve what will be important elements of the UK NBI market, such as biodiversity.

[7] At https://www.pwc.com/gx/en/nature-and-biodiversity/nature-fin-accelerator-mode.pdf

The concentration on a few sectors seen globally is mirrored (although with less hard data available) in the way that the UK market appears to be developing. Here, we see activity focussed in the two natural asset classes for which measurement, verification and trading protocols have been developed, namely woodland and peatland.

Although details of transactions are not public, the main platform for credits created under these protocols, the Woodland Carbon Code[8] and Ecosystem Marketplace, noted 684 transactions between 2020-2023, 575 under the Woodland Carbon Code and 109 under the Peatland Code. These represented the sale of over 525,000 carbon units, almost 100% (as would be expected, given the newness of the codes) being Pending Issuance Units. Only the Woodland Code, of course, is materially applicable in Hampshire, so this limits further the presence of the most established UK markets as a starting point.

Biodiversity units, nutrient neutrality, and soil carbon, are still, relatively speaking, nascent. These will benefit in time from regulatory pressure if consistently applied and – in the case of soil, and hedgerows – the establishment of protocols, on which significant work is now under way. Other sectors, such as water quality and greening supply chains, appear to be still at the stage of bespoke, bilateral arrangements rather than any systematic approach, although there are notable common areas of focus in, for example, supply chain schemes set up by retailers and manufacturers.

At the apex of 'green finance' (i.e for climate and nature), the UK is well served by the **Green Finance Institute**[9] (GFI), established by the Government in 2019 to give direction and impetus to the growth of the market. The GFI covers all aspects of green finance, but has done useful work in the NBI segment, not least the recent publication of an excellent **Farmers' Toolkit**[10], which provides a comprehensive guide to addressing the NBI market.

Among market players relevant to the potential for NBI in Hampshire, there are transaction managers / brokers in woodland carbon, and some emerging specialists in BNG/NN, such as **Wild Capital**[11], which has a presence locally and has set up schemes in Wiltshire and the Isle of Wight. Trading in voluntary carbon is well-established.

There are also a number of 'impact' investors that have an interest in NBI. These range from 'wallets' in large investment managers such as **Federated Hermes**[12], to the 'ethical bank' **Triodos**[13], 'social' investor **Better Society Capital**[14] and the **Wheatsheaf Group**[15], part of the Grosvenor Estate, that specialises in food and agriculture technology investments.

[8] At https://woodlandcarboncode.org.uk/uk-land-carbon-registry/uk-carbon-prices
[9] At https://www.greenfinanceinstitute.com/
[10] At https://www.greenfinanceinstitute.com/gfihive/farming-toolkit/
[11] At https://wild-capital.co.uk/about-us/
[12] At https://www.hermes-investment.com/uk/en/individual/about-us/
[13] At https://www.triodos.co.uk/about-us
[14] At https://bettersocietycapital.com/impact-report-2020/people/conservation-of-the-natural-environment/
[15] At https://www.grosvenor.com/food-agtech

These are complemented by NBI-focussed funds, for example the **Hermes UK Nature Impact Fund**[16] and Aviva's **Natural Capital Transition Fund**[17], investment platforms such as **Abundance**[18] and investment trusts such as **Impax Environmental Markets**[19].

A number of biodiversity funds have been launched in the UK recently, including one by alternative asset manager **Gresham House**[20], with $300 million committed by investors to date. This will invest in biodiversity 'habitat banks' being created by **Environment Bank**[21], which aims to have 8,000 ha in place by 2026. This is a good example of the importance of aggregation to a scale that will interest institutional investors.

More widely, the 'front-line' players are backed by 'conveners' such as the Sustainable Markets Initiative and its **Natural Capital Investment Alliance**[22] and research groups such as **Nature-based Solutions Initiative**[23].

Turning to the 'supply side' of natural capital assets, and in particular to advisory services for owners or managers of such assets, we see a mixed picture. On the one hand, green finance expertise in the UK, outside London, is thinly spread among 'traditional' business advisers, for example banks or accountancy firms. On the other hand, strong specialist advisers such as **Finance Earth**[24] and **Natural Capital Advisory**[25] are emerging. The latter is focussed on farmers and has been very active in convening farm clusters and establishing area-wide groups capable of creating aggregated investment opportunities, the importance of which is discussed further below. In particular, its **Environmental Farmers Group**[26], established with the Game and Wildlife Conservation Trust, includes farm clusters in the Hampshire Avon and Itchen/Test areas.

The NBI market in the UK is one that is still very much finding its feet. This means that it is even more necessary for landowners or managers to do whatever they can to make investment opportunities as investor-friendly as possible. This in turn makes consideration of the following important in terms of accessing NBI markets as they grow:

- Understanding the exact interests and mandates of investors — for example investors buying credits for offsetting will have different criteria than those buying them for financial return;
- Creating investments of a large enough size to interest larger players and reduce transaction costs. This may entail — in many or even most cases — aggregation of smaller assets, and
- Using the services of specialist brokers and managers who have experience in structuring investments that match risk for investors ith returns and that have access to investors and their networks.

[16] At https://finance.earth/fund/uknature/
[17] At https://www.avivainvestors.com/en-gb/capabilities/equities/natural-capital-transition-global-equity-fund/
[18] At https://www.abundanceinvestment.com/
[19] At https://impaxenvironmentalmarkets.co.uk/
[20] At https://greshamhouse.com/natural-capital-investment/
[21] At https://environmentbank.com/nature-shares
[22] At https://www.sustainable-markets.org/ncia/
[23] At https://www.naturebasedsolutionsinitiative.org/what-are-nature-based-solutions/
[24] At https://finance.earth/about/
[25] At https://www.naturalcapitaladvisory.co.uk/
[26] At https://www.environmentalfarmersgroup.co.uk/areas/

Table 5.1 illustrates the potential funding mechanisms for the opportunities and provides an indication of scale. The rows list the land management opportunities as identified in Table 4.1. and highlights those mechanisms for which an existing funding stream is in place (with “Y”). It also highlights the areas in which there are funding mechanisms under development (marked as “emerging”), such as the soil carbon code. The penultimate row provides an indication of existing annual funding levels at a national scale (where known or reasonably estimable), and the final row provides an indication of the annual level of funding that could be realised for the six core NCAs in scope for this project. ***It should be noted that these are indications only, and some funding streams have the capacity to grow substantially***. Each funding stream is explained in turn below.

Table 5.1: Table of Funding Instruments

	Grants	ELM			Ecosystem Service Markets						Incidental
Opportunities	Private Grants	SFI	CS+	Landscape Recovery	Carbon	BNG Units	Other BD	Nutrient Neutrality	Nutrient Reduction	Other [c]	Other returns[d]
Re-gen Agriculture		**Y**	**Y**	**Y**					**Y**	**Emerging**	**Y**
Soil Sequestration	Y	Y			Emerging						Y
Supply chain support	Y									Emerging	Y
Woodland creation	Y		Y	Y	Y	Y	Emerging	Y			Y
Grassland creation	Y	Y	Y	Y		Y	Emerging			Emerging	
Heathland creation	Y	Y	Y	Y		Y	Emerging			Emerging	
Wetland creation	Y	Y	Y	Y		Y	Emerging	Y		Emerging	
BNG Credits						Y					
Hedgerow creation	Y	Y		Y	Emerging	Y					
Nutrient reduction	Y	Y	Y	Y				Y	Y	Emerging	Y
Current Funding (England)/year			£2,400 m		£5 m [b]	>£20 m	Unknown	Unknown	>£15 m?	Unknown	Unknown
Hampshire £'m/year			**~£80 m** [a]		**>£1.8 m**	**~£1m**	Unknown	**~£5m**	**>£1.2 m**	Unknown	Unknown

a) Hampshire core NCA farm area is around 3.3% of England's utilised agricultural area and ELM funding is indicated as the England average (£273/ha).
b) UK volume of woodland carbon code deals at average price in 2022, however this market can be expected to grow substantially over the next decade or so.
c) Other emerging ecosystem markets include natural flood mitigation, and social prescribing.
d) Other returns includes income and benefits that may be an ancillary benefit of an improvement, such as reduced fertiliser cost from nutrient reduction, or improved crop yields with increases in soil carbon.

Grants may be available for specific purposes, such as retailers or supply chains providing financial assistance to farmers to achieve environmental goals or accreditation. Note that most Defra grants (such as woodland creation grants) are expected to be included under ELM budgets, so for the purposes of this table are included under the ELM columns. Furthermore, water company grants for nutrient reduction activities are covered under nutrient reduction measures below.

ELM funding is structured around three main elements: Sustainable Farming Incentive (SFI), Countryside Stewardship (CS+) and Landscape Recovery. In addition, the Defra budget also funds other pilot schemes and various grants (such as the English Woodland Creation Offer, EWCO), and Table 5.1 assumes these are covered under the ELM budget. The UK Government has made repeated statements[27] that ELM funding in England will be held at £2.4 billion per year. The specific funding offers will develop over the next few years, in response to rates of uptake and to feedback from the farming industry, hence the structure and split of funding by the three core components is impossible to predict.

For the purposes of this report, we assume that the ELM funding in England is held at £2.4 billion**.** The level of ELM funding in Hampshire will depend upon the choices farmers make, but **assuming that the in-scope NCAs in Hampshire receive the national average funding per ha, this gives a total annual funding rate of around £80 million per year.** For context, this would be spread across approximately 1,800 holdings across the six NCAs. The figures in Table 5.1 highlight the dominant role that ELM funding currently plays, whilst private funding instruments are either relatively new or still in the nascent stages of development.

Some existing elements of ELM scheme have a strong tie into the specific improvement opportunities that have the greatest potential for realising the benefits highlighted in Section 4. For example:

- SFI, SAM1 (Soil testing, assessment and plan) is a low cost activity but lays the groundwork for soil improvement.
- SFI, NUM1 - Complete a nutrient management (NM) assessment and produce an NM review report), can be y=used to support nutrient reduction efforts.
- SFI, SAM3 (Herbal leys) can be used to realise multiple benefits including nutrient reduction and enhancing soil carbon.
- SFI, IPM2 (Establish and maintain flower-rich grass margins, blocks, or in-field strips, payment rate at £798/ha in 2024) can support grassland enhancement in the chalk downs.
- In addition, Countryside Stewardship 2024 provides 260 items (including 111 options, 123 grants and 26 supplements), covering items such as, unharvested headlands, flower rich margins and plots, legume and herb-rich swards, creation of species rich grassland, very low nitrogen inputs to groundwaters, nil fertiliser supplement, woodland creation and maintenance, and various wetland creation offers.

The Landscape Recovery element of ELMS funded 34 new projects in 2023 (£25 million, covering 200,000 ha and 700 farmers/landowners)[28], in addition to the 22 projects funded in the previous year. Funding has

[27] See: https://deframedia.blog.gov.uk/2024/01/03/inaccurate-coverage-on-our-farming-budget/
[28] See: https://defrafarming.blog.gov.uk/2023/11/29/round-two-projects/

been allocated on a competitive basis and can be expected to be the norm going forward. This funding stream may be useful for consortia of farmers/landowners that can organise around landscape scale goals.

Key issues in the future development of ELM schemes are the ongoing questions of what public goods should be funded, and the extent to which private funding can be stacked with ELM funding. For example, ELM funding can act as a low cost and low risk starter activity that can open up other funding streams (such as SFI schemes for soil monitoring and nutrient planning, which may lead to opportunities for nutrient reduction funding from water companies).

Ecosystem Service Markets include carbon, BNG and other biodiversity, nutrient neutrality and reduction and other markets.

The **voluntary carbon market** has been established in the UK for several years now and is dominated by the woodland carbon code, (as sequestration in woodland is relatively easy to forecast, measure and verify). Based on transactions for the most recent full year this market is trading at around **£5 million per year**, with average prices at around £25/tCO_2e[29]. These prices can be expected to rise as the drive to achieve net zero becomes more pressing and because the vast majority of current transactions are for Pending Issuance Units (rather than verified units which can be expected to sell for a higher price). Best current prices are around £50/tCO_2e which can be considered a minimum value for trades in future. The **value for Hampshire, is at least £1.8 million per year** (Table 5.1) and is based on assuming 3,500 ha of woodland creation at 10 tCO_2e average annual sequestration for 70 years at £50/tCO_2e. This should be considered a low minimum as prices may be expected to rise over time and the potential for woodland creation in excess of 3,500 ha is significant.

A more detailed review of the woodland carbon code is given in Section 5.2. The UK peatland code has been recently established and generating significant transactions, but as this relates to upland peat it is not relevant in a Hampshire context, and so not considered further here. Other carbon opportunities that are in development, but for which it is too early to forecast funding streams with sufficient degree of confidence include:

- Soil carbon. The potential quantities of carbon that can be sequestered and stored in soil is very large and can be achieved without a major change of land use such as switching to woodland. However, there are substantial challenges to creating a robust and authoritative soil carbon sequestration code. These challenges include the ability to predict future rates of carbon sequestration for any given soil type and soil management regime, the potential for carbon sequestration to be reversed, and understanding the carbon saturation point (maximum carbon storage capacity point) of soils. However, given the huge potential, the Sustainable Soils Alliance[30] has developed a set of principles that should inform the development of any soil carbon code. Given the lack of maturity no estimate for Hampshire has been included in Table 5.1.
- Hedgerow carbon. In principle the sequestration of carbon in hedgerows is similar to that of

[29] See Woodland Carbon Registry: https://woodlandcarboncode.org.uk/uk-land-carbon-registry/uk-carbon-prices
[30] Sustainable Soils alliance, see: https://sustainablesoils.org/soil-carbon-code/about-the-code

woodland, and the development of a suitable code is underway in the UK[31]. Again, given the nascent state of this code no estimate has been included for Hampshire.

BNG Credits, have become mandatory for large scale residential and commercial developments from the beginning of 2024, and present a significant opportunity for funding habitat creation or restoration. This market is supported by legal requirements and an authoritative methodology for assessing biodiversity losses and gains that may be used to compensate for those losses. From work that eftec has conducted in a previous project (confidential) the range of demand for BNG units is subject to a wide range of confidence limits, chiefly due the the varying extent to which developers can avoid greenfield developments, and the degree to which they can provide compensatory habitat on site rather than purchase off-site credits as compensation. Furthermore, the price of credits is highly variable, being determined by the local supply and demand for particular habitat types. Consequently, a broad range of value (between £3 million and £20 million per year) is assessed for the market in England. The same project was used to assess likely demand in Hampshire, which again is subject to a very wide confidence range (£0.4 to £1.2 million). **The size of this market will be determined by the scale of local development and the extent to which developers cannot mitigate the requirement for off-site compensation**. A more in-depth discussion of the BNG market is given in Section 5.33. Other voluntary biodiversity credits may emerge as funding opportunities, but these are very much in their infancy and not considered further here.

Nutrient Neutrality. The government is planning to introduce law to guide and direct the planning system to ensure that developments at least maintain nutrient neutrality (NN). In principle this system is similar to the BNG system, but for NN there is no government-mandated nationwide trading system for nutrient neutrality credits yet, and there are different methodologies for assessing the nutrient impacts and mitigation measures. In addition, the Government is planning a package of investment measures to reduce pollution at source to create scope for more housing development. Some of these could fund improvements in farming practice. However, given the lack of definition at this stage, we have not attempted to estimate the size of the market, but it does have significant potential and several schemes are under planning consideration in Hampshire and are likely to raise substantial funds for mitigation measures.

Nutrient reduction measures are aimed at reducing nutrient loading to reduce risks/costs to public water supply and the general water environment (without the aim of creating scope for further residential or commercial development). The main interested buyers are the water companies where reducing pollution at source can be less costly than investing in more expensive water treatment plant. In all the Hampshire NCAs nitrate loading is a significant problem, but this is most acute where water supply is heavily reliant on aquifers such as in the Hampshire Downs, South Downs and the Avon aquifer on the western fringe of the New Forest NCA. Whilst the water companies are spending significant sums on reducing nutrient loads from wastewater treatment works, smaller sums are being targeted at reducing diffuse pollution from agricultural sources.

Based on a paper shared by Sean Ashworth, (Southern Water, representative on the Hampshire Advisory

[31] See: https://www.forestcarbon.co.uk/news/unlocking-power-hedgerows-uk#:~:text=Hedgerow%20Carbon%20Code%20development&text=Its%20goal%20is%20to%20%E2%80%9Cunlock,up%2C%20height%2C%20and%20length.

Board) since 2021 the recent levels of spend by Southern Water on measures such as use of cover crops, reversion of arable land to low nitrate grassland and advice and assistance in use of precision fertiliser applications is at least £300k per year. The three other water companies that abstract water from Hampshire have similar programmes and assuming the same level of spend for each**, this suggests that current spending in Hampshire is around £1.2 million/year**. The water companies are preparing plans for AMP8 and are likely to increase funding on these measures. Once the water company plans are agreed for AMP8, it would be useful to compile details of the total funds available for these nutrient reduction measures.

Other payments for ecosystem services include payments for natural flood risk mitigation measures, green spaces for health and well-being, or noise mitigation and or visual impacts of transport infrastructure. Given the broad range of potential payment mechanisms for these services, and the uncertainty around how these might operate, it was not feasible to include these in our assessment of investment scale. However some of these opportunities may provide an important source of funding under the right circumstances.

Other returns category recognises that many of these investment opportunities may produce a benefit flow to the landowner/manager as a consequence, or as a by-product of the land management improvement. For example, investment in soil carbon sequestration may also increase the productivity of soils, raise food production and provide a resilience benefit to mitigate the adverse impacts of climate change. Likewise, nutrient reduction measures (such as precision application techniques) are likely to reduce fertiliser costs without adversely impacting upon food production. Woodland creation may also provide a timber or wood fuel benefit in addition to woodland carbon sequestration. These benefits may be significant but are too diverse to assess in a concise way here.

5.2 Voluntary Carbon - Woodland Carbon Code

The woodland carbon market in the UK is dominated by the **Woodland Carbon Code**[32] (WCC). This is a voluntary standard, with a code of practice developed by a consortium of stakeholders including government, forestry organisations and environmental groups. Projects complying with the Code can issue Woodland Carbon Units (WCUs), each representing one tonne of verified carbon dioxide sequestered. The quality of the credits created under the Code is ensured by a rigorous framework for verifying and validating carbon sequestration claims from the projects it covers. The WCC is thus essentially a quality mark that enhances the credibility and value of woodland carbon credits on the market. The significant weight the Code provides in the market is supported by government recognition (in light of its alignment with government policies on climate change and forestry management) and buyers value WCC-certified credits for their reliability and transparency.

The UK market has its origins in the 1990s, when projects were often driven by forward-thinking corporations or environmentalists, but awareness of the risks to its development from lack of standard methodologies and a robust market structure led the government to work with stakeholders to create the WCC, which was launched in 2011.

[32] At https://woodlandcarboncode.org.uk/uk-land-carbon-registry/uk-carbon-prices

While the Code brought order to the market, uptake remained gradual with limited demand for credits in the early years. Volumes have, however, grown significantly in recent years, with increased public focus on climate change, allied to growing pressure on corporations to set net-zero goals, boosting the demand for credible carbon offsets.

The consequent rise in prices for Woodland Carbon Units in turn incentivised more woodland creation projects and greater levels of participation by all three sets of key players – landowners / managers, brokers and investors – resulting in a market that is both active and growing.

This momentum has been further sustained by a growing awareness of the potential for the co-benefits of biodiversity alongside carbon sequestration, aligning with wider nature restoration goals and, on the policy front, by the introduction (in England) of the Woodland Carbon Guarantee (WCaG)[33]. This £50 million scheme gives landowners creating new woodlands the option (but not the obligation) to sell the carbon sequestered to the government at a guaranteed price, spread over several years. The Guarantee thus provides them with a predictable income stream, but also the potential for 'upside' via sales on the open market if this offers a better price.

The WCaG should assist the continued growth of the woodland carbon market by lowering the financial risk for landowners considering woodland projects, creating a steady demand and – via the WCaG auction process – establishing a more transparent pricing mechanism and a benchmark price.

The main 'suppliers' of potential woodland credits are landowners and managers, forestry operators and conservation organisations (which often have a strong emphasis on biodiversity and nature restoration alongside carbon benefits). There is no single dominant "creator profile" for WCC woodland projects and the scale of projects can vary from small farm initiatives to large-scale commercial ventures.

The main investors in WCC credits are corporations (to fulfil sustainability commitments or to offset residual emissions under net-zero targets) and investment funds focused on sustainability and environmental impact. These include specialist carbon funds, specifically targeting the woodland carbon market and funds more broadly addressing Environmental, Social, and Governance (ESG) goals that often include woodland carbon credits as part of their portfolio.

These investors, especially the larger ones, often operate in the market both directly (i.e. developing their own woodland projects for carbon credits) and as purchasers of credits through brokers or trading platforms. Other investors include environmentally conscious individuals (who might invest in woodland carbon credits to offset their personal carbon footprint or for speculative purposes), conservation organisations (looking to offset their operational emissions or support wider conservation goals) and the government, through the Woodland Carbon Guarantee scheme mentioned above.

Among the main brokers / developers in the market in England are **Forest Carbon**[34] and **CarbonStore**[35], both involved in all aspects of creating woodland carbon projects, providing advice and brokering credits. There are also some centralised / online platforms emerging, such as **IHS Markit Environmental**

[33] See https://www.gov.uk/guidance/woodland-carbon-guarantee
[34] At https://www.forestcarbon.co.uk/
[35] At https://carbonstoreuk.com/

Registry[36] where potential buyers and sellers can directly view listings of opportunities.

Pricing:

There are two types of unit available on the market: Pending Issuance Units (PIUs) and verified Woodland Carbon Units (WCUs). PIUs generally command a lower price than WCUs, as they represent the "promise" of a future WCU, based on the predicted amount of carbon a young woodland will sequester as it grows, but carry the risk that the full potential of that woodland will not materialise when verification occurs.

The timeframe for initial verification (validation) of the unit varies according to the type of project, but will typically be at least 5-10 years from inception, with periodic verification at similar intervals thereafter. Unit pricing between PIUs and WCUs also reflects verification costs, and although the market is complex WCUs typically command a 20-50% price premium over PIUs for the same amount of carbon sequestration.

Pricing is also affected by project type (with woodland creation projects usually trading at a premium compared to those focused solely on existing woodland management) and the existence of co-benefits (projects with, for example, biodiversity improvements, flood mitigation, or the creation of recreational areas potentially trading at higher levels).

Prices for woodland carbon credits in the UK have risen considerably in recent years, reflecting the growing demand from different investors noted above. Data from **Ecosystem Marketplace**[37] indicates that volume-weighted average prices per WCU rose from £15 in 2021 to £25 in the first half of 2023, and that volumes are around 220,000 units per year, giving an annual value of around £5 million.

Factors attracting investors: Apart from the financial returns available, investors are attracted by a number of features of the woodland carbon market, including:

- Net-Zero Alignment: Carbon credits from nature-based solutions like woodlands help companies meet their climate commitments
- Brand Reputation: Investing in woodland carbon can boost a company's sustainability image and positively impact public perception
- Co-benefits: Woodlands offer benefits beyond carbon, such as biodiversity, flood risk reduction, and community benefits, adding appeal for some investors

Issues with woodland carbon: Alongside the opportunities, there are some significant challenges for both the market generally and participants in it, including:

- Long-term commitment: Woodland projects require long-term horizons, especially because of maintenance requirements
- Price volatility: The price of carbon credits can fluctuate, making it a somewhat unpredictable investment
- Land suitability: Finding land that is right for afforestation (i.e. that avoids competing land use

[36] At https://www.spglobal.com/commodityinsights/en/ci/products/environmental-registry.html
[37] At https://www.ecosystemmarketplace.com/

demands) is critical and may limit supply

- Project expertise: Access to forestry knowledge and WCC compliance experience is essential and may prove a challenge for new entrants
- Policy influence: Government policies can significantly impact the market's scale and direction

5.3 Biodiversity Net Gain

The UK, like many countries, has witnessed a significant decline in biodiversity arising from human activity across the board from agriculture to residential and commercial development to name just a few of the drivers. As the scale of the problem has become clear, responses have emerged in two strands that are different in approach but share the same overall goal – to halt biodiversity decline and improve habitats.

These strands are, first, a regulatory approach, via the official Biodiversity Net Gain (BNG) regime imposed on developers and, second, wider biodiversity conservation efforts that are voluntary and contractual. These are described in turn below.

BNG is a regulatory tool enforced through the planning permission process for development projects. Developers must achieve a measurable 10% biodiversity net gain to secure planning approval. The regime offers developers two main ways to achieve the mandated 10% gain – onsite and offsite actions.

Ecological consultants assess the characteristics of the development site and calculate the number of Biodiversity Units (BU) required to achieve the 10% net gain. This will vary, potentially significantly, based on the biodiversity value of the site at the time of development.

The regime was introduced in the Environment Act 2021 and is being rolled out in phases:

- Phase 1, in force from February 2024, covers major developments such as large infrastructure projects and housing developments exceeding a certain size. Detailed statutory guidance is available from the government to help developers understand and meet the BNG requirements with respect to these schemes.
- Phase 2, came into force from 2 April 2024, making BNG mandatory for smaller developments (specific size thresholds apply).
- Still under discussion is a potential Phase 3, applying to Nationally Significant Infrastructure Projects (NSIPs, e.g. major energy projects, airports), from late 2025.

Onsite actions are measures taken within the development site itself to improve or create habitats. These might include, for example:

- Habitat creation: Planting trees, creating ponds, installing green roofs, or restoring degraded areas to provide suitable habitats for wildlife.
- Habitat enhancement: Improving existing habitats on the site by managing vegetation, removing invasive species, or installing features like nesting boxes.
- Integration of nature: Designing developments with nature in mind, such as creating wildlife corridors or incorporating green spaces.

Onsite actions give developers more control over the design and implementation of biodiversity improvements and can improve the aesthetics of the development and potentially enhance public perception of both the site and the developer itself. The rules also require developers to undertake work for net gain onsite in the first instance. In some instances, developers will need to turn to measures taken outside the development site to compensate for any biodiversity loss. This will be achieved through purchasing biodiversity units (BU)[38].

These tradable units represent the biodiversity value of habitat creation or improvements undertaken elsewhere, and units will typically be purchased from established 'habitat banks' or projects managed by conservation organisations or specialist companies. Benefits for developers of purchasing offsite units therefore include the opportunity to access skilled habitat developers and to avoid the need for long-term monitoring and maintenance of habitats.

Compared to the woodland credits market, the BNG market relatively new. There are 6 or so main players, the largest of which is the **Environment Bank**[39]. A specialist with local experience in Hampshire **Wild Capital**[40]. BUs are currently trading at £40-60,000 depending on the type of habitat involved.

It would appear that the market is demand-driven at quite a precise level at present – that is, BNG unit creators are responding to specific requests from developers for offsite units and seeking habitats to suit, rather than having 'off the shelf' units available. This approach is likely to change as the market becomes more mature and unit providers are confident enough of demand and pricing to start to build habitat banks, and the recent creation of funds to do this is an indication of that direction beginning to take shape.

The general assumption has been that around 10% of BUs required for development will be needed from offsite sources, but in an interview for this project one of the main BNG brokers said that the proportion was likely to be substantially higher than this. Even at the lower estimate, given that effectively all development except for small residential sites will require BNG offsets, this could create a significant market for offsite units as the regime begins to take hold. If this market materialises, it could be a substantial opportunity for landowners and farmers prepared to dedicate land to nature restoration and management. Well-designed BNG projects could also simultaneously provide ecosystem services like flood mitigation, improved water quality, and recreational green spaces, potentially adding to their income-generating potential.

Specifically regarding Hampshire, as BNG regulations kick in, websites of planning authorities like district councils may have information from time to time on:

- BNG planning policy, outlining procedures and local expectations;
- Development approvals requiring BNG, potentially referencing suppliers;
- Landowner registers if they maintain databases of those offering units;
- Wider Biodiversity Conservation Efforts, and

[38] See: https://www.gov.uk/government/publications/statutory-biodiversity-metric-tools-and-guides
[39] At https://environmentbank.com/nature-shares
[40] At https://wild-capital.co.uk/about-us/

- Priorities set for LNRS, and NCAs.

Alongside the regulatory BNG market, there is a wider set of biodiversity-related initiatives that are voluntary and contract, (rather than statute) based. Such initiatives include activities aimed at species protection, habitat management (managing existing natural areas to improve their biodiversity value, as opposed to creating new habitats) and raising both public awareness of the importance of biodiversity and public participation in conservation efforts. Examples of such activities would be protecting designated sites and areas of high biodiversity value like National Parks or Sites of Special Scientific Interest (SSSIs), conservation projects such as rewilding initiatives, restoring degraded habitats and tackling invasive species, and community engagement through volunteer-led initiatives, educational programmes, and promoting sustainable practices.

Many of these efforts will themselves be important to the BNG market over time as they inform practices that will contribute to onsite arrangements and the availability of offsite assets.

Actors and stakeholders

Landowners and farmers will clearly be critical stakeholders and actors within this wider biodiversity 'ecosystem'. Indeed they are already increasingly engaged in biodiversity projects, often through government schemes that provide incentives for managing land in ways that benefit wildlife, while biodiversity co-benefits are also frequently a part of 'green' or regenerative agricultural schemes. Some landowners independently invest in habitat restoration due to their own environmental commitment.

In terms of investors in / funders of biodiversity schemes and projects in the UK, these comprise a diverse range of entities engaging for a wide set of reasons. This is an encouraging picture in the sense that there is potentially a healthy variety of sources of funds, but a more difficult one in the sense that the market is fragmented and lacking, for example, in universally agreed metrics. Among the key actors are:

- Government Agencies and Public Bodies include Natural England, Environment Agency, Forestry England and local authorities.
- Conservation Organizations include large NGOs like RSPB, Wildlife Trusts, and the Woodland Trust acquire and manage land for nature reserves, undertaking habitat restoration and creation, and smaller, local conservation groups often focus on specific habitats or species within their area, and rewilding groups like **Rewilding Britain**[41] and **Wild Ken Hill**[42].
- Corporations with sustainability commitments, partnerships, investment funds, environmental funds and 'biodiversity investment vehicles' to focus specifically on generating returns through the BNG market and habitat restoration.
- Individuals through donations and volunteering.

Finally, biodiversity brokers are emerging to facilitate the BNG market. In the wider ecosystem they potentially have roles in assessing biodiversity value, intermediating between developers and potential providers of offsite locations, and managing longer-term projects to ensure biodiversity gains are achieved.

[41] At https://www.rewildingbritain.org.uk/
[42] At https://wildkenhill.co.uk/

Opportunities in Hampshire:

In the Hampshire context, apart from agricultural practices and woodland and hedgerow projects, three main opportunities have been identified for biodiversity projects. These are grassland, heathland, and wetland, significant areas of all of which are available at different levels of priority, each habitat providing a unique environment for different plants, animals, and ecological processes.

These different characteristics affect the type of, and potential for, biodiversity value that may be 'monetised' through biodiversity projects, either via BNG units or more bilateral / contractual arrangements. Some aspects of these differences are summarised below:

Grassland

- Characteristics: Areas dominated by grasses, with varying degrees of wildflowers, shrubs, and trees. Different types of grassland (calcareous, acid, improved) will have distinct species compositions.
- Biodiversity Focus: Birds (skylarks, meadow pipits), pollinators (bees, butterflies), small mammals (voles, shrews), specific plant communities.
- Value: Biodiversity units often reflect the difficulty of restoration (see below) and the specific species assemblages they support. Calcareous grasslands, for example, may carry higher credit value due to their unique species richness and rarity.

Heathland

- Characteristics: Low-growing, shrubby vegetation dominated by heathers, gorse, bracken with acidic, nutrient-poor soils
- Biodiversity Focus: Specialized plants, reptiles (adders, sand lizards), ground-nesting birds (nightjars, woodlarks), rare invertebrates
- Value: Heathland restoration can attract higher credits due to its rarity, difficulty of restoration, and the suite of specialised species it supports.

Wetland

- Characteristics: Range of habitats including marshes, fens, bogs, wet woodlands, reedbeds. Crucial role in water regulation and flood control
- Biodiversity Focus: Waterbirds, amphibians, dragonflies, wetland plants, fish, with specific species depending on wetland type.
- Value: Wetlands are hotspots for biodiversity but also offer carbon sequestration. Credits may reflect both habitat rarity and potential carbon benefits.

Another factor in the value of biodiversity projects / credits is the (presently informal) 'hierarchy' created by factors like difficulty of restoration and ecological rarity. These factors can have an effect in the following ways;

- Degree of difficulty in restoration/creation: Habitats requiring significant effort, time, and specialised knowledge to restore will typically have higher credit value. E.g., heathlands with specific soil conditions and plant communities, or wetlands requiring complex water management infrastructure

- Rarity: Habitats with limited distribution or facing significant decline will have higher credit value, such as: lowland heathlands, a rapidly disappearing habitat in the UK, or grasslands with unique species assemblages not found elsewhere.

5.4 Nutrient Neutrality and Nutrient Reduction

There are two main funding vehicles to address nutrient pollution and eutorphication:

- To combat the role that residential property development has in contributing to this pollution, the UK is introducing **a 'nutrient neutrality'** regime (NN). This is to specifically offset nutrient loading for new developments only.
- **Nutrient reduction measures** aim to reduce diffuse pollution at source or use nature base solutions to remove excess nutrients. These measures can be funded from a variety of sources including public (e.g., ELM options) and private (e.g., the main water companies).

NN is currently in development, with pilot schemes being undertaken to test different approaches and assess their effectiveness. Under the NN regime, developers will need to demonstrate their projects will not cause additional overall nutrient pollution in a particular area, in two main ways:

- Reducing Nutrient Load on-site: Implementing measures like Sustainable Drainage Systems (SuDS) to capture and treat rainwater runoff before it enters waterways, and
- Offsetting Measures: If on-site reductions are insufficient, developers might need to invest in nutrient mitigation projects elsewhere in the relevant catchment area. This could involve wetland restoration or working with farmers to improve nutrient management practices to reduce the load from agriculture in the area.

How a fair and workable trading system for nutrient neutrality credits can be developed, and the mechanisms for measurement and monitoring of the effectiveness of NN schemes are among the development challenges for the regime.

NN Market:

NN has certain similarities to BNG as a policy tool, and whilst in the early stages of enactment it is possible to sketch out some of the likely drivers of, and main players in, the market as it evolves. These notes refer to the offsite credits element of the regime. Key actors, and their roles, will probably be:

- Local Authorities and Planning Agencies will be the main party driving demand for nutrient neutrality credits as they enforce requirements on developers through the planning system. They will establish the neutrality requirements for their catchment areas, and might also directly manage some mitigation schemes
- Landowners and Farmers are likely to become involved as many potential nutrient neutrality projects will focus on changing land management practices on farms to reduce nutrient runoff. Landowners could become credit sellers through such schemes

- Conservation Organizations, with their experience in habitat restoration (especially wetlands) could be well-placed to create nutrient mitigation areas and generate credits

Servicing the market and assisting in its development will be environmental consultants for evidence on change in nutrient levels and 'credit brokers' might start to be seen emerging to facilitate trading, similar to the ones now present in the BNG market. In terms of monetary investment (as opposed to acquiring the credits for set-off purposes), there may be some long-term investors or funds that see the potential to invest in larger-scale nutrient mitigation projects, but it is not yet clear who these might be.

Areas around the Solent have been leading in implementing nutrient neutrality schemes due to acute pollution issues. Views from a local expert working in this sector are that the market aims to mitigate around 20,000 kg of nitrogen in Hampshire per year[43]. The value of offsets can vary but the range of £2,500 to £3,500 per kg of nitrogen is typical for 10 years of coverage. ***This indicates that the local market is worth around £5 million a year*** but the long term direction of this market (i.e. beyond 5 years) is difficult to predict. There is presently no central register tracking nutrient neutrality schemes or credit transactions in the UK. Data is mainly collected on a catchment level. An active player in the Hampshire area is Wild Capital, which has a NN pilot scheme running at Alresford and a combined NN/BNG scheme running on the Isle of Wight.

Unlike BNG, there is no government-mandated nationwide trading system for nutrient neutrality credits as yet. Many pilots are localised, making it difficult to assess the overall market size. Information about schemes and credit activity is therefore presently best sought on a catchment level, as this is how nutrient neutrality is likely to be regulated. Local Authority websites may be a first starting point, especially those of councils in areas with known nutrient pollution issues as they often provide updates on schemes and planning requirements. Planning and environmental consultants working in affected areas might have insight into ongoing projects and credit availability.

Nutrient Reduction

To avoid the high capital and operating costs of additional nitrate treatment plant and water blending, all the water companies that operate in Hampshire are offering various incentives to farmers to reduce the impacts of diffuse pollution to water sources. Some examples offered[44] under the current AMP 7 (2020-25) are:

- Cover crops (payment rate from Southern water at £80 -135/ha)
- Herbal leys (Southern Water at £400/ha)
- Soil, manure and tissue testing, crop nutrition advice at £1,500 per holding per year
- Supporting farmer knowledge exchange - workshops, support for Clusters, including specialist advisory visits

Based on the area of focus and number of farms supported by Southern Water we estimate that at least £300,000 per year has been allocated to famers to reduce diffuse nitrate pollution. Assuming the other three water companies that operate in Hampshire are funding at the same level, **we estimate that at least**

[43] Report to the Partnership for South Hampshire Joint Committee, 14 March 2024, at: https://www.push.gov.uk/work/our-meetings/joint-committee/

[44] Water Company Catchment Work Brief to Hampshire ELM Convenor Project Board, 7th November 2023

£1.2 million per year is being spent on nutrient reduction measures by water companies in Hampshire. This is likely to increase in the next planning round (AMP 8, 2025-30) and should be an important source of funding.

5.5 Supply Chain Support and Accreditation

A range of strategies is emerging as major UK food manufacturers and retailers collaborate with farmers and landowners to reduce GHG emissions in their supply chains and promote less carbon- and input-intensive land management practices. These can broadly be categorised under three headings (all described in more detail below): Sustainable sourcing programmes, Investments in innovation and Collaboration and knowledge sharing.

Sustainable Sourcing Programmes

Many major retailers and manufacturers have instigated programmes with suppliers establishing sustainability standards for their agricultural products. These standards often include requirements for practices that reduce GHG emissions and input use, promote better soils and encourage carbon sequestration. Such practices include reduced tillage, improved nutrient management, cover cropping and manure management.

Farmers meeting the standards set can gain certification and potentially enjoy benefits such as premium prices for sustainably-grown produce, technical assistance support in implementing sustainable practices through training and resources, and long-term contracts that provide farmers with more secure markets and income stability.

The programmes set up by the major manufacturers and retailers of course align with growing consumer interest in sustainably and ethically produced food. Some examples of programmes include the following (note: programmes are often multi-faceted, so links are representative samples in some cases).

- Marks & Spencer's **'Farming with Nature'**[45] programme covers meat, dairy, and produce and works with a group of some 7,000 'select' farmers providing tailored support for practices like Integrated Pest Management (IPM), precision fertiliser application and a focus on soil health and biodiversity
- Waitrose's **regenerative agriculture initiative**[46] is a newer initiative working with farmers and researchers on long-term trials and support for regenerative farming practices. These include minimal tillage systems, diversity in crop rotations, use of cover crops to improve soil health and reduce pest pressure, and agroforestry projects that integrate trees into farmscapes, adding biodiversity and providing long-term carbon storage
- Sainsbury's **agriculture, horticulture, and innovation programme**[47] covers a wide range of initiatives including pilot projects focused on use of precision technologies for fertiliser and pesticide

[45] At https://corporate.marksandspencer.com/producing-delicious-ms-quality-products-nature-friendly-ways-three-years-ms-leading-farming-nature

[46] At https://www.johnlewispartnership.co.uk/csr/our-strategy/agriculture.html

[47] At https://www.about.sainsburys.co.uk/sustainability/better-for-the-planet/agriculture

use and the provision of tools for farmers to track resource use and make data-driven management decisions.

- Nestle's **Wheat Plan**[48] is focussed on helping UK farmers to improve the sustainability of their wheat supply via biodiversity enhancement (e.g. set-aside of field margins for pollinators and beneficial insects), soil health initiatives and the adoption of IPM
- Unilever's **Sustainable Agriculture Code**[49] is a global initiative that sets standards for their agricultural supply chains. Support to UK suppliers is focussed on optimising fertiliser use (including reduction of nutrient runoff), IPM and water conservation.

It should be noted that many of the schemes being implemented include projects to improve soil health that should also have the capacity to generate soil carbon credits as the market for these gets more active and structured.

Table 5.2 Supply chain incentives for farmers

Business	Supply chain incentive	Source
Supermarkets and co-ops		
Aldi	Supports ARLA and Red Tractor suppliers Contributes £90k/year to Princes Countryside Fund	Link
Arla	Rewards farmers with higher milk price for permanent grasslands, performing soil samples or other biodiversity activities	Link
Co-op	Supports Red Tractor assured producers and gives a fair price to farmers for milk Have a two-year programme to monitor the impact of integrating sustainable farming practices within its beef supply base - involves 10% of supplier base	Link
Lidl	3-year fixed prices to allow farmers to invest in farms, including in biodiversity Supports Red Tractor or Global GAP accredited suppliers and RSPCA assured meat and poultry Premium paid to farmers for grass fed beef	Link
Marks and Spencer	Supports LEAF Marque, Red Tractor and GLOBAL G.A.P. schemes certified producers. Runs 'Farming with Nature' programme with 7,000 'select' farmers providing tailored support for practices like Integrated Pest Management (IPM), precision fertiliser application and a focus on soil health and biodiversity	Link
Morrisons	Package of support for livestock suppliers, including incentives, subsidies, discounts and advice for greener farming. 'For Farmers' milk range gives additional retail price directly back to farmers Support The Prince's Farm Resilience Programme, which provides free training in business skills to family farms	Link
OMSCO	Supports organic farming	Link
Sainsbury's	Agriculture, horticulture, and innovation programme focused on use of precision technologies for fertiliser and pesticide use and the provision of tools for farmers to track resource use and make data-driven management decisions.	Link
Tesco	Supporting all Red Tractor assured and LEAF certified suppliers and those with net zero ambitions. Committed to improving biodiversity at a landscape-scale, by supporting soil, water, pollinator and nature-based outcomes in priority locations Established the Innovation Connections fund, which saw five cutting-edge innovations receive funding and the opportunity to trial their innovations with leading Tesco suppliers.	Link

48 At https://www.nestle-cereals.com/uk/our-promises/better-planet/wheat-plan
49 At https://www.unilever.com/sustainability/nature/sustainable-and-regenerative-sourcing/

Business	Supply chain incentive	Source
Waitrose	Ambition to introduce regenerative farming techniques that focus on topsoil regeneration, improving the water cycle as well as increasing carbon capture, biodiversity and resiliance to climate change. Commitment to pay farmers a fair price and Support for LEAF certified producers Premium for Hereford/Angus beef and for their liquid milk in return for higher standards of production Working with farmers and researchers on long-term trials to support regenerative farming practices. These include minimal tillage systems, diversity in crop rotations, use of cover crops to improve soil health and reduce pest pressure, and agroforestry projects that integrate trees into farmscapes, adding biodiversity and providing long-term carbon storage.	Link
Manufacturers and other businesses		
Amazon	Supports Soil Association certified products	link
Unilever's	Sustainable Agriculture Code initiative that sets standards for their agricultural supply chains. Support to UK suppliers to optimise fertiliser use, IPM and water conservation.	Link
Nestle	Wheat Plan is focussed on helping UK farmers to improve the sustainability of their wheat supply via biodiversity enhancement, soil health initiatives and the adoption of IPM	Link
Butchers	Significant premiums paid by many butchers and other meat product retailers for regeneratively farmed beef	Link
Muller UK	Incentivises farmers to reduce emissions and improve soil health and biodiversity Muller Advantage Programme – offer support and 1p/litre extra	Link
Nestle UK	Landscape Enterprise Network (LENs) programme which supports more than 120 farmers to regenerate more than 20,000 hectares of British farmland.	Link
Ocado	Helps farmers identify and adopt practical, nature-friendly farming practices through funding of the FABulous Farmers programme. Supports British producers and Red Tractor or Bord Bia certified schemes	Link

Investing in Innovation

The second broad category of interventions is investment by manufacturers and retailers in innovation in the production and distribution of food. Many of these investments are part of the programmes mentioned above, but there are also a number of partnerships that have been established with academic institutions – for example Sainsbury/Cambridge, Waitrose/Cranfield, Nestle/Rothamstead.

Retailers and manufacturers are also involved in the network of Agri-Tech Centres that has now been established, with government backing, to drive innovation in the agricultural sector. Each of these has a centre of excellence providing specialist expertise in areas such as crop health and protection, precision agriculture, innovation in livestock management, and agrimetrics (data-driven agriculture).

As well as conducting cutting-edge research and developing new technologies, the Centres offer state-of-the-art testing facilities to help bring innovations from concept to commercialisation in the shortest possible time.

Collaboration and Knowledge Sharing

Probably the key initiative under this heading is the Sustainable Food Supply Chain Initiative (SRI), a multi-stakeholder initiative in the UK that provides a platform for food businesses, farmers, NGOs, and government representatives to work together on sustainability challenges and develop best practices for sustainable food production. These focus not just in areas like GHGs and biodiversity but across wider issues such as promoting responsible sourcing and tackling food waste.

The SRI facilitates knowledge sharing between members by organising workshops, conferences and dissemination of best practice resources, and also does advocacy work to influence government policy towards a more sustainable food system in the UK. The SRI has a diverse membership base, including major food retailers and manufacturers, agricultural organisations such as the NFU, environmental NGOs such as WWF and The Wildlife Trusts and academic institutions involved in sustainable food systems research.

Note: The SRI doesn't have a dedicated public website, but information on it can be found on the websites of some of its members, for example the **Food and Drink Federation[50].**

[50] At https://www.fdf.org.uk/fdf/what-we-do/environmental-sustainability/sustainable-supply-chains/

6. Lessons Learned & Recommendations

The outputs of this project have been set in the context of exploring how a convenor approach could work to assess and set local priorities in a "joined-up way". A key purpose of the trial is to test this approach, document lessons learned and assess the extent to which this is transferable across the country.

Key Lessons

Key learning from this work includes:

- Decisions about public and private funding need information on what is funded and what benefits can be delivered from natural assets, recognising that there can be a significant gap between the two.
- Before making decisions about how to use their land and which benefits to sell, Land owners / managers ought to have access to information on the assets they have, what benefits they provide and who may be interested in paying for those benefits.
- While we are able to quantify and value the many benefits from nature, financing potential is still emerging and/or unclear. There is a big gap between the potential benefits of nature and finance available to deliver them. This project helps address one key barrier and makes another more explicit, respectively:
    - Reducing uncertainty: Information presented here is intended to help both funders and land owners in gaining the same understanding about what is funded and what returns can be expected.
    - Clarity of objectives and making them reality: LNRSs identified priorities for local areas, which we used in our work.
- The priorities for funding needs to be supported by the involvement of the relevant stakeholders, which is why the composition of this Board and what it can do with this information is important.
- Finally, necessary time and resources should be given to enable different stakeholders to familiarise themselves with the information and language from different approaches. There is a tendency to underestimate the time needed for the information to be internalised. However, without that time, we risk selecting wrong priorities and wasting even more time, money, and more importantly, natural (and social) capital.

Recommendations

From this work we think the following are important recommendations:

- Defra increases ELM resources to fund appropriate soil health measures and encourage greater uptake of regenerative farming methods.
- That Defra consider how to gather soil sample data (capitalising on the update of SFI option SAM1) to build up a national picture of soil carbon stocks and monitor improvement over time.
- All counties (or at similar sub-national level) should have publicly available biodiversity/habitat

opportunity maps – hosted by local records centres (or similar permanent archive)

- County based (or similar) convenors to publish, periodically review, and update statements of local priorities and monitor change over time.
- To inform priorities and to monitor change overtime, all counties (or at similar sub-national level) should produce and publish periodic natural capital accounts.
- Defra to provide clarity on stacking and bundling of public and private finance, as the current uncertainty is a significant barrier to uptake of funding options.

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Appendix 1 : List of Maps

Stock & Condition Maps

BD	Biodiversity Stock: Hampshire Downs	https://Environment Systems.co.uk/hampshire/39_NCA_Hampshire_Downs_Biodiversity_Stock.png
BD	Biodiversity Stock: New Forest	https://Environment Systems.co.uk/hampshire/40_NCA_New_Forest_Biodiversity_Stock.png
BD	Biodiversity Stock: South Downs	https://Environment Systems.co.uk/hampshire/41_NCA_South_Downs_Biodiversity_Stock.png
BD	Biodiversity Stock: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/42_NCA_South_Hampshire_Lowlands_Biodiversity_Stock.png
BD	Biodiversity Stock: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/43_NCA_Thames_Basin_Heaths_Biodiversity_Stock.png
BD	Biodiversity Stock: Wealden Greensand	https://Environment Systems.co.uk/hampshire/44_NCA_Wealden_Greensand_Biodiversity_Stock.png
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BD	Grassland Ecological Network: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/54_NCA_South_Hampshire_Lowlands_Grassland_Ecological_Network.png
BD	Grassland Ecological Network: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/55_NCA_Thames_Basin_Heaths_Grassland_Ecological_Network.png
BD	Grassland Ecological Network: Wealden Greensand	https://Environment Systems.co.uk/hampshire/56_NCA_Wealden_Greensand_Grassland_Ecological_Network.png
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BD	Woodland Ecological Network: New Forest	https://Environment Systems.co.uk/hampshire/58_NCA_New_Forest_Woodland_Ecological_Network.png
BD	Woodland Ecological Network: South Downs	https://Environment Systems.co.uk/hampshire/59_NCA_South_Downs_Woodland_Ecological_Network.png
BD	Woodland Ecological Network: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/60_NCA_South_Hampshire_Lowlands_Woodland_Ecological_Network.png

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BD	Biodiversity Hotspots: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/108_NCA_South_Hampshire_Lowlands_Biodiversity_Hotspot.png
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BD	Biodiversity Hotspots: Wealden Greensand	https://Environment Systems.co.uk/hampshire/110_NCA_Wealden_Greensand_Biodiversity_Hotspot.png
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BD	SSSI Condition: New Forest	https://Environment Systems.co.uk/hampshire/NCA_New_Forest_SSSI_Condition.png
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BD	SSSI Condition: Wealden Greensand	https://Environment Systems.co.uk/hampshire/NCA_Wealden_Greensand_SSSI_Condition.png
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Soil	Soil Carbon Stock: New Forest	https://envsys.co.uk/hampshire/46_New_Forest_Carbon_Stock_v4.png
Soil	Soil Carbon Stock: South Downs	https://envsys.co.uk/hampshire/47_South_Downs_Carbon_Stock_v4.png
Soil	Soil Carbon Stock: South Hampshire Lowlands	https://envsys.co.uk/hampshire/48_South_Hampshire_Lowlands_Carbon_Stock_v4.png
Soil	Soil Carbon Stock: Thames Basin Heaths	https://envsys.co.uk/hampshire/49_Thames_Basin_Heaths_Carbon_Stock_v4.png
Soil	Soil Carbon Stock: Wealden Greensand	https://envsys.co.uk/hampshire/50_Wealden_Greensand_Soil_Carbon_Stock_v4.png
Vegetation	Vegetation Carbon Storage: Hampshire Downs	https://Environment Systems.co.uk/hampshire/111_NCA_Hampshire_Downs_Veg_Carbon_Storage_v2.png
Vegetation	Vegetation Carbon Storage: New Forest	https://Environment Systems.co.uk/hampshire/112_NCA_New_Forest_Veg_Carbon_Storage_v2.png
Vegetation	Vegetation Carbon Storage: South Downs	https://Environment Systems.co.uk/hampshire/113_NCA_South_Downs_Veg_Carbon_Storage_v2.png
Vegetation	Vegetation Carbon Storage: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/114_NCA_South_Hampshire_Lowlands_Veg_Carbon_Storage_v2.png
Vegetation	Vegetation Carbon Storage: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/115_NCA_Thames_Basin_Heaths_Veg_Carbon_Storage_v2.png
Vegetation	Vegetation Carbon Storage: Wealden Greensand	https://Environment Systems.co.uk/hampshire/116_NCA_Wealden_Greensand_Veg_Carbon_Storage_v2.png

Water	WQ Regulation Stock: Hampshire Downs	https://Environment Systems.co.uk/hampshire/81_NCA_Hampshire_Downs_Water_Quality_Regulation_Stock.png
Water	WQ Regulation Stock: New Forest	https://Environment Systems.co.uk/hampshire/82_NCA_New_Forest_Water_Quality_Regulation_Stock.png
Water	WQ Regulation Stock: South Downs	https://Environment Systems.co.uk/hampshire/83_NCA_South_Downs_Water_Quality_Regulation_Stock.png
Water	WQ Regulation Stock: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/84_NCA_South_Hampshire_Lowlands_Water_Quality_Regulation_Stock.png
Water	WQ Regulation Stock: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/85_NCA_Thames_Basin_Heaths_Water_Quality_Regulation_Stock.png
Water	WQ Regulation Stock: Wealden Greensand	https://Environment Systems.co.uk/hampshire/86_NCA_Wealden_Greensand_Water_Quality_Regulation_Stock.png
Water	Overall WFD Condition; Hampshire Downs	https://Environment Systems.co.uk/hampshire/NCA_Hampshire_Downs_WFD_Condition_Overall_Condition.png
Water	Overall WFD Condition; New Forest	https://Environment Systems.co.uk/hampshire/NCA_New_Forest_WFD_Condition_Overall.png
Water	Overall WFD Condition; South Downs	https://Environment Systems.co.uk/hampshire/NCA_South_Downs_WFD_Condition_Overall.png
Water	Overall WFD Condition; South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/NCA_South_Hampshire_Lowlands_WFD_Condition_Overall.png
Water	Overall WFD Condition; Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/NCA_Thames_Basin_Heaths_WFD_Condition_Overall.png
Water	Overall WFD Condition; Wealden Greensand	https://Environment Systems.co.uk/hampshire/NCA_Wealden_Greensand_WFD_Condition_Overall.png
Water	Surface water regulation stock: Hampshire Downs	https://Environment Systems.co.uk/hampshire/75_NCA_Hampshire_Downs_Surface_Water_Regulation_Stock.png
Water	Surface water regulation stock: New Forest	https://Environment Systems.co.uk/hampshire/76_NCA_New_Forest_Surface_Water_Regulation_Stock_v2.png
Water	Surface water regulation stock: South Downs	https://Environment Systems.co.uk/hampshire/77_NCA_South_Downs_Surface_Water_Regulation_Stock.png
Water	Surface water regulation stock: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/78_NCA_South_Hampshire_Lowlands_Surface_Water_Regulation_Stock.png
Water	Surface water regulation stock: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/79_NCA_Thames_Basin_Heaths_Surface_Water_Regulation_Stock.png

Water	Surface water regulation stock: Wealden Greensand	https://Environment Systems.co.uk/hampshire/80_NCA_Wealden_Greensand_Surface_Water_Regulation_Stock.png
Water	Drought Mitigation Stock: Hampshire Downs	https://Environment Systems.co.uk/hampshire/93_NCA_Hampshire_Downs_Drought_Mitigation_Stock.png
Water	Drought Mitigation Stock: New Forest	https://Environment Systems.co.uk/hampshire/94_NCA_New_Forest_Drought_Mitigation_Stock.png
Water	Drought Mitigation Stock: South Downs	https://Environment Systems.co.uk/hampshire/95_NCA_South_Downs_Drought_Mitigation_Stock.png
Water	Drought Mitigation Stock: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/96_NCA_South_Hampshire_Lowlands_Drought_Mitigation_Stock.png
Water	Drought Mitigation Stock: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/97_NCA_Thames_Basin_Heaths_Drought_Mitigation_Stock.png
Water	Drought Mitigation Stock: Wealden Greensand	https://Environment Systems.co.uk/hampshire/98_NCA_Wealden_Greensand_Drought_Mitigation_Stock.png
Water	Current Groundwater quality chemical status	https://envsys.co.uk/hampshire/207_Current_groundwater_quality_chemical_status.png
Agriculture	Agriculture Production stock Hampshire Downs	https://Environment Systems.co.uk/hampshire/87_NCA_Hampshire_Downs_Agricultural_Production_Stock.png
Agriculture	Agriculture Production stock New Forest	https://Environment Systems.co.uk/hampshire/88_NCA_New_Forest_Agricultural_Production_Stock.png
Agriculture	Agriculture Production stock South Downs	https://Environment Systems.co.uk/hampshire/89_NCA_South_Downs_Agricultural_Production_Stock.png
Agriculture	Agriculture Production stock South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/90_NCA_South_Hampshire_Lowlands_Agricultural_Production_Stock.png
Agriculture	Agriculture Production stock Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/91_NCA_Thames_Basin_Heaths_Agricultural_Production_Stock.png
Agriculture	Agriculture Production stock Wealden Greensand	https://Environment Systems.co.uk/hampshire/92_NCA_Wealden_Greensand_Agricultural_Production_Stock.png
Agriculture	Agriculture Land Classification	https://Environment Systems.co.uk/hampshire/Hampshire_ALC.png

Risk Maps

Soil	Soil Erosion Risk: Hampshire Downs	https://Environment_Systems.co.uk/hampshire/99_NCA_Hampshire_Downs_Soil_Erosion_Risk.png
Soil	Soil Erosion Risk: New Forest	https://Environment_Systems.co.uk/hampshire/100_NCA_New_Forest_Soil_Erosion_Risk.png
Soil	Soil Erosion Risk: South Downs	https://Environment_Systems.co.uk/hampshire/101_NCA_South_Downs_Soil_Erosion_Risk.png
Soil	Soil Erosion Risk: South Hampshire Lowlands	https://Environment_Systems.co.uk/hampshire/102_NCA_South_Hampshire_Lowlands_Soil_Erosion_Risk.png
Soil	Soil Erosion Risk: Thames Basin Heaths	https://Environment_Systems.co.uk/hampshire/103_NCA_Thames_Basin_Heaths_Soil_Erosion_Risk.png
Soil	Soil Erosion Risk: Wealden Greensand	https://Environment_Systems.co.uk/hampshire/104_NCA_Wealden_Greensand_Soil_Erosion_Risk.png
Climate Change	Areas where Agricultural Production is Currently Limited by Drought: Hampshire Downs	https://Environment Systems.co.uk/hampshire/123_NCA_Hampshire_Downs_Ag_Production_Currently_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Currently Limited by Drought: New Forest	https://Environment Systems.co.uk/hampshire/124_NCA_New_Forest_Ag_Production_Currently_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Currently Limited by Drought: South Downs	https://Environment Systems.co.uk/hampshire/125_NCA_South_Downs_Ag_Production_Currently_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Currently Limited by Drought: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/126_NCA_South_Hampshire_Lowlands_Ag_Production_Currently_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Currently Limited by Drought: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/127_NCA_Thames_Basin_Heaths_Ag_Production_Currently_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Currently Limited by Drought: Wealden Greensand	https://Environment Systems.co.uk/hampshire/128_NCA_Wealden_Greensand_Ag_Production_Currently_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Predicted to be Limited by Drought (2080M): Hampshire Downs	https://Environment Systems.co.uk/hampshire/129_NCA_Hampshire_Downs_Ag_Production_Predicted_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Predicted to be Limited by Drought (2080M): New Forest	https://Environment Systems.co.uk/hampshire/130_NCA_New_Forest_Ag_Production_Predicted_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Predicted to be Limited by Drought (2080M): South Downs	https://Environment Systems.co.uk/hampshire/131_NCA_South_Downs_Ag_Production_Predicted_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Predicted to be Limited by Drought (2080M): South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/132_NCA_South_Hampshire_Lowlands_Ag_Production_Predicted_Drought_Limited.png
Climate Change	Areas where Agricultural Production is Predicted to be Limited by Drought (2080M): Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/133_NCA_Thames_Basin_Heaths_Ag_Production_Predicted_Drought_Limited.png

Climate Change	Areas where Agricultural Production is Predicted to be Limited by Drought (2080M): Wealden Greensand	https://Environment Systems.co.uk/hampshire/134_NCA_Wealden_Greensand_Ag_Production_Predicted_Drought_Limited.png
Climate Change	Predicted Change in Annual Average Rainfall (Present Day-2080): Hampshire Downs	https://Environment Systems.co.uk/hampshire/141_Climate_Change_AAR_Change_Hampshire_Downs.png
Climate Change	Predicted Change in Annual Average Rainfall (Present Day-2080): New Forest	https://Environment Systems.co.uk/hampshire/142_Climate_Change_AAR_Change_New_Forest.png
Climate Change	Predicted Change in Annual Average Rainfall (Present Day-2080): South Downs	https://Environment Systems.co.uk/hampshire/143_Climate_Change_AAR_Change_South_Downs.png
Climate Change	Predicted Change in Annual Average Rainfall (Present Day-2080): South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/144_Climate_Change_AAR_Change_South_Hampshire_Lowlands.png
Climate Change	Predicted Change in Annual Average Rainfall (Present Day-2080): Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/145_Climate_Change_AAR_Change_Thames_Basin_Heaths.png
Climate Change	Predicted Change in Annual Average Rainfall (Present Day-2080): Wealden Greensand	https://Environment Systems.co.uk/hampshire/146_Climate_Change_AAR_Change_Wealden_Greensand.png
Climate Change	Predicted Change in Precipitation of the Wettest Quarter (Present Day-2080): Hampshire Downs	https://Environment Systems.co.uk/hampshire/153_Climate_Change_Predicted_Change_in_Precipitation_of_the_Wettest_Quarter_Present_Day-2080_Hampshire_Downs.png
Climate Change	Predicted Change in Precipitation of the Wettest Quarter (Present Day-2080): New Forest	https://Environment Systems.co.uk/hampshire/154_Climate_Change_Predicted_Change_in_Precipitation_of_the_Wettest_Quarter_Present_Day-2080_New_Forest.png
Climate Change	Predicted Change in Precipitation of the Wettest Quarter (Present Day-2080): South Downs	https://Environment Systems.co.uk/hampshire/155_Climate_Change_Predicted_Change_in_Precipitation_of_the_Wettest_Quarter_Present_Day-2080_South_Downs.png
Climate Change	: Predicted Change in Precipitation of the Wettest Quarter (Present Day-2080): South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/156_Climate_Change_Predicted_Change_in_Precipitation_of_the_Wettest_Quarter_Present_Day-2080_South_Hampshire_Lowlands.png
Climate Change	Predicted Change in Precipitation of the Wettest Quarter (Present Day-2080): Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/157_Climate_Change_Predicted_Change_in_Precipitation_of_the_Wettest_Quarter_Present_Day-2080_Thames_Basin_Heaths.png
Climate Change	: Predicted Change in Precipitation of the Wettest Quarter (Present Day-2080): Wealden Greensand	https://Environment Systems.co.uk/hampshire/158_Climate_Change_Predicted_Change_in_Precipitation_of_the_Wettest_Quarter_Present_Day-2080_Wealden_Greensand.png
Climate Change	Predicted Change in Precipitation of the Driest Quarter (Present Day-2080): Hampshire Downs	https://Environment Systems.co.uk/hampshire/159_Climate_Change_Predicted_Change_in_Precipitation_of_the_Driest_Quarter_Present_Day-2080_Hampshire_Downs.png

Climate Change	Predicted Change in Precipitation of the Driest Quarter (Present Day-2080): New Forest	https://Environment Systems.co.uk/hampshire/160_Climate_Change_Predicted_Change_in_Precipitation_of_the_Driest_Quarter_Present_Day-2080_New_Forest.png
Climate Change	Predicted Change in Precipitation of the Driest Quarter (Present Day-2080): South Downs	https://Environment Systems.co.uk/hampshire/161_Climate_Change_Predicted_Change_in_Precipitation_of_the_Driest_Quarter_Present_Day-2080_South_Downs.png
Climate Change	Predicted Change in Precipitation of the Driest Quarter (Present Day-2080): South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/162_Climate_Change_Predicted_Change_in_Precipitation_of_the_Driest_Quarter_Present_Day-2080_South_Hampshire_Lowlands.png
Climate Change	Predicted Change in Precipitation of the Driest Quarter (Present Day-2080): Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/163_Climate_Change_Predicted_Change_in_Precipitation_of_the_Driest_Quarter_Present_Day-2080_Thames_Basin_Heaths.png
Climate Change	Predicted Change in Precipitation of the Driest Quarter (Present Day-2080): Wealden Greensand	https://Environment Systems.co.uk/hampshire/164_Climate_Change_Predicted_Change_in_Precipitation_of_the_Driest_Quarter_Present_Day-2080_Wealden_Greensand.png
Climate Change	Predicted Change in Agricultural land Classification Grade: Hampshire Downs	https://Environment Systems.co.uk/hampshire/135_NCA_Hampshire_Downs_Predicted_Change_ALC_Grade.png
Climate Change	Predicted Change in Agricultural land Classification Grade: New Forest	https://Environment Systems.co.uk/hampshire/136_NCA_New_Forest_Predicted_Change_ALC_Grade.png
Climate Change	Predicted Change in Agricultural land Classification Grade: South Downs	https://Environment Systems.co.uk/hampshire/137_NCA_South_Downs_Predicted_Change_ALC_Grade.png
Climate Change	Predicted Change in Agricultural land Classification Grade: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/138_NCA_South_Hampshire_Lowlands_Predicted_Change_ALC_Grade.png
Climate Change	Predicted Change in Agricultural land Classification Grade: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/139_NCA_Thames_Basin_Heaths_Predicted_Change_ALC_Grade.png
Climate Change	Predicted Change in Agricultural land Classification Grade: Wealden Greensand	https://Environment Systems.co.uk/hampshire/140_NCA_Wealden_Greensand_Predicted_Change_ALC_Grade.png
Features	Designated areas, common land and flood zones Hampshire Downs	https://Environment Systems.co.uk/hampshire/165_NCA_Hampshire_Downs_Limitations.png
Features	Designated areas, common land and flood zones New Forest	https://Environment Systems.co.uk/hampshire/166_NCA_New_Forest_Limitations.png
Features	Designated areas, common land and flood zones South Downs	https://Environment Systems.co.uk/hampshire/167_NCA_South_Downs_Limitations.png

Features	Designated areas, common land and flood zones South Hampshire Lowlands	https://Environment_Systems.co.uk/hampshire/168_NCA_South_Hampshire_Lowlands_Limitations.png
Features	Designated areas, common land and flood zones Thames Basin Heaths	https://Environment_Systems.co.uk/hampshire/169_NCA_Thames_Basin_Heaths_Limitations.png
Features	Designated areas, common land and flood zones Wealden Greensand	https://Environment_Systems.co.uk/hampshire/170_NCA_Wealden_Greensand_Limitations.png

Opportunity maps		
BD	**Opportunities to Enhance Biodiversity: Legend for next six pams**	https://Environment Systems.co.uk/hampshire/184a_Opportunities_to_Enhance_Biodiversity_Legend_v2.png
BD	Opportunities to Enhance Biodiversity: Hampshire Downs	https://Environment Systems.co.uk/hampshire/183_Opportunities_to_Enhance_Biodiversity_Hampshire_Downs_v3.png
BD	Opportunities to Enhance Biodiversity: New Forest	https://Environment Systems.co.uk/hampshire/184_Opportunities_to_Enhance_Biodiversity_New_Forest_v3.png
BD	Opportunities to Enhance Biodiversity: South Downs	https://Environment Systems.co.uk/hampshire/185_Opportunities_to_Enhance_Biodiversity_South_Downs_v3.png
BD	Opportunities to Enhance Biodiversity: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/186_Opportunities_to_Enhance_Biodiversity_South_Hampshire_Lowlands_v3.png
BD	Opportunities to Enhance Biodiversity: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/187_Opportunities_to_Enhance_Biodiversity_Thames_Basin_Heaths_v3.png
BD	Opportunities to Enhance Biodiversity: Wealden Greensand	https://Environment Systems.co.uk/hampshire/188_Opportunities_to_Enhance_Biodiversity_Wealden_Greensand_v3.png
Soil	Potential Gain in Soil Carbon Stock: Hampshire Downs	https://Environment Systems.co.uk/hampshire/171_NCA_Hampshire_Downs_Prioritised_Potential_Soil_Carbon_Gain.png
Soil	Potential Gain in Soil Carbon Stock: New Forest	https://Environment Systems.co.uk/hampshire/172_NCA_New_Forest_Prioritised_Potential_Soil_Carbon_Gain.png
Soil	Potential Gain in Soil Carbon Stock: South Downs	https://Environment Systems.co.uk/hampshire/173_NCA_South_Downs_Prioritised_Potential_Soil_Carbon_Gain.png
Soil	Potential Gain in Soil Carbon Stock: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/174_NCA_South_Hampshire_Lowlands_Prioritised_Potential_Soil_Carbon_Gain.png
Soil	Potential Gain in Soil Carbon Stock: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/175_NCA_Thames_Basin_Heaths_Prioritised_Potential_Soil_Carbon_Gain.png
Soil	Potential Gain in Soil Carbon Stock: Wealden Greensand	https://Environment Systems.co.uk/hampshire/176_NCA_Wealden_Greensand_Prioritised_Potential_Soil_Carbon_Gain.png
Soil	Opportunities to Reduce Soil Erosion Risk: Hampshire Downs	https://Environment Systems.co.uk/hampshire/177_NCA_Hampshire_Downs_opp_reduce_soil_erosion_risk.png
Soil	Opportunities to Reduce Soil Erosion Risk: New Forest	https://Environment Systems.co.uk/hampshire/178_NCA_New_Forest_opp_reduce_soil_erosion_risk.png
Soil	Opportunities to Reduce Soil Erosion Risk: South Downs	https://Environment Systems.co.uk/hampshire/179_NCA_South_Downs_opp_reduce_soil_erosion_risk.png
Soil	Opportunities to Reduce Soil Erosion Risk: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/180_NCA_South_Hampshire_Lowlands_opp_reduce_soil_erosion_risk.png

Soil	Opportunities to Reduce Soil Erosion Risk: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/181_NCA_Thames_Basin_Heaths_opp_reduce_soil_erosion_risk.png
Soil	Opportunities to Reduce Soil Erosion Risk: Wealden Greensand	https://Environment Systems.co.uk/hampshire/182_NCA_Wealden_Greensand_opp_reduce_soil_erosion_risk.png
Water	Opportunities to Improve Surface Water Quality - with habitat opportunities: Hampshire Downs	https://Environment Systems.co.uk/hampshire/208_Opportunities_to_Improve_Surface_Water_Quality_with_habitat_opportunities_Hampshire_Downs.png
Water	Opportunities to Improve Surface Water Quality - with habitat opportunities: New Forest	https://Environment Systems.co.uk/hampshire/209_Opportunities_to_Improve_Surface_Water_Quality_with_habitat_opportunities_New_Forest.png
Water	Opportunities to Improve Surface Water Quality - with habitat opportunities: South Downs	https://Environment Systems.co.uk/hampshire/210_Opportunities_to_Improve_Surface_Water_Quality_with_habitat_opportunities_South_Downs.png
Water	Opportunities to Improve Surface Water Quality - with habitat opportunities: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/211_Opportunities_to_Improve_Surface_Water_Quality_with_habitat_opportunities_South_Hampshire_Lowlands.png
Water	Opportunities to Improve Surface Water Quality - with habitat opportunities: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/212_Opportunities_to_Improve_Surface_Water_Quality_with_habitat_opportunities_Thames_Basin_Heaths.png
Water	Opportunities to Improve Surface Water Quality - with habitat opportunities: Wealden Greensand	https://Environment Systems.co.uk/hampshire/213_Opportunities_to_Improve_Surface_Water_Quality_with_habitat_opportunities_Wealden_Greensand.png
Water	Opportunities to Improve Groundwater Quality: Hampshire Downs	https://Environment Systems.co.uk/hampshire/195_Hampshire_Downs_prio_opp_improve_GW_water_quality_v2.png
Water	Opportunities to Improve Groundwater Quality: New Forest	https://Environment Systems.co.uk/hampshire/196_New_Forest_prio_opp_improve_GW_water_quality.png
Water	Opportunities to Improve Groundwater Quality: South Downs	https://Environment Systems.co.uk/hampshire/197_South_Downs_prio_opp_improve_GW_water_quality.png
Water	Opportunities to Improve Groundwater Quality: South Hampshire Lowlands	https://Environment Systems.co.uk/hampshire/198_South_Hampshire_Lowlands_prio_opp_improve_GW_water_quality.png
Water	Opportunities to Improve Groundwater Quality: Thames Basin Heaths	https://Environment Systems.co.uk/hampshire/199_Thames_Basin_Heaths_prio_opp_improve_GW_water_quality.png
Water	Opportunities to Improve Groundwater Quality: Wealden Greensand	https://Environment Systems.co.uk/hampshire/200_Wealden_Greensand_prio_opp_improve_GW_water_quality.png

Appendix 2 Estimating the Economic Value of Natural Capital Benefits

This Appendix presents the methodologies, data and assumptions behind the quantification and monetary valuation of each benefit that is included in the assessment. Each benefit listed here is assessed in physical and monetary terms using 2023 as the assessment year. Prices have been adjusted to 2023 levels using HM Treasury indices.

A2.1.1 Food Provision

Crops

The area for each crop type grown in Hampshire was provided by CROME Land Use data (Defra (2021)), which subdivided the data into the six National Character Areas (NCAs). The crops were grouped into cereal crops, legumes, maize and beet, vegetables and oil crops and were reported in these categories. An assumed 3-year average crop yield for each crop type in the UK (Redman G, 2021, 2022 & 2023) was multiplied by the area of each crop type, to give the total estimated yield, in tonnes, of each crop by NCA. We assumed the area and yield remain constant over time. The 3-year average gross margin per tonne of each crop was used to calculate the annual benefit of each crop type in each NCA (Redman G, 2021, 2022 & 2023).

Livestock

The total number of sheep and cattle in each NCA in Hampshire was provided by Defra (2022a) and the data clipped to each NCA area by special request. The numbers of livestock were divided into the age and type categories in order to establish the productive proportions of each livestock type. This was done by dividing the total herd stock into the same proportions as those provided for the whole of Hampshire (from Defra (2022b). The categories are listed below in Appendix Table 1 .

Appendix Table 1 Categories used in calculations for sheep, dairy and beef output

	Sheep	Dairy Herd	Beef Herd
Productive output calculated on:	Lambs under 1 yr	Dairy breeding herd	Beef breeding herd Beef female 2yr+ no offspring Beef female 1-2yr Beef female < 1yr Male 2 years and over Male less than 2yrs, plus 12.5% of dairy herd
Non-productive herd included	Breeding ewes Rams Other sheep > 1 year	Dairy female 2yr+ no offspring Dairy female 1-2yr Dairy female < 1yr	

Lamb output and gross margin. Lamb output was calculated by multiplying the number of lambs produced annually by a typical deadweight per lamb (ADHB 2023b). Gross margin of lamb production was calculated from the 3-year average gross margin per ewe multiplied by the number of breeding ewes to estimate the total gross margin from sheep farming in each NCA (Redman G, 2021, 2022 & 2023).

Dairy. Milk production quantity was estimated using the number of cows in the breeding herd and the 3-year average milk production per cow (AHDB, 2023a) at 8,160 litres per cow. The 3-year average gross margin per cow was used to calculate the total monetary benefit of dairy farming in each NCA (Redman G, 2021, 2022 & 2023).

Beef. An estimated proportion of each category in the beef herd that enters the food chain each year was provided by Strutt and Parker. The 3-year average liveweight of store cattle (Redman G, 2021, 2022 & 2023) and the average cattle deadweight (AHDB, 2023b) were used to estimate the total tonnes of liveweight and deadweight of beef entering the food chain annually in each NCA. The 3-year average gross margin per head of store cattle (Redman G, 2021, 2022 & 2023) was applied to the total heads of livestock entering the foodchain, to estimate the total benefit of beef farming provided in each NCA.Carbon sequestration

The areas of carbon sequestering habitats in each NCA were taken from the Asset Register, and grouped into the categories shown below in Appendix Table 2 , along with their estimated carbon sequestration rates. Although there are estimated carbon sequestration rates available for different grassland types, this was not used in the calculations as they were considered to carry too much uncertainty due to their dependence on management approaches used.

Appendix Table 2 The categories used to estimate carbon sequestration and sequestration rates

Habitat Type	Sequestration rates (tCO_2 e/ha)	Source
Broadleaved, mixed, and yew woodland (including wet woodland)	5.7	ONS (2019) Forestry Commission (2017)
Coniferous woodland	5.7	
PAWS - Plantations on ancient woodland sites	5.7	
Traditional orchard	2.9	Gregg et al. (2021)
Wood Pasture/parkland	2.9	
Saltmarsh	5.2	
Wetland fen	0.9	
Hedgerows	2.0	Natural England (2021)

The areas of each habitat were multiplied by the relevant CO_2 equivalent sequestration rate per hectare, to estimate the total tonnes of carbon sequestered in each NCA by habitat. The monetary value of the carbon sequestered and emitted was calculated using the central estimate for the non-traded price of carbon for 2022 (Department for Energy Security and Net Zero, 2023), inflated to 2023 prices - £273 per tonne CO_2. Sequestration rates are assumed to remain constant over time.

A2.1.2 Carbon emissions

Emissions from crops. The tonnes of each crop type included in the food provision calculations were multiplied by the estimated tonnes of CO_2 equivalent emitted by each crop type as estimated by recent research in the UK (CHAP & AHDB, 2022), to calculate the total tonnes emitted by cropland in each NCA (see Appendix Table 3). The cost of these emissions to society (the disbenefit) was calculated using the non-traded price of carbon as in the carbon sequestration values above.

Appendix Table 3: Low, mean and high GHG emissions intensity for UK crops (tCO_2e/t crop)

Crop	Low	Mean	High
Spring Barley	0.29	0.32	0.71
Winter Barley	0.30	0.34	0.73
Spring Wheat	0.12	0.34	0.93
Winter Wheat	0.12	0.34	0.93
Spring Oats	0.24	0.31	0.38
Winter Oats	0.24	0.31	0.38
Winter Rye	0.30	0.32	0.34
Winter Triticale	0.30	0.32	0.34
Spring Field beans	-	0.10	-
Winter Field beans	-	0.10	-
Spring Peas	-	0.41	-
Beet		0.12	
Maize	0.34	0.47	1.38
Potato	0.08	0.22	0.36
Winter Oilseed	0.64	0.7	1.00

Emissions from livestock. The emissions from dairy were estimated using the litres of milk included in the food provision calculations and the average kg CO_2 equivalent per litre of milk (AHDB, 2014), converted to tCO_2e. Beef and sheep emissions were calculated using the deadweight of lambs and beef entering in food chain, as estimated in the food provision calculations, and converted to tCO_2e (AHDB, 2014). Conversion factors used are shown in Appendix Table 4. All monetary values were calculated by multiplying the DESNZ (2023) non-traded carbon values.

Appendix Table 4: Low, mean and high GHG emissions intensity milk, beef and lamb production

Output type	Low	Mean	High
Milk (KgCO_2e/litre)	0.80	1.20	2.10
Beef (KgCO_2e/ Kg deadweight)	5.60	23.40	55.00
Lamb (KgCO_2e/ Kg deadweight)	13.70	25.20	41.90

A2.1.3 Recreation

Recreational benefit is measured in terms of the number of visits to accessible greenspaces, and the average welfare value associated with these visits. This benefit is estimated by the number of visits and welfare value per visit. The online tool ORVal[51] is used to for this purpose. The physical flow (number of annual visits) and monetary value (welfare value) is assumed to remain constant over time.

It should be noted that the data from ORVal considers the location of the recreation asset, surrounding population, habitat type(s) and local alternatives, but makes the assumption that accessible green space is in average condition for its type. If the green space is in a better (worse) condition than average, this will likely have higher (lower) values for number and welfare value of visits. Similarly, as the model underlying ORVal is based on MENE data[52], it does not take into account visits by children or overseas visitors to the UK.

ORVal data is available at the Middle Layer Super Output Area (MSOA) level. However, because MSOAs don't align with the six NCAs included in this project, proportions were taken corresponding to the proportion of an MSOA located within an NCA. This was achieved by using QGIS to clip the MSOA boundary shapefile by NCA and calculating the area of polygons in the clipped layer. A spatial join was then carried out so that the area data from the clipped polygons were represented as attributes in the original MSOA data. The data was then exported to excel and the area attributes were used to calculate the proportions with which an MSOA intersects a given NCA. This dataset was matched to the ORVal data using an index match. Finally, the ORVal data was weighted according to the proportion of the MSOA located within a given NCA to estimate the total outdoor recreational welfare by NCA.

A2.1.4 Physical health benefits from recreation

Recreation can also have measurable physical health benefits, if visitors are physically active during their visits. This benefit is estimated by using the ORVal visitor data and calculating the proportion of the visits that are active, as per White et al (2016) who estimated that 51.5% of all recreational visits are active. The health benefits of active recreation (in terms of improvements in Quality Adjusted Life years – QALYs[53]) and

[51] ORVal is a spatial model that shows the recreational sites, number of visits and the benefit to visitors using data from mapping tools, Monitor of Engagement in Natural Environment (MENE) survey and economic valuation literature. University of Exeter (2018) ORVal v2.0 - The Outdoor Recreational. https://www.leep.exeter.ac.uk/orval/

[52] See: https://www.gov.uk/government/collections/monitor-of-engagement-with-the-natural-environment-survey-purpose-and-results

[53] QALY is a health measurement used widely in health and health economics research. QALY of zero denotes death, and 1 denotes full health.

the economic value of health improvement (in terms of the avoided health cost due to improvement in QALY).

Beale et al. (2007) analysed Health Survey for England data, estimating that 30 minutes a week of moderate-intense physical exercise, if undertaken 52 weeks a year, would be associated with 0.0107 QALYs per individual per year. Beale et al. (2007) assume this relationship between physical activity and QALYs is both cumulative and linear. Claxton et al. (2015) estimate a cost-effectiveness threshold of a QALY to be roughly £12,900/QALY in 2008 prices. This figure is used as a proxy for health costs, reflecting the avoided health costs when QALY is improved by one unit. Based on this information, the avoided health cost is estimated as £3.65 in 2023 prices. The monetary unit value is assumed to remain constant over time.

We assume that all visits are active (involving more than 30 minutes exercise) and hence use a value of £3.65 per visit.

A2.1.5 Renewable energy

The renewable energy benefit is estimated by the installed capacity of solar photovoltaic (kW) in each NCA. The dataset of installed capacity by site came from (DESNZ, 2024). In order to calculate the installed capacity for each NCA, the data was uploaded into QGIS and the NCA each solar site is located in was added as an attribute via a spatial join. It is assumed renewable energy generation remains constant over time. A gross value of £50 per MWh (Goodall, C., 2022) and 15% (Cathcart, R., 2023) return was used to calculate the solar electricity margin (i.e. £7.50 per MWh). Output was calculated based on 950 kWh generated per kWp of installed electric capacity (Exeo Energy, 2024).

A2.1.6 Air quality regulation

Air quality benefit arises from the ability of different types of vegetation to remove PM2.5 from the air and the human health benefits of this removal. Jones et al. (2017) modelled this benefit for the UK national accounts reflecting the variety of different levels of PM2.5 concentration, types and extent of vegetation and density of human population across the country. An update to this study (UKCEH and eftec, 2019) has produced estimates of PM2.5 removal per hectare of woodland by local authority across the UK. The benefit of removal is estimated as the avoided health care cost (UKCEH and eftec, 2019).

A2.1.7 Soil carbon sequestration opportunity

Data identifying the areas of opportunity and scale of opportunity in tonnes of carbon (tC) by soil type were provided by Environment Systems. The NatMap dataset contained 49 soil types across the NCAs and the area of these are summarised by higher level soil type and by NCA in Appendix Table 5.

Appendix Table 5: Area of soil types by NCA (ha)

Soil Type	Hampshire Downs	New Forest	South Downs	South Hampshire Lowlands	Thames Basin Heaths	Wealden Greensand	Total	%
Peat	2,588	-	798	1,144	397	168	5,095	2%
Clay / clay loam	1,870	25,180	1,407	24,667	22,269	331	75,725	22%
Pozol	-	256	-	-	3,406	-	3,662	1%
Loam	11,520	2,909	420	241	1,822	7,181	24,093	7%
Loamy over chalk	59,907	-	11,024	170	743	106	71,950	21%
Sandy loam	50,228	-	6,489	634	424	514	58,289	17%
Sandy / sandy loam	15,088	28,006	8,929	9,594	10,904	10,656	83,177	25%
Loamy/ sandy loam	-	10,181	-	1,035	1,687	301	13,205	4%
Silt, sand, silty clay loam	73	341	255	1,018	-	1,403	3,091	1%
Total	**141,275**	**66,874**	**29,323**	**38,503**	**41,651**	**20,661**	**338,286**	100%

Peat holds the greatest quantity of carbon but only covers 2% of the total NCA area. Next clay/clay loam, pozols and loam, are good at holding carbon, and clay/clay loam has high land coverage in South Hampshire lowlands, Thames basin heaths and the New Forest. Loamy soil over chalk is characteristic of the Hampshire Downs (42% of NCA area) and the South Downs (38% of NCA area). This soil type holds a moderate quantity of carbon. Next the sandy loam soils cover all six NCAs at significant coverage (42% of total NCA area) and these have moderate to low carbon carrying potential. The remaining soils have low carbon carrying capacity and cover relatively small areas.

The mean tonnes of organic carbon stored at 30cm depth is shown by soil type and NCA in Appendix Table 6.

Appendix Table 6: tC/ha by soil types and by NCA

Soil Type	Hampshire Downs	New Forest	South Downs	South Hampshire Lowlands	Thames Basin Heaths	Wealden Greensand	Total
Peat	357.6	-	160.4	346.4	501.9	158.2	328.9
Clay / clay loam	214.8	236.2	159.6	171.3	208.9	203.1	204.9
Pozol	-	153.5	-	-	116.0	-	118.6
Loam	147.6	143.9	223.6	192.3	177.2	188.6	163.4
Loamy over chalk	137.4	-	203.6	163.1	119.0	173.7	147.5
Sandy loam	165.2	-	170.8	180.4	171.5	197.6	166.3
Sandy / sandy loam	187.2	262.4	288.0	133.1	169.0	213.9	218.1
Others	226.5	148.1	451.1	185.0	122.4	174.7	158.0
Average by NCA	**158.5**	**228.9**	**221.2**	**168.0**	**186.8**	**200.6**	**185.0**

As expected, peat holds the highest quantity of carbon per unit area, but there is considerable variation across NCAs. The New Forest has the highest average soil carbon stock, reflecting the low level of cultivation in that NCA, whilst Hampshire Downs has the lowest carbon stock, presumably reflecting the high proportion of arable cultivation. Whilst this general trend is expected, the overall level of carbon stock seems high relative to figures quoted in literature (e.g. 27-88 tC/ha for arable soils and 72 – 204 tC/ha for grassland, see Natural England Report, Gregg et al (2021)).

There is some reason to suspect that the figures are high. NatMap uses the most comprehensive data on UK soils, held by Cranfield University, and comes from the UK Soil Survey of England and Wales conducted between 1968 and 1984, with peak activity in the late 1970s. This data, now over 45 years old, predates significant agricultural changes affecting soil carbon. Continuous tillage has reduced carbon stocks via oxidation, while inorganic fertilizers, particularly nitrogen, disrupt the carbon/nitrogen balance, depleting soil carbon for rapid plant growth. Additionally, climate change, through acid rain and increased temperatures, has likely decreased soil organic carbon (SOC). Conversely, regenerative agriculture and rewilding efforts have begun to restore soil carbon on some sites, increasing sequestration annually. The Cranfield data presented in this report is outdated and is likely to reflect higher soil carbon values than currently exist. However, some individual holdings employing regenerative practices may show improved soil carbon levels. Consequently, given the significant level of uncertainty, and the extent to which soil carbon stock can vary within soil types (depending upon soil management practice), we have not presented these figures the main report outputs.

In terms of opportunity to sequester more carbon, arable soils and improved grassland have the greatest potential for improvement in soil carbon content, and that these comprise the majority of land use in the county, these are the main land types we have included in our opportunity estimate. Appendix Table 7 shows the area of these farmed soils by soil type and NCA. This covers an area of over 188,000 ha or over 55% of the total study area. This shows that clay/clay loam, loamy soil over chalk, and sandy loam are the most significant soil types for agriculture, but there is considerable variation of type by NCA (e.g., Loamy over chalk is prominent in the Hampshire Downs and South Downs).

Appendix Table 7: Area of farmed soil types by NCA (ha)

Soil Type	Hampshire Downs	New Forest	South Downs	South Hampshire Lowlands	Thames Basin Heaths	Wealden Greensand	Total	%
Peat	1,326	-	640	632	245	132	2,975	2%
Clay / clay loam	989	6,037	357	10,361	13,245	266	31,256	17%
Pozol	-	79	-	-	588	-	667	<1%
Loam	7,788	1,411	315	126	1,063	4,143	14,846	8%
Loamy over chalk	45,169	-	8,659	95	601	82	54,607	29%
Sandy loam	36,779	-	4,958	519	366	383	43,005	23%
Sandy / sandy loam	10,194	7,126	6,082	3,000	2,854	4,501	33,757	18%
Others	44	5,101	166	701	863	659	7,535	4%
Total	**102,289**	**19,754**	**21,178**	**15,434**	**19,825**	**10,167**	**188,647**	**100%**

The NatMap dataset was used to model the difference between the mean soil carbon content and the maximum by soil type and NCA and these results are shown in Appendix Table 8. This provides an indication of the extent to which soil carbon content could be increased (if the mean could be raised to the level of the maximum).

Appendix Table 8: Opportunity to increase soil carbon stock, (tC/ha at 30cm depth) by soil types and by NCA

Soil Type	Hampshire Downs	New Forest	South Downs	South Hampshire Lowlands	Thames Basin Heaths	Wealden Greensand	Total
Peat	922.3	-	196.4	958.1	912.9	196.6	740.8
Clay / clay loam	115.2	138.5	136.8	130.5	121.9	168.3	128.3
Pozol	-	505.0	-	-	472.3	-	476.1
Loam	262.7	124.5	189.0	256.9	238.6	149.7	214.7
Loamy over chalk	263.5	-	266.0	282.6	261.2	258.4	263.9
Sandy loam	121.6	-	121.6	123.9	122.2	117.3	121.6
Sandy / sandy loam	307.6	375.7	219.3	243.9	302.0	242.4	291.2
Others	203.1	150.4	112.2	498.5	169.3	279.7	195.7
Average by NCA	**223.9**	**227.6**	**212.1**	**204.9**	**180.6**	**199.9**	**215.6**

This shows that peat soils have the greatest capacity for further sequestration, (but these soils are limited to only 2% of the farmed area). This also suggests that other soils also have considerable potential for further carbon sequestration but given the comments above about the age of this data, we suggest the opportunity value is treated with considerable caution.

Furthermore, achieving the maximum carbon stock for any given soil type may entail a radical land use change. For example, in realising the maximum potential for peat, this land should not be farmed at all but allowed to re-wet and accumulate carbon naturally. In this project we have placed emphasis on retaining land for food production, whilst improving soil carbon sequestration within the bounds of existing land use (e.g., use of farmyard manures, minimal or no tillage, use of cover crops and herbal leys for arable production systems).

Consequently, we have taken a range of views on the rate of sequestration that may be possible within an agricultural system. Greg et al (2021) quotes typical ranges of 27-88 tC/ha for arable soils and 72 – 204 tC/ha for grassland, suggesting that the difference between mid-point values and the highest is around 30 tC/ha and 60tC/ha respectively. If achieved over a 50 year period, this would equate to an annual average sequestration rate of 0.6 to 1.2 tC/ha/year. This is in line with rates of soil sequestration quoted by the Sustainable Soils Alliance (conservative estimate of up to 2 tCO_2e/ha/year or 0.55

tC/ha/year)[54]. In rough terms the range 30-60 tC/ha is around 1-2% Soil Organic Carbon (SOC) content. We have assumed that 30 tC/ha is a readily achievable target for all farm soils, whilst 60 tC/ha is a suitable stretch target. Our subsequent sequestration calculations are based on this range.

Appendix Table 9 shows that these assumptions provide a range of sequestration of 5.7 to 11.3 million tonnes of carbon (over say 50 years). Converting to CO2e, this gives a range of 20.8 to 41.5 million tonnes of CO_2e (over 50 years). These are the base figures used in Table 4.3.

Appendix Table 9: Soil Carbon Opportunities, by NCA

NCA Name	Opportunity Area (ha)	% of NCA	High sequestration MtC (at 60 tC/ha)	Low sequestration MtC (at 30 tC/ha)	High sequestration $MtCO_2e$ (at 60 tC/ha)	Low sequestration $MtC0_2e$ (at 30 tC/ha)
Hampshire Downs	102,289	72%	6.1	3.1	22.5	11.3
New Forest	19,754	29%	1.2	0.6	4.3	2.2
South Downs	21,178	72%	1.3	0.6	4.7	2.3
South Hampshire Lowlands	15,434	40%	0.9	0.5	3.4	1.7
Thames Basin Heaths	19,825	47%	1.2	0.6	4.4	2.2
Wealden Greensand	10,167	49%	0.6	0.3	2.2	1.1
Total	**188,647**	**56%**	**11.3**	**5.7**	**41.5**	**20.8**

[54] See: https://sustainablesoils.org/soil-carbon-code/economic-and-policy-context

A2.1.8 GHG reduction opportunity

Opportunities to reduce GHG emissions from farming are based on the assumption that the maximum feasible potential opportunity is the difference between the total average emissions and the total low emissions for each subsector of livestock and arable farming (CHAP & AHDB, 2022). It is further assumed that only 50% of this potential is likely to be achieved. The carbon prices shown in Appendix Table 10, were used to show the range in the value of reducing emissions.

Appendix Table 10: Total and likely potential emission reductions and value ranges of reduction.

National Character Area	GHG emissions Reduction Potential (tCO2e)	Emissions that can be reduced – Assume 50% (tCO_2e)	Value of public benefit		Potential to generate income
			£ million (Central non-traded value of £273/ tCO_2e)	£ million (Low non-traded value of £136/ tCO_2e)	£ million (Market Value of £50/ tCO_2e)
Hampshire Downs	92,351	46,175	12.6	6.3	2.3
New Forest	25,038	12,519	3	2	1
South Downs	19,604	9,802	3	1	0
South Hampshire Lowlands	18,335	9,167	2	1	0
Thames Basin Heaths	15,638	7,819	2	1	0
Wealden Greensand	10,387	5,193	1	1	0
Total	**181,353**	**90,677**	**24.7**	**12.3**	**4.5**

A2.1.9 Water quality improvement Opportunity

Two methods were used to calculate the amount of nitrate removal in Hampshire waters, and the value of this to society

Method 1: Environment Systems supplied the area, in hectares, of overlap between farm area and the groundwaters in poor chemical condition (0). This was multiplied by Defra's estimate of the average excess nitrogen per hectare from UK annual nutrient balance of farming data (Defra, 2022), 89.2 kg of N/ha or 0.395 tonnes of nitrate per ha per year. This is an all-England average and is assumed to be a reasonable estimate for Hampshire. This gives a total nutrient balance of around 40,000 tonnes of nitrate per year in the three main NCAs most seriously impacted. The mid-point estimate assumed 20% removal of this quantity and 25% removal as a high estimate. These figures are used in Table 4.5, and have been valued at the Farmscoper average cost of nitrate removal of £1,266 per tonne of nitrate (at 2023 prices).

Appendix Table 11: Mid-point and high estimates of nitrate removal

NCA	Farm Area overlap with groundwater sources (ha)	Excess Nitrate (tNO_3/year)	Mid-point Estimate Tonnes of nitrate (Remove 20% of excess)	High Estimate Tones of nitrate (Remove 25% of excess)
Hampshire Downs	83,353	32,938	6,588	8,234
New Forest	2,717	1,074	215	268
South Downs	14,812	5,853	1,171	1,463
Total	**100,883**	**39,864**	**7,973**	**9,966**

Method 2: Southern Waters' abstraction volumes for ground and surface waters for each NCA were multiplied by the Environment Agency's average excess nitrate levels (30mg/l) found in Hampshire waters (EA, 2021), to estimate the total annual tonnes of nitrates to be removed from abstracted water in each NCA. This was used as the low estimate.

Appendix Table 12: Tonnes nitrate removal from groundwater and surface waters in each NCA

NCA	Vol of water abstracted (cubic metres/year)	(tNO_3 removed)
Hampshire Downs	115	2,335
New Forest	14	411
South Downs	26	791
Total	**155**	**3,537**

The cost of reducing nitrates was estimated using the average cost of removing a tonne of nitrates from drinking water (Farmscoper, 2021), inflated to 2023 prices (HM Treasury, 2023), at £1,266 per tonne of nitrate.

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