



DEVELOPING CORPORATE NATURAL CAPITAL ACCOUNTS

Final Report

For the Natural Capital Committee

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EXECUTIVE SUMMARY

ES.1 Introduction

The objective of this study is to develop a methodology for corporate natural capital accounting. Enabling organisations to gather natural capital information in a coherent and comparable format will help both companies and policy-makers make better informed decisions about the management of natural capital. The study is structured around three main phases of work:

1. Construct a methodological framework for corporate natural capital accounting: working with the Natural Capital Committee the aim was to prepare a draft framework which would then be tested via a piloting exercise;
2. Develop pilot natural capital accounts: in collaboration with a small group of organisations to test the draft methodology; and
3. Prepare ‘generic’ corporate natural capital framework and guidance: based on the lessons learnt from pilot accounts, refine the framework and produce guidelines to aid its practical application.

The resulting CNCA framework is designed for organisations that: (i) own, are responsible for, or rely on significant stocks of natural capital; (ii) have an explicit or implied responsibility to maintain their natural assets intact; (iii) see potential benefits from enhancing or better utilising their natural assets; and/or (iv) seek to reduce operational risks through improved management of their natural assets. The framework establishes a system for measuring and valuing natural capital over time along with the explicit recognition of the funding that is required for its maintenance and enhancement.

Outputs from the study are intended to inform the Natural Capital Committee (NCC)’s third State of Natural Capital Report which will be published in early 2015. This report is accompanied by: a standalone Summary document that describes the key features of the framework and its application; and a separate ‘Guidelines’ document which provides high-level practical guidance for applying the CNCA framework and developing a natural capital account.

ES.2 Key principles

The development of the framework has been informed by the conceptual understanding of natural capital that has been developed by the NCC (2012; 2013). Natural capital includes both biotic (living) and abiotic (physical condition and non-living, such as energy and mineral reserves) assets. The framework is concerned with the inter-dependencies between these assets and the organisation. It focuses on the impact an organisation can have on the health and long-term viability of natural capital. Extensions are also considered with respect to interactions with natural assets that are not owned or directly managed by an organisation, but are strongly influenced by its activities (e.g. downstream catchment impacts).

The principles that have guided the development of the framework include:

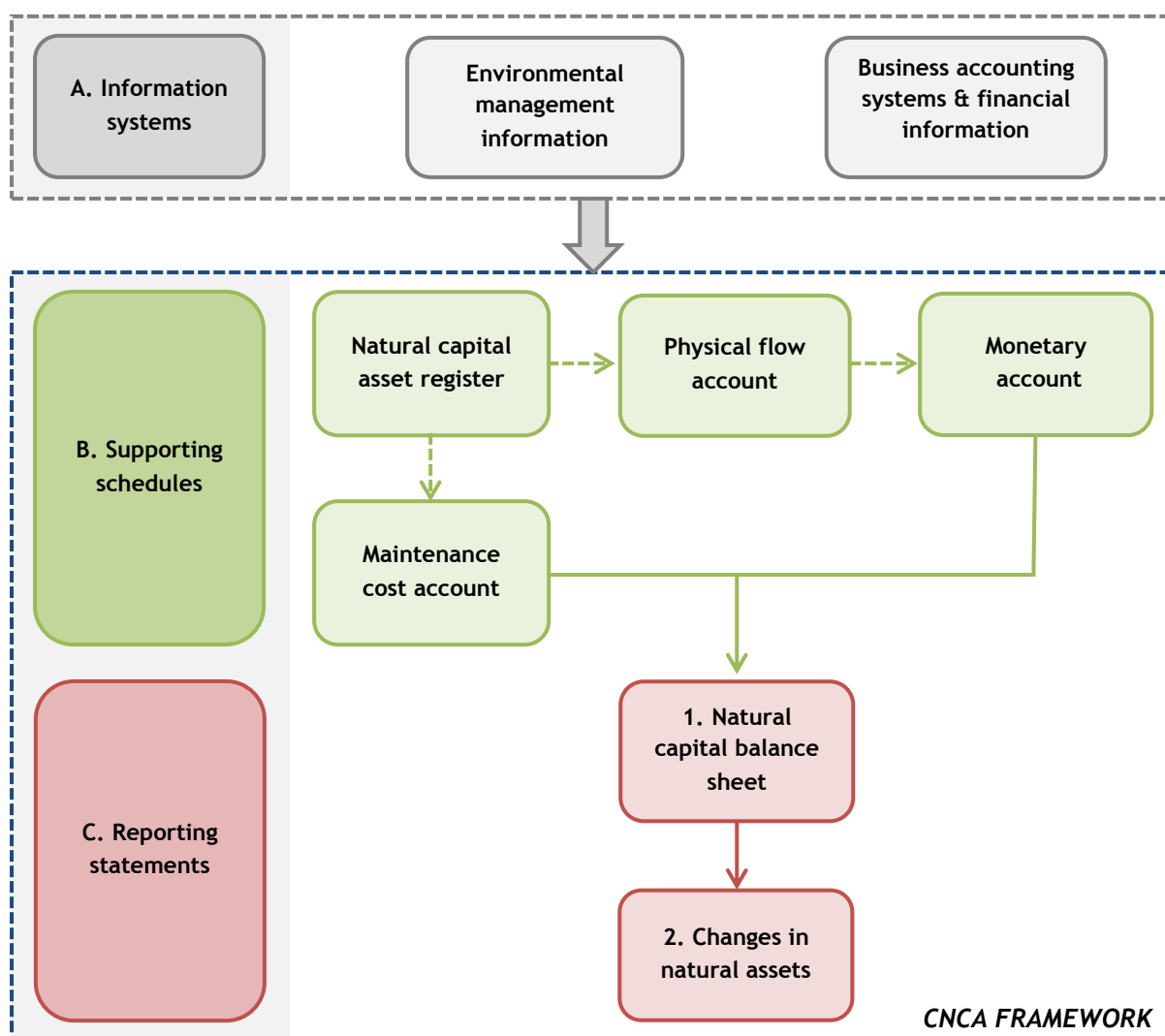
- A balance sheet structure is used to explicitly measure and compare natural capital assets and liabilities;
- Asset value includes both ‘private’ values accruing to the organisation and the ‘external’ values accruing to the rest of the society. Both must be measured to capture the ‘full’ value of natural capital;
- Liabilities are the costs of maintaining the natural assets;

- The framework is forward-looking as the objective is to safeguard the health and condition of natural capital into the future, which requires the reporting of long-term values of natural capital assets and liabilities;
- In order to monitor the status of natural capital, changes in the quality and quantity of natural capital assets need to be reported relative to a baseline; and
- The framework must reflect the causes of changes in value (e.g. quantity, quality, beneficiaries, and internal/external factors) to meaningfully inform a user.

ES.3 CNCA framework

The framework set out in this report is summarised in Figure ES.1. The Main Report content explains the structure, definitions, and key concepts. The approach incorporates a degree of flexibility to enable organisations to apply the framework to deliver the most useful information for their own purposes.

Figure ES.1: CNCA framework, reporting statements, supporting schedules and information



The CNCA framework features two principle reporting statements:

1. Natural capital balance sheet: this reports the value of natural capital assets, and the costs (liabilities) of maintaining those assets.
2. Statement of changes in natural assets: this reports the change (gain or loss) in asset values and liabilities over an appropriate accounting period.

The reporting statements are underpinned by:

- Financial and environmental information systems: needed to define and measure the natural capital that is in the scope of the account, value the benefits derived from it, and determine the costs of maintaining it.
- Supporting schedules: that compile the data and calculations needed to populate the reporting statements. This includes: a natural capital asset register (an inventory of natural assets and their condition); a physical flow account (the quantities of goods and services that depend on natural capital); a monetary account (the value of the flow of goods and services); and a maintenance cost account (the maintenance activities/liabilities associated with natural capital assets).

Example reporting statements and supporting schedules are provided in the Main Report (Section 3.3 - 3.5 and Annex 2).

ES.4 Pilot accounts

Pilot accounts were developed with four organisations: Lafarge Tarmac; National Trust; The Crown Estate, and United Utilities. These helped to refine the draft framework by testing its application with ‘real world’ data. The pilot accounts reflect a range of business sectors, commitments to the maintenance of natural capital, land use and land cover types, as well as different aspects of natural capital (Table ES.1).

Table ES.1: Pilot accounts

	Lafarge Tarmac Construction industry	National Trust Conservation NGO	The Crown Estate Statutory corporation	United Utilities Water utility
Pilot site	Mancetter, Warwickshire	Wimpole Hall Estate, Cambridgeshire	The Windsor Estate, Berkshire/Surrey	Fylde Coast, Lancashire
Natural capital responsibility	Owner (land) and operator	Owner and land manager	Owner and land manager	Liability to limit pollution
Business activity on-site	Hard rock quarry with restoration plans post extraction	Farm undergoing conversion from ELS to HLS and organic. Open for recreation	Farming and forestry activities. Open for recreation	Permit to discharge effluent
Significant services supported by natural capital	Non-renewable extraction, carbon storage, water regulation, recreation, biodiversity	Climate regulation, food provision, recreation, and biodiversity	Food provision, timber, recreation, landscape amenity, climate regulation air filtration	Water quality regulation

Overall the pilot accounts demonstrate ‘proof of concept’ for the framework. In combination they show that its practical application is feasible and that it provides useful results. The Main Report provides a summary of each pilot account, covering the background context for its development, the main results (including reporting statements), and the main lessons learnt that aided the refinement of the framework.

ES.5 Conclusions

The CNCA framework is not intended to be highly prescriptive. This is to reflect the potential diversity of organisations and natural capital assets and their uses, to which the framework could be applied to help improve the management of natural capital. Moreover the potential uses of the framework by an organisation are varied, as demonstrated by the pilot accounts. The first step for an organisation will be to understand how the framework can be applied to different business objectives - for example: strategy and natural capital risks and opportunities; land use/investment decisions; new revenue opportunities; stakeholder communications; and governance - and establish which of these the framework should support.

The development of a natural capital account by an organisation should be viewed as an iterative process. Initially data and information gaps may be encountered that imply that an account will only provide a partial assessment of natural capital assets. However, if CNCA is embedded into an organisation these limitations will be addressed over time. Indeed the inception of an account and its initial outputs should be the stimulus for review and improvement. A significant gain for an organisation can be in the task of drawing together seemingly disparate information; a lesson from the pilot accounts is that much of the effort is related to the compilation and organisation of data. Population of an account is, by comparison, relatively straightforward.

Overall the framework complements and enhances an organisation’s management systems; it does not replace any current tools or methods. Whilst the natural capital balance sheet and statement of changes in net assets are similar in appearance to conventional accounting, they need to be interpreted differently. A natural capital account must be recognised as a ‘free-standing’ tool that can be applied by an organisation. Given the definition of natural capital and underpinning concepts, the valuations reported on the balance sheet differ markedly from those on financial balance sheets.

1. INTRODUCTION

1.1 Background

The Natural Capital Committee (NCC) was established in 2012 to provide independent advice to the Government on the sustainable use of England's natural capital. The principal means through which the Committee addresses its Terms of Reference is the annual State of Natural Capital Report¹. The first report, published in April 2013, presented evidence that significant economic and wellbeing benefits can be secured through management of natural capital (NCC, 2013). In March 2014, the second report highlighted that natural capital is not being used sustainably and the benefits that are derived from it are at risk. The Committee proposed that a long-term restoration plan is necessary to maintain and improve natural capital in order to secure its benefits for the long-term (NCC, 2014a).

As part of its work to integrate natural capital into the economy the Committee has implemented a number of workstreams, including developing ways to measure natural capital and identifying which assets are at risk, and contributing to the development of national natural capital accounts with the Office for National Statistics and the Department for Environment, Food and Rural Affairs (Defra).

A further priority for the Committee is the development of a methodology for corporate natural capital accounting (CNCA). Private and non-governmental organisations own or manage a significant proportion of England's natural assets, and the Committee is encouraging them to develop natural capital accounts. The role of natural capital accounting is to document an organisation's ownership, liability and assets related to natural capital in a balance sheet format. In the same way that the structured recording of other company assets and liabilities in conventional financial accounts informs and improves an organisation's management decisions, natural capital accounts will enable better decisions to be made about natural capital.

1.2 Objectives

The objective of this study is to develop a methodology for corporate natural capital accounting, which will contribute to improved reporting and management of natural capital. Enabling organisations to gather natural capital information in a coherent and comparable format will help both companies and policy-makers to make better informed decisions about the management of natural capital assets, to the benefit of business and society more generally.

The study is structured around three main phases of work with specific aims:

1. Construct a methodological framework for corporate natural capital accounting: working with the Natural Capital Committee and building on Mayer (2014), the aim was to prepare a draft framework to be tested via a piloting exercise.

¹ The Natural Capital Committee was established in May 2012 with the following remit: (1) Provide advice on when, where and how natural assets are being used unsustainably; (2) Advise the Government on how it should prioritise action to protect and improve natural capital, so that public and private activity is focused where it will have greatest impact on improving wellbeing in our society; and (3) Advise the Government on research priorities to improve future advice and decisions on protecting and enhancing natural capital. The Committee reports to the Economic Affairs Committee (EAC) of the Cabinet, chaired by the Chancellor of the Exchequer.

2. Develop pilot natural capital accounts: in collaboration with a small group of organisations, the draft framework was piloted to test the draft methodology, including establishing the coverage (scale) of the account, data requirements, compilation of data and analysis, and reporting results.
3. Prepare ‘generic’ corporate natural capital framework and guidance: based on the lessons learnt from producing the pilot accounts, the framework was refined and guidelines prepared to assist organisations in its practical application.

The CNCA framework is designed for organisations that: (i) own, are responsible for, or rely on significant stocks of natural capital; (ii) have an explicit or implied responsibility to maintain their natural assets intact; (iii) see potential benefits from enhancing or better utilising their natural assets; and/or (iv) seek to reduce operational risks through improved management of their natural assets. Overall the framework is intended to establish a system for measuring and valuing natural capital over time with the explicit recognition of the funding that is required for its maintenance and enhancement. Hence it is central to the management and financing of natural capital as well as to its measurement.

In undertaking the study, the views of a wider group of interested organisations beyond those participating in the pilot accounts have also been sought, including engagement with the NCC’s Landowners Group to further explore the role for natural capital accounts at the corporate level.

Outputs from the study are intended to inform the Committee’s third State of Natural Capital Report which will be published in early 2015.

1.3 Scope of CNCA framework

Natural capital includes both biotic (living) and abiotic (physical condition and non-living, such as energy and mineral reserves) assets. The CNCA framework is concerned with the interdependencies between these assets and the organisation. It is principally focussed on the impact an organisation can have on the health and long term viability of natural capital, as well as the benefits the organisation receives from natural capital. Extensions are also considered with respect to interactions with natural capital that are not owned or directly managed by an organisation, but are strongly influenced by its activities. This includes, for example, downstream catchment impacts. The framework therefore is concerned with the ‘costs’ and ‘benefits’ associated with natural capital assets that the company has an identifiable stewardship role for, either via ownership or due to legal or regulatory obligations.

The framework does not include ‘upstream’ supply chain impacts. For example, a food manufacturer that chooses to minimise the environmental impact of its activities by purchasing ‘environmentally sensitive’ inputs (e.g. organic crops) would not record these actions within its natural capital account. In part, the impacts would be recorded in the supplier’s accounts - i.e. the land owner/manager - which would recognise the enhanced natural capital outcomes from less intensive production processes. In addition the environmental impacts from the use of outputs produced by an organisation (‘downstream’ in the supply chain) are not within the scope of the framework. For example the environmental impact of the use of fossil fuels by end users (e.g. energy utilities) would not be attributed to the company extracting the fuels (although impacts on natural capital from extraction activities would be accounted for).

The omission of supply chain impacts from the scope of the CNCA framework does not imply that they are not significant considerations for an organisation. Where they are of material interest

reporting on upstream and/or downstream supply chain impacts can be considered as complementary to a natural capital account. Used together, they can provide a fuller account of an organisation's interactions with the environment along the entire value chain. The link between the CNCA framework and other environmental performance and accounting tools is reviewed in Section 2.

1.4 Report structure

This report sets out the natural capital accounting framework. It outlines the guiding principles and concepts that have informed its development, along with a description of the key features. Findings from the piloting exercise are reported along with recommendations for future implementation of the framework.

Following this introduction:

- Section 2 provides an overview of the approach to developing the CNCA framework, covering the definition of natural capital, the guiding principles that have established the rationale for the structure and scope of the framework, and a review of where the framework sits within the wider range of tools and initiatives that are available for organisations for measuring and valuing natural capital.
- Section 3 presents the CNCA framework in terms of the structure of the reporting statements and supporting accounts, principal concepts and definitions that establish its scope and role.
- Section 4 summarises the key findings from the pilot accounts, including illustrative results that demonstrate the practical application of the framework. A synthesis of the key findings and lessons that have informed the refinement of the framework and the recommendations for its implementation is also provided.
- Section 5 concludes with a summary of the main outcomes from the study, along with discussion and recommendations concerning future implementation.

In addition, four supporting annexes are provided. Annex 1 provides a summary of the project workshop with the pilot organisations and representatives from the Landowners Stakeholder Group. Annex 2 provides a set of example supporting schedules from the pilot accounts. Annex 3 provides a brief summary of issues concerning the valuation of natural capital benefits in the context of natural capital accounting. Annex 4 describes an extension to the 'core' CNCA framework to incorporate wider interactions between an organisation's activities and natural capital where these are highly material.

Finally, this report is accompanied by a standalone Summary document that describes the key features of the framework and its application, and a separate 'Guidelines' document which provides high-level practical guidance for applying the CNCA framework and developing a natural capital account. The intended audience for the guidelines document are individuals within an organisation tasked with coordinating and producing a natural capital account. The guidelines set out a stepped process for: (1) preparing for; (2) developing, and (3) reviewing an account. The guidelines document should be read in conjunction with this report - particularly Section 3.

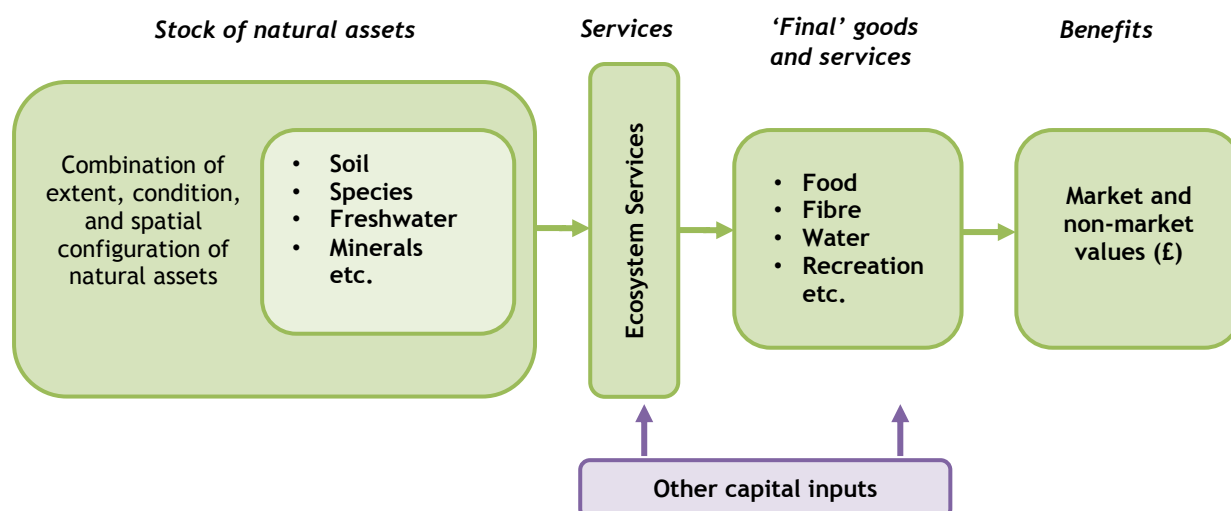
2. OVERVIEW

2.1 Defining natural capital

In the publication ‘*Towards a Framework for Defining and Measuring Changes in Natural Capital*’, the Natural Capital Committee proposes that natural capital should be defined as: “the elements of nature that directly and indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions” (NCC, 2014b; p5). Whilst the links between natural capital and the benefits it provides are complex, the concepts underpinning this definition can be summarised in general terms - as depicted in Figure 2.1 - as follows:

- **Natural capital stock:** there is a stock of natural capital that comprises of both biotic (living) and abiotic (physical conditions and non-living) elements of the natural environment, including non-renewable assets such as minerals and energy reserves. The natural capital assets that make up this stock include ecological communities, species, soils, land, freshwaters, minerals, sub-soil resources, oceans, the atmosphere, and the natural processes that underpin their functioning.
- **Services:** natural capital stocks provide a flow of potential services, including ecosystem services such as the provision of food and raw materials (e.g. biomass for timber) and various regulating functions of the natural environment (e.g. climate regulation, water flow regulation).
- **Final goods and services:** these are produced, often in combination with other types of capital input such as labour and man-made capital, and include timber, drinking water, crops, and recreation activities, etc.
- **Benefits:** the consumption or experience of final goods and services yields benefits to human populations. These benefits can be valued in economic terms based on the trade-offs that are made by individuals in their consumption (i.e. money in return for goods and services). This trade-off reveals the economic value of the good or service, and can vary over time and place, being dependent on factors such as relative scarcity and quality of substitutes. Aggregate benefits are estimated by summing individual values over the beneficiary population.

Figure 2.1: Natural capital assets and flows of services, goods and benefits



The flow of services, goods and benefits derived from the stock of natural capital is influenced by the quantity of natural assets (the amount and extent/coverage), the quality of natural assets (the condition) and the spatial configuration (relating to the location of the asset and beneficiary populations). As NCC (2014b) highlights, the relationship between the quantity, quality, and spatial configuration of the natural capital stock and the flow of goods or services may not be fully understood. It can be subject to non-linear thresholds, where a small change in one aspect of natural capital may result in a large change in the benefits provided, or have no impact at all. In general, though, it is assumed that larger natural capital stocks in better condition are preferred and are more sustainable in the long-run.

Interpreting natural capital in the context of natural capital accounting has two important aspects. First, natural capital is a 'stock', which, in principle, can be measured in physical terms. Metrics could, for example, include species richness and abundance, area and condition of habitats. These biophysical metrics represent critical information for assessing the long term sustainability of the benefits from natural capital and are therefore a fundamental component of the CNCA framework. Second, natural capital includes both biotic (living) and abiotic (physical conditions and non-living) elements of the natural environment. Hence ecosystem assets are a component of natural capital, but broader elements such as non-renewable assets are included within the definition. Therefore the accounting framework should not be limited to ecosystem service flows but also include treatments for non-renewable assets.

The value to people of natural capital stocks is measured by the current and future flows of services that are derived from them. This includes the physical flows of services over time and the (monetary) value associated with these flows. There are though notable challenges that stem from the complexities of natural capital. NCC (2014b) highlights that natural capital stocks are dispersed, interconnected and dynamic, and part of the value of natural capital is dependent on these characteristics, such as the capacity to fulfil different functions, and to function differently under changed circumstances.

Therefore, some assumptions about conditions, flows, and values associated with natural capital are inevitable. The necessity to use assumptions does not discount the importance or robustness of measuring and valuing natural capital. But it increases the importance of founding such assumptions on the best available information and subjecting them to continuing review as improved data become available. At the corporate level, there is potentially much to be gained from developing natural capital accounts, as a means of compiling data on natural capital stocks and revealing the broader values that are dependent upon their continued maintenance. The process should also bring natural capital considerations more firmly to the attention of the executive officers of a company through improved compilation of environmental, economic and financial data.

2.2 Guiding principles

The CNCA framework focuses on the structure, definitions, and key concepts for developing a natural capital account. The approach incorporates a degree of flexibility to enable organisations to apply the framework to deliver the most useful information for their own purposes².

² As a result the framework is largely descriptive since a prescriptive approach is not desirable given the potential diversity of organisations and natural capital assets and their uses, to which the framework could be applied. For this reason specific guidance on how natural capital stocks and value service flows should be valued is not provided - only some guidance in general terms is provided.

The structure of the CNCA framework is described in Section 3. This has been subject to an iterative development process, involving the input from the Natural Capital Committee, the pilot organisations and other interested organisations. It has been informed by previous work on natural capital accounting including Mayer (2014), and as far as relevant, the framework is consistent with developing national accounting methodologies (e.g. UN SEEA - United Nations System of Environmental-Economic Accounting³).

The principles that have steered the development of the framework reflect the objectives of the study and the conceptual understanding of natural capital that is set out in Section 2.1. In summary these principles are:

- The natural capital accounting framework is foremost an approach for helping organisations measure and establish the importance of natural capital to their business (current and future);
- A balance sheet structure is used to explicitly measure and compare natural capital assets and liabilities;
- Asset value includes both ‘private’ values accruing to the organisation and the ‘external’ values accruing to the rest of the society. Both must be measured to capture the ‘full’ value of natural capital;
- Liabilities are the costs of managing and maintaining natural assets to a specified condition;
- The framework is forward-looking as the purpose is to help safeguard the health and condition of natural capital into the future, which requires the reporting of the long-term value of natural capital assets and liabilities;
- In order to monitor the status of natural capital, changes in the quality and quantity of natural capital assets need to be reported relative to a baseline (a ‘reference scenario’); and
- To meaningfully inform the users of an account on changes in natural capital over time, the framework must reflect the causes of changes in value (e.g. quantity, quality, beneficiaries, and internal/external factors).

The potential applications for a natural capital account within an organisation are wide ranging and include both internal management applications and external reporting. For example:

- Developing long-term strategies:
 - Opportunities to generate new revenues to safeguard natural capital (e.g. new products/services, payments for ecosystem services).
 - The risk to revenues, liabilities, reputation and customer base of not maintaining natural capital.

³ UN SEEA aims to produce international standards for environmental accounting. The SEEA Central Framework (2012) applies the System of National Accounts (SNA) model to environmental-economic accounting, covering ‘individual environmental assets’ (e.g. timber, subsoil assets, and fossil fuels) and expected flow of benefits in basic resource accounts. The SEEA Experimental Ecosystem Accounting (2013) framework focuses on ‘ecosystem assets’, including for example species, ecological communities, soils, rivers and land.

- Operational decision-making: for example investing in natural versus man-made infrastructure, assessing the impacts of changes to natural assets, or prioritising how to allocate limited maintenance budgets.
- Reporting: to demonstrate the health and performance of natural capital to important stakeholders, such as different parts of the business, investors, regulators, customers and employees.
- Environmental management: supporting and enhancing outcomes for natural capital.

Measuring the state of natural capital can help an organisation assess whether financial performance is at the expense of natural capital degradation or if natural capital is sufficiently healthy and stable to underpin future sustainable financial performance. An account can also show the influence an organisation has on the value of the natural capital assets it owns and their impact on the financial viability of the organisation.

An account may also assist in consultations with policy makers and regulators. For example, in establishing benefits and detriments of natural capital that may justify a subsidy or tax, or in determining the shortfall in legal liabilities to sustain natural assets and the liability regime that might be justified in due course to preserve natural capital.

2.3 Links to other natural capital accounting tools

The development of the corporate natural capital accounting framework for the NCC represents part of the growing interest both in the UK and internationally in understanding the inter-dependencies between business and natural capital. This growth of interest has led to a proliferation of tools and frameworks designed to measure and value various aspects of natural capital, addressing different objectives, scopes, boundaries, outputs, and users.

Adequately categorising the range of available tools is challenging due to the diversity of the issues they help organisations address, their scope, aims, and intended application. One broad distinction can be drawn between those that emphasise improvements in internal management decision-making, and those that focus more on accountability to stakeholders, for example, by supporting a company's 'license to operate' through external reporting and disclosure. However, even this simple distinction is rarely clear cut, many of the tools and frameworks (including corporate natural capital accounts), can be employed to address either or both objectives.

Note that a full review of this topic area is not attempted⁴; rather the summary below is intended to set the CNCA framework in the context of other efforts, principally by outlining the variety of approaches available and the main issues they help organisations address.

2.3.1 *Natural capital management tools*

There is a wide range of frameworks that use scores and checklists to help companies understand their inter-dependencies with natural capital. As each is designed with a particular purpose it is difficult to be generic about the questions they help business address. However, typically, they include:

- What and where are the most significant natural capital interdependencies;

⁴ For more detail on specific tools see, for example, Natural Capital Coalition (2013) and WBCSD (2013).

- What impact does the business have on natural capital, and where; and
- How can the business minimise or mitigate impacts?

These tools tend to rely on subjective scores and checklists, rather than explicit quantification. Some are designed to focus on specific aspects of natural capital, particularly biodiversity or carbon. For example, 'Biodiversity in the Global Water Tool'⁵ provides a framework for companies to undertake a macro-level assessment of its sites and identify any that are in biodiversity hotspots. Others provide more detail to enable organisations to better understand the interdependencies of their business on biodiversity (examples include the Biodiversity Accounting Framework and Biodiversity Interdependence Indicator self-assessment frameworks⁶). Others involve the additional step of guiding organisations to develop actions to mitigate and/or compensate impacts, such as the LIFE Methodology⁷. These specific tools can illuminate impacts and inter-dependencies of a business with respect to the specified issue but are not designed to provide information on the full range of ecosystem services.

Tools that cover the broader range of inter-dependencies with natural capital include the Corporate Ecosystem Service Review⁸ that helps identify the ecosystem services which the company depends and impacts upon, as well as develop strategies to minimise negative impacts. While most tools can be applied by a wide range of organisations, a number are designed for particular sectors, most commonly those whose business is directly dependent on natural capital, such as extractive industries, farming and fishing. The Sustainable Seafood Finance Initiative (SSF)⁹ is one example designed for banks and seafood companies to jointly identify and address the sustainability risks associated with the sector.

Overall, management tools tend to be well developed to address specific business needs in relation to either specific sectors or particular ecosystem service issues. While they can play an integral role in developing management plans and investment, they tend to be limited in the range of ecosystem services and/or aspects of natural capital. In particular, there is limited quantification of the full range of ecosystem services and rarely are these impacts or dependencies valued in monetary terms. None compare the costs and benefits in monetary terms of natural capital under direct influence of the company, nor do they align financial information with impacts and inter-dependencies on natural capital.

2.3.2 Environmental reporting - guidelines, protocols and standards

Environmental standards aim to enable organisations to measure performance with consistency, enabling results to be used for reporting and disclosure to stakeholders. While the approaches differ in their focus, they tend to address questions such as:

- How does a company's environmental performance compare to others in the sector;
- Where are the company's greatest environmental impacts; and
- How is performance changing over time?

Sustainability reporting guidelines, such as the Global Reporting Initiative (GRI)¹⁰, define sustainability criteria against which companies can report and disclose. A growing range of voluntary initiatives address specific aspects of natural capital including for example, the GHG

⁵ See: <http://www.wbcsd.org/work-program/sector-projects/water/global-water-tool.aspx>

⁶ See: <http://www.oree.org/en/presentation-of-the-guide-biodiversity.html>

⁷ See: <http://institutolife.org/en/certificacao-life/o-que-e-a-certificacao-life/>

⁸ See: <http://www.wri.org/publication/corporate-ecosystem-services-review>

⁹ See: <http://www.sustainableseafoodfinance.org/>

¹⁰ See: <https://www.globalreporting.org/Pages/default.aspx>

Protocol¹¹ and the Water Footprint standard (ISO 14046:2014). The Business and Biodiversity Offset Programme (BBOP) Standard on Biodiversity Offsets¹² provides a standard to evaluate biodiversity offsets and proposes an auditable approach to measuring ‘no net loss’ of biodiversity. Many other frameworks, guidelines, protocols, and standards have also been developed - often aimed at specific sectors or environmental issues.

These existing environmental reporting guidelines, protocols and standards are not generally designed to relate environmental impacts to financial information and they rarely involve valuation of environmental costs and benefits.

2.3.3 Life cycle assessment

A diverse range of emissions and resource use along the corporate value chain (e.g. supply chain, company operations, product use, and end of life) can be investigated using life cycle assessment (LCA) approaches. In this context, ‘LCA approaches’ describes a vast array of guidelines, methods, models, tools, databases and standards which themselves codify a plethora of decision rules. Their unifying characteristic is that they relate to the measurement of emissions or resource use across a lifecycle (most commonly quantitative measurement across the lifecycle of a given product). Some also allow for the estimation of environmental ‘endpoints’ such as eutrophication of water bodies.

Where estimation of emissions or resource use (rather than primary measurement) is necessary, life cycle assessments can draw on life cycle inventory databases, environmentally extended input-output modelling or material flow analysis as well as a range of other estimation techniques.

In general they help organisations address questions such as:

- How does one product compare to another in terms of a range of environmental metrics; and,
- Which parts of the value chain have the greatest impacts on natural capital?

LCA is a well-established practice and is supported by a range of internationally recognised standards, tools and guides, which enable some consistency between studies - although significant challenges with comparison remain. While the LCA literature does include a number of approaches that relate to biodiversity and ecosystem services, they do not currently cover the full range of ecosystem services (Koellner *et al.*, 2013). Furthermore, as the majority of standard LCA studies are not location specific, their application to natural capital considerations is often limited. Several initiatives are underway to develop metrics and standards to integrate ecosystem services within the framework. For example, UNEP/SETAC Life Cycle Initiative¹³, the EU Business and Biodiversity Campaign¹⁴, The Sustainability Consortium¹⁵ and Eco LCA¹⁶ are developing impact indicators so that additional ecosystem service considerations can be incorporated in to LCA studies in the future.

Overall these approaches have the advantage that they can incorporate a wide range of environmental impacts as well as some social impacts along the whole value chain. However, metrics specific to ecosystem services are still under development. Moreover, traditional LCA

¹¹ See: <http://www.ghgprotocol.org/>

¹² See: <http://bbop.forest-trends.org/pages/guidelines>

¹³ See: <http://www.lifecycleinitiative.org/>

¹⁴ See: <http://www.business-biodiversity.eu/>

¹⁵ See: <http://www.sustainabilityconsortium.org/>

¹⁶ See: <http://resilience.eng.ohio-state.edu/eco-lca/>

approaches focus on quantification rather than valuation of impacts and therefore do not facilitate the comparison of costs and benefits associated with maintaining natural capital.

2.3.4 Ecosystem services toolkits

A range of toolkits, including InVEST¹⁷, ARIES¹⁸, SERVES¹⁹, CEV²⁰, and TESSA²¹, are available to help organisations quantify, in bio-physical and/or monetary terms the ecosystem services delivered by a specific spatial area. These toolkits include a selection of ecosystem services and require different levels of software and expertise. The aim of these toolkits is to improve the accessibility of ecosystem service assessments, enabling organisations to address questions such as:

- What ecosystem services are delivered by a given site area;
- Who and where are the beneficiaries; and
- What is the value of the ecosystem service benefits?

The toolkits focus on the benefits delivered by a defined site and can be used standalone or to complement other tools to enable a wider range of ecosystem services to be assessed and/or valued where data or resources are otherwise limited.

In general these approaches have the advantage that they provide bio-physical estimates on the level of ecosystem services delivered by a landscape. Some also take the additional step of valuing impacts. For the most part they do not distinguish between private benefits to an organisation from natural capital and benefits to others; nor do they tend to consider the costs of maintaining natural capital assets. They can, however, provide useful inputs to broader frameworks, such as corporate natural capital accounting.

2.3.5 Sustainability Accounting

An area of growing attention is the integration of financial and non-financial impacts and risks in a transparent and comparable format. This ‘integrated reporting’ provides investors and other stakeholders with information over the long-term enabling a more complete picture of corporate performance, while also improving accountability.

Table 2.1 summarises the different types of initiative that fall within the ‘sustainability accounting’ remit, along with comparisons to conventional financial accounting and the CNCA framework outlined in this report:

1. Financial accounting and reporting follows generally agreed sets of principles and standards, notably the International Financial Reporting Standards (IFRS). Natural capital is reflected in financial accounts to the extent that it delivers a private value to the company or imposes a private cost, often associated with legal obligations. However, these are rarely explicitly attributed to natural capital and hence do not support management of natural capital assets.
2. Environmental financial reporting aims to separately identify private costs and benefits associated with natural capital or environmental obligations. This provides more information on private costs and benefits, but has limited coverage of the state of natural capital assets or their wider external/social value.

¹⁷ See: http://www.naturalcapitalproject.org/pubs/NatCap_InVEST_and_Case_Study_Summary_TEEB_2010.pdf

¹⁸ See: <http://ariesonline.org/>

¹⁹ See: <http://esvaluation.org/about-serves>

²⁰ See: <http://www.wbcsd.org/pages/edocument/edocumentdetails.aspx?id=104&nosearchcontextkey=true>

²¹ See: <http://www.birdlife.org/worldwide/science/assessing-ecosystem-services-tesa>

3. (Extra-financial) environmental reporting guidelines, protocols and standards provide approaches for companies to report additional environmental indicators, generally in bio-physical units and separate from the financial statements.
4. Valuation of environmental externalities focusses on monetary valuation of positive and negative impacts on the environment, often along the whole value chain of an organisation or product. Environmental Profit and Loss (EPL) accounting provides an example of this approach, valuing impacts along the value chain as well as providing corresponding bio-physical data. However a limitation of methods focussed on environmental externalities is that they do not tend to assess the state or value of individual natural capital assets or the costs of maintaining them.

A few existing approaches combine bio-physical information on natural capital assets and monetary accounts. For example, the BBOP Standards and Handbooks²² combines bio-physical metrics to measure the target of 'no net loss' and combines this with financial cost data. Houdet *et al* (2014) present an experimental accounting approach that also includes both bio-physical and monetary accounts. The framework proposes developing a natural capital 'mirror' account that includes natural capital impacts and/or dependencies using bio-physical accounting units. The framework is centered around changes from the status quo or 'no net loss'. Whilst the proposed approach provides some interesting avenues for further investigation, it is yet to be applied in practice and may encounter challenges representing the more complex aspects of natural capital.

The CNCA framework provides an approach that links financial and non-financial data through the application of the asset register, and physical and monetary flow accounts (see Section 3). The choice of metrics to measure the condition of natural capital assets is relatively flexible, and the combination of monetary values and physical metrics addresses the challenge of comprehensively capturing direct corporate natural capital dependencies and impacts.

²² <http://bbop.forest-trends.org/pages/guidelines>

Table 2.1: Comparison of sustainability and natural capital accounting approaches

	1. Financial accounting and reporting	2. Environmental financial reporting	3. Extra-financial environmental reporting	4. Valuation of environmental externalities	5. Corporate natural capital accounting framework
Data reported	Financial costs and private value, which includes those relating to natural capital	Financial costs and/or benefits associated with natural capital	Non-monetary key performance indicators and qualitative measures	Bio-physical measures of emissions and resource use, non-market value estimates of impacts	Biophysical indicators of natural capital condition, financial and economic inter-dependencies inc non-market values
Examples include	International Financial Reporting Standards (IFRS); International Public Sector Accounting Standards (IPSAS); or Generally Accepted Accounting Principles (GAAP)	Integrated reporting ^a (includes areas beyond environment), Sustainability Accounting Standards Board ^b (includes areas beyond environment), and accounting for material events such as financial implications of Deep Water Horizon oil spill (Houdet and Germaneau (2011))	Carbon Disclosure Project ^c ; Global Reporting Initiative ^d , BBOP	Puma Environmental Profit and Loss account (E P&L) ^e PwC Total Impact Measurement and Management (TIMM) ^f (includes social and economic impacts)	Pilot accounts for Lafarge Tarmac, National Trust, The Crown Estate and United Utilities.
Metrics	Monetary (financial)	Monetary (financial)	Bio-physical and qualitative	Bio-physical and monetary	Bio-physical and monetary
Temporal perspective	Mainly historic and current	Mainly historic and current with recognition of future natural capital maintenance requirements (i.e. maintenance charge)	Current and historic and may include future plans	Historical and current bio-physical data, current and future impacts arising. Results frequently used for forward looking scenario analysis	Forward-looking - profile of benefits and costs associated with natural capital over time, reporting change from baseline year
Scope of natural capital impacts and dependencies	Natural capital under direct control of the company or directly liable for	As (1)	As (1), and may also include natural capital inter-dependencies along supply chain and product use/disposal	As (3)	As (1), plus impacts on natural capital from company assets or activities. Not including supply chain or product use/disposal.
Business decision-making/use	Reporting financial performance to investors/ stakeholders. (Underlying management accounts used for financial management).	As (1) plus understanding of current and future costs of natural capital maintenance.	Reporting environmental performance measured in bio-physical units / qualitative measures to investors/ stakeholders.	Detailed results used for strategic planning and operational risk management/ decision making as well as product and supply chain environmental	Informs on asset use decisions, strategy and planning. Reporting environmental performance in monetary and biophysical units,

	1. Financial accounting and reporting	2. Environmental financial reporting	3. Extra-financial environmental reporting	4. Valuation of environmental externalities	5. Corporate natural capital accounting framework
				optimisation. (Summary results can also be used for reporting environmental performance measured in monetary units to investors/ stakeholders).	including future private and external value.
Natural capital policy use	Limited - cost of historic spending on natural capital maintenance (if possible to disaggregate)	Provides information on costs of natural capital maintenance and informs on private obligations and potential tax and subsidy incentives.	Quantitative bio-physical data can be aggregated into sector or national environmental accounts (emissions and resource use).	If publicly reported: provides information on scale and location of key environmental externalities and potential areas for taxes / subsidies / trading schemes. Quantitative bio-physical data can be aggregated into sector or national environmental accounts (emissions and resource use).	If publicly reported: quantitative and monetary data can be aggregated into regional or national natural capital accounts. Provides information on costs of natural capital maintenance and informs on private obligations and potential tax and subsidy incentives.
Advantages	Established and verifiable.	Verifiable. Relatively easy to establish natural capital maintenance or replacement costs.	Standards for some ecosystem services developed and verifiable.	Can encompass full company value chain. Informs on scale of impact of company activities on others.	Framework for measuring bio-physical and monetary impacts, and private and external values. Includes future impacts.
Limitations/ Challenges	No explicit natural capital information. No coverage of future sustainability of natural capital.	No coverage of total value (private and external) dependent on natural capital maintenance.	No measure of monetary impacts or relation to costs.	Uncertainty of non-market values. Does not quantify natural capital asset values. Excludes future flows in value.	Practical challenges in estimating future flows of value. Uncertainty of non-market values.

Notes: ^a see: <http://www.theiirc.org/>; ^b See: <http://www.sasb.org/>; ^c see: www.CDP.net; ^d see: www.globalreporting.org; ^e see: <http://www.kering.com/en/sustainability/environmental-pl>; ^f see: <http://www.pwc.com/totalimpact>

3. CNCA FRAMEWORK

3.1 Structure of accounts

Corporate natural capital accounting produces a set of reporting statements that can be used to monitor and measure the state of natural capital and the value of benefit flows it supports. The reporting statements record the value that natural capital produces for an organisation and for society in general, now and in the future (assets), and the costs of maintaining this value (liabilities).

The CNCA framework features two principle reporting statements:

1. **Natural capital balance sheet:** this reports the value of natural capital assets, and the costs associated (liabilities) of maintaining natural capital assets.
2. **Statement of changes in natural assets:** this reports the change (gain or loss) in asset values and liabilities over an appropriate accounting period.

In order to populate these reporting statements, financial and environmental information systems and a framework of supporting accounting schedules are required. Figure 3.1 illustrates the typical elements that are needed:

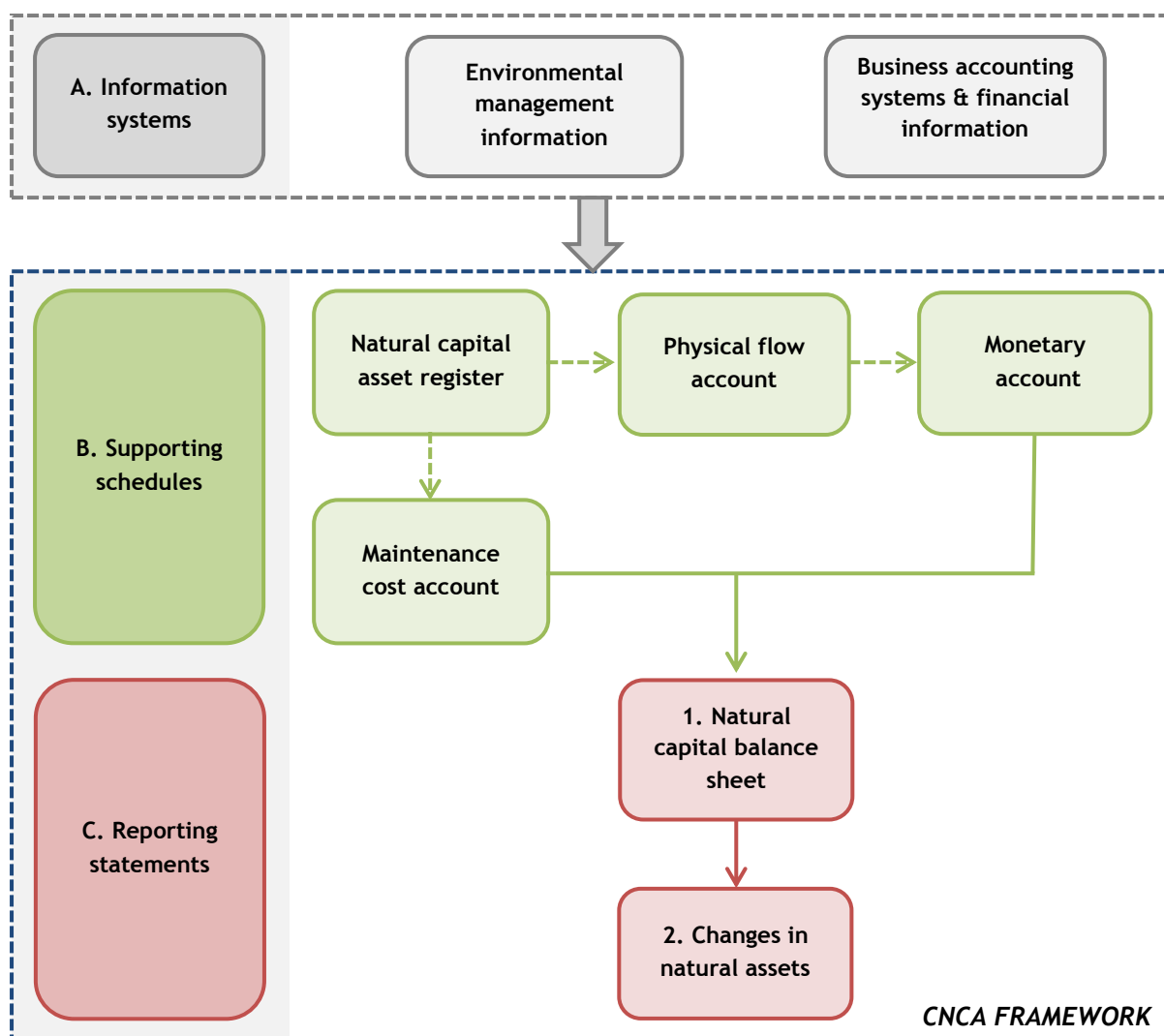
A. Information systems

- **Environmental management information:** to define and measure natural capital assets included in the scope of the account.
- **Business accounting systems and financial information:** to value the benefits derived from natural capital and to determine the costs of maintaining it.

B. Supporting schedules

- **Natural capital asset register:** an inventory that holds details of all the natural capital asset stocks that are relevant to the accounts, including their condition, as measured by their extent, quality and other relevant factors. For example, a woodland may contain a variety of species and the quality of this diversity may be measured by the number of species recorded on the site for a few selected taxa (fungi, insects, birds, etc.).
- **Physical flow account:** the expected flow of goods and services which are dependent on the natural capital assets stocks that are identified in the asset register. This can include benefits related to sub-soil natural capital resources (e.g. aggregates) and other natural capital (e.g. provision of final ecosystem services).
- **Monetary account:** the value of the expected flow of goods and services that are captured in the physical flow account. This includes both value derived by the organisation from natural capital assets ('private value') and wider societal benefits ('external value') from natural capital.
- **Maintenance cost account:** the costed schedule of current and future maintenance activities for natural capital assets.

Figure 3.1: CNCA framework, reporting statements, supporting schedules and information



An account does not need to be comprehensive to be useful. However, where it is compiled on a partial basis this should be made clear, avoiding the risk of drawing conclusions that are not based on data.

Whilst ‘accounting’ implies the use of monetary values, it should be recognised that these alone are not sufficient to monitor the long term health of natural capital assets. Lack of data or gaps in scientific understanding may result in some values being omitted from the (monetary) account. In addition, supporting services, such as the role of biodiversity in supporting regulating services, are not valued separately in the monetary account (to avoid potential double counting). This is why the CNCA framework explicitly includes both physical stock and flow information. Hence, the CNCA framework can be used not only for accounting purposes but also to coherently compile and interpret natural capital asset information held within an organisation.

Regardless of the metric used, not all capital assets may need to be included in a CNCA, provided this does not give a misleading picture of losses and gains (or profit and loss). It is likely to be appropriate to define the scope of the account to report on assets that are ‘material’; i.e. those that have a significant role in supporting the organisation’s operations, and/or those that the organisation has a significant positive or negative impact on. Terms such as ‘materiality’ and

‘significance’ are of course open to interpretation, and in practice, determinations will vary across organisations. However, criteria to help make such determinations are set out in the accompanying CNCA guidelines document. In addition an ‘asset-benefits flow matrix’ can be used to help establish the most important natural capital assets, accounting units and material benefits for inclusion in the supporting schedules (see Section 4.2).

3.2 Concepts and definitions

The fundamental concepts and definitions that have informed the development of the CNCA framework are set out in the following:

- Accounting units;
- Accounting period;
- Valuation;
- Specification of the baseline;
- Reporting gains and losses, and
- Comparison with financial accounts.

Further detail on the reporting statements and supporting schedules are presented in subsequent sections.

3.2.1 *Accounting units and natural capital assets*

An ‘accounting unit’ is the basic unit for which data are collected. It is proposed that the NCC (2014b), HMT (2014), and SEEA (2012) guidance of using major land cover categories as accounting units for natural capital is used for the CNCA framework. Units of land cover, such as woodland, farmland, and grassland, have the advantage that they are spatially distinct and additive. This allows the aggregation of values in the production of reporting statements. Consequently, each accounting unit is a delineated parcel of land of a single land cover type.

For each accounting unit, the following data may be defined and collected:

- Natural capital assets, such as soil, species, freshwater, minerals etc., that comprise the land cover should be compiled in an inventory (the natural capital asset register) and their condition measured by physical metrics and indicators concerning their extent, quality and spatial configuration.
- The flow of physical goods and services delivered (e.g. the flow of benefits such as food, fibre, recreation etc.) should be measured and recorded in the physical flow account.
- The monetary value of the physical goods and service delivered should be recorded in the monetary valuation account in terms of the expected stream of benefits over time.
- Liabilities are defined as the costed schedule of maintenance activities that delivers the reported benefits of the accounting unit, as identified in the physical flow account and monetary account.

The above data need to be compiled for an accounting unit to represent the natural capital asset-benefit relationship described in Section 2.1. Hence the task is to capture as best as possible the

qualitative, quantitative and spatial aspects of natural capital in order to provide a firm basis for its management.

3.2.2 Accounting period

Similar to financial accounting, there will be an appropriate 'accounting period', to allow the measurement of natural capital change over time. The selection of a suitable period may depend upon the nature of the assets involved, but typically could be set to coincide with the organisation's financial accounting period. This would facilitate the comparison of natural capital accounts with financial accounts. There will also be a 'reporting date' which will be used to determine the state of affairs and values at that date.

Hence the aim could be to prepare and review accounts annually in order to keep natural capital under frequent management review. However some natural capital elements will change slowly or may be difficult or costly to measure on an annual basis. In such cases these elements of the account may be updated on an appropriate basis, which could follow the rate of change of the asset, such as every five years, or after a significant event (e.g. a forest fire). However annual accounts should still be prepared even if only updated for the few elements that have changed, (such as maintenance costs that may change annually with wage rises or other input costs).

It may be practical to plan for a thorough revaluation exercise of all natural capital information on a regular five year basis, or some other appropriate time interval. A key part of the planning phase of CNCA implementation is to decide how often natural capital data will need to be evaluated and to ensure that adequate resources are made available at the right time.

3.2.3 Valuation

A guiding principle of the CNCA framework is to report future streams of benefits and costs for a given state of natural capital. All values in the reporting statements are expressed in present value terms; i.e. discounted flows of expected benefits and cost streams over the persisting life of the natural capital concerned. Although, typically this is not common practice in financial accounting statements, it does sometimes occur (e.g. in the practice of stating future pension liabilities). Consequently, it is worth emphasising this important departure from conventional accounting. The following example illustrates the approach (solely in relation to recreation) and some of the implications²³:

- A woodland provides recreation benefits worth £1m per annum that, if the organisation invests in appropriate maintenance activities, could be sustained in perpetuity. In present value terms these benefits are worth £25m over perpetuity if a 4% discount rate is applied²⁴.
- If, the organisation invests in maintenance activities that improve the condition of the woodland, this could lead to increased recreational value from more nature watching opportunities - say to £1.4m per annum. The present value of benefits would then increase to £35m.
- For the purposes of natural capital accounting, the recreational value of the woodland would have increased from £25m to £35m. As these represent the flow of benefits derived from the

²³ Note that this example ignores the costs associated with maintaining the asset values; discussion of net asset values is provided in Section 3.5.

²⁴ A constant annual value and discount rate of 4% is assumed for illustrative purposes only. The formula for calculating the present value (PV) of a constant steady state stream of benefits in perpetuity is, $PV = \text{annual value} / \text{discount rate}$. In this case $£1m / 0.04 = £25m$.

woodland natural capital assets over time, these are the relevant figures for inclusion in the reporting statements.

The first implication is that this approach values the capacity of natural capital to generate benefits into the future. It does not report the actual benefits delivered historically, which is the usual convention in financial accounts. The second implication is that, whereas the purpose of conventional accounts is to accurately report the changes in assets and liabilities over an accounting period, the focus is on flow of costs and benefits in the long run. The account reports a long term perspective, rather than short term fluctuations in benefits or costs. In particular small but permanent shifts in the profile of benefits or costs over time can be more significant for calculations of (net) present value, than current year or short term fluctuations which are the focus of year-on-year comparisons.

Additionally, the framework is concerned with differentiating between the private value that an organisation receives from natural capital assets and the value of benefits enjoyed by others, such as value of the open-access recreation or climate regulation. Therefore, the private and external values of expected benefits streams are recorded and reported separately. The private value associated with natural capital will typically be measured from the sale of market goods, such as the net revenue a farmers' receives from crop production. As in a financing accounting context, market goods can be valued at their 'exchange' price. An organisation may also derive non-market benefits from natural capital, such as the use of private water supplies (e.g. sourced on-site), which can also be reported as a private value²⁵. The benefits enjoyed by others (external value) are typically characteristic of public goods and subject to missing or incomplete markets. In these cases exchange prices are not observable, but non-market valuation techniques can be applied to estimate external values²⁶.

3.2.4 Specification of the baseline

One of the key components of the CNCA framework is the establishment of a 'baseline' position and the reporting of natural capital gains and losses relative to this. The baseline provides a reference scenario which is primarily concerned with the condition of natural capital and thereby setting a reference asset value against which subsequent changes in the state of natural capital can be measured in monetary terms. Although the baseline is primarily concerned with providing a reference point for reporting asset values, the baseline scenario may also have implications for the liabilities recognised on the liabilities side of the balance sheet (see also Section 3.5.3). Setting a baseline entails consideration of multiple factors for each accounting unit, including its boundary and extent, the condition of natural assets, use and management actions, and the resulting flow of costs and benefits overtime (Box 3.1).

²⁵ In the private water supply example, the private value to the organisation is the avoided cost of alternative supply (e.g. from public utilities); i.e. the cost of replacement.

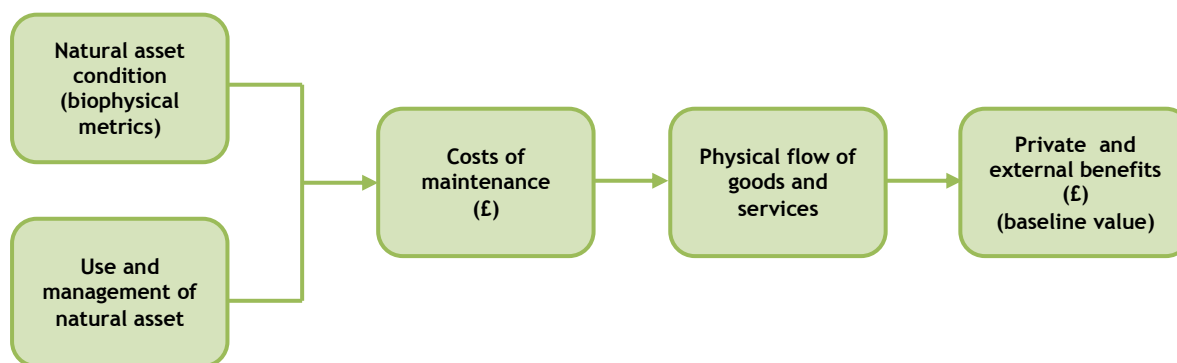
²⁶ Market prices are based on exchange values. Non-market valuation techniques tend to focus on estimating changes in economic welfare. The degree to which these two approaches differ is considered in Annex 3.

Box 3.1: Components of the baseline scenario

The baseline provides the ‘reference scenario’ against which the condition and associated asset value of natural capital is subsequently measured and tracked. Any enhancement or deterioration of natural capital value is reported as either a cumulative gain or loss relative to this baseline and as such this is the main indicator of natural capital status (in monetary terms). The baseline is dynamic in the sense that it requires the specification of the profile of costs and benefits over time and encompasses a number of dimensions for a given unit of natural capital. Namely:

- The condition of the natural assets that comprise the unit of natural capital (measured by appropriate quantity, quality and spatial configuration metrics and indicators);
- The use and required maintenance activities to sustain the baseline condition of natural assets over time;
- The physical flow of goods and services that are expected to flow over time; and
- The value of the goods and services and the costs of maintenance over time.

The combination of the natural asset condition and assumptions concerning its use and management should be the ‘grounding point’ for the expectations that are then set in relation to the time profile of benefits:



For the natural asset condition the baseline should relate to biophysical measures of its status, consistent with the information reported in the natural capital asset register. Hence, whilst the baseline will be most clearly reported on the natural capital balance sheet - as the baseline asset value - it is underpinned by a coherent rationale concerning the state of natural capital over time.

As for liabilities, the treatment may be more nuanced. One possible approach is to consider the baseline as a reference point against which losses are to be avoided; then, as a minimum, liabilities should be determined by the natural capital maintenance costs required to sustain the baseline condition of natural capital over time. However, there may be occasions when the reported liabilities may be higher than baseline. For example, if legal obligations dictate a higher level of spend, or if the organisation is currently spending at a higher level to achieve a higher asset value and is committed to sustaining this over time. In some cases, this may simply imply recurring (land) management activities (e.g. thinning of woodland), or it could also entail significant restoration actions.

For the purposes of measuring physical flows and consequent values, the minimum requirement for establishing a reference scenario is the level of physical ecosystem services delivered. Hence, in these cases, development of an account can be iterative, and improved information on the condition of natural capital stocks that underpin these benefits can be refined in subsequent

iterations²⁷. It is likely to be a demanding exercise to cover all natural capital assets that support all the flows of benefits within a single accounting period. Indeed, more may be learnt by attempting to measure the condition of natural capital along with the expected flows, in order to understand how changes in the former may impact the latter.

The actual profile of the baseline also requires careful consideration. A number of alternative scenarios could be relevant, depending on an organisation's natural capital management objectives. Possible alternatives include, for example:

- Maintaining the current extent and condition of natural capital, implying that the baseline would be set at the existing situation (the status quo) and assuming that this prevails over time;
- Restoring natural capital and benefits to some important historical level, implying that the baseline would be set in relation to a historical reference point; or
- Enhancing natural capital to meet the organisation's, or wider social objectives, including regulatory requirements or Government policy, implying that the baseline would be set at a 'target' level.

Note that this set of options is indicative only and is not exhaustive.

Although there are many potential approaches to setting the baseline, the guiding principles for the development of the framework are concerned with monitoring the status of natural capital over longer term. Hence in the absence of a reference scenario that implies the improvement of natural capital, or a fully specified and costed plan for natural capital investments, it may be interpreted that a baseline which maintains the existing natural capital situation (the status quo), should be adopted as a minimum²⁸. This would ensure that any losses against the status quo are made visible, and that the costs of maintaining existing natural capital are reported as a minimum liability.

A possible implication of the specification of a baseline is that it can represent a natural capital management 'plan' for an organisation. This could be both formally recognised in company or regulatory targets, or simply an outcome from establishing an account and specifying a baseline that is consistent with maintaining the current extent and condition of natural capital. The requirement for a 'plan', however, is not essential. The CNCA framework can be applied as a tool for measuring the status of natural capital over time without any association to management objectives.

A key aspect of the range of alternative reference scenarios that can be considered for an account is that they may result in changes in overall (net) natural capital value being reported very differently on a balance sheet. For example: as a net gain in value in some situations, or no change, or even a loss in others (Box 3.2). The possibility for different organisations to specify different baselines also implies that different organisations' accounts would require careful comparison. However, in providing a framework for natural capital accounting, it is desirable to recognise the need for flexibility and not set requirements that are too prescriptive or restrictive, particularly at the inception stage of the framework. It is noted that consistency and comparability

²⁷ Note that in these cases care should be taken to ensure the partial nature of the account is fully reflected in any conclusions and results that are reported. In particular it will not be possible to assert no net loss in natural capital if a baseline is not appropriately grounded in biophysical measures of the status of natural capital.

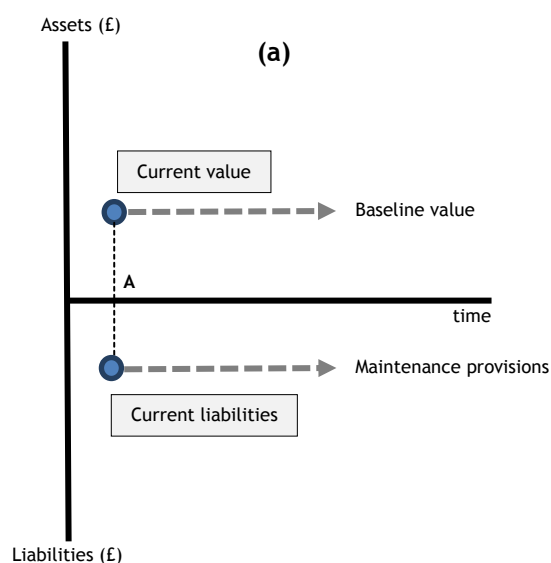
²⁸ In effect an organisation may adopt a 'business as usual' perspective for developing an account provided that implications of this for the baseline condition of natural assets and their associated value are sustainable against some feasible maintenance regime.

between organisations may be a future goal and aspects such as the specification of the baseline can be subject to ongoing review and refinement.

Box 3.2: Implications of alternative baseline specifications

As the baseline provides the reference scenario for measuring changes in (net) natural asset values, its selection could influence – in combination with actual and forecast performance – whether outcomes are reported as net gains or net losses on the balance sheet. For example, taking two possible baseline specifications:

1. *Maintaining the status quo*

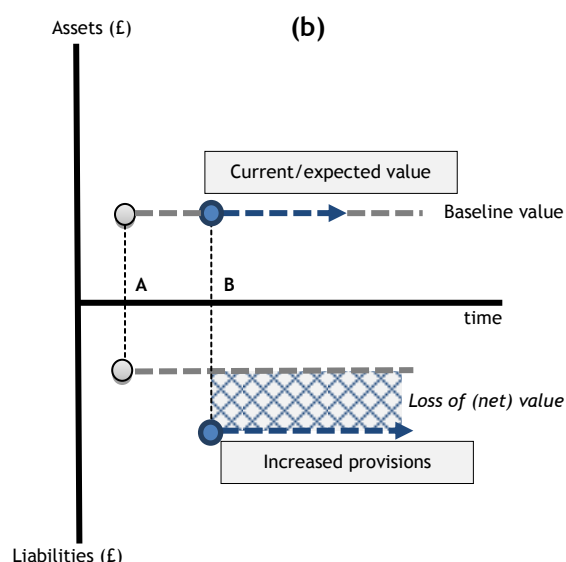


Panel (a)

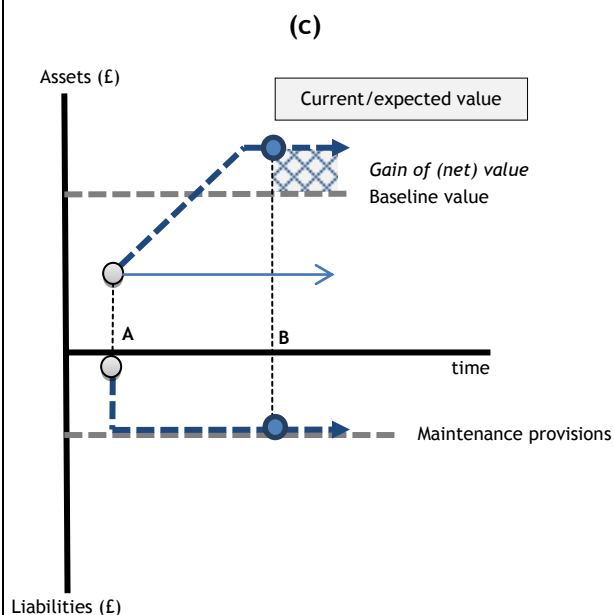
- At the inception of the account (point A), the baseline is specified based on current performance (i.e. current asset value and liabilities).
- Future liabilities are assumed to remain at the same level as current.
- The flow of asset value in the baseline is assumed to remain at the same level as current, given these maintenance actions.

Panel (b)

- At the accounting period (point B), an increase in the future natural capital maintenance provision is recognised in order to sustain the baseline asset value.
- Accounting for the increased maintenance provisions would therefore result in a loss of net natural capital value being reported on the balance sheet.
- However, if at the outset of the account the increase in future maintenance cost was recognised and incorporated into the baseline (i.e. a ‘spending more to standstill’ profile for liabilities) then no loss in net value would be recorded.



Continued.

Box 3.2 (cont.): Implications of alternative baseline specifications**2. Target level of natural capital****Panel (c)**

- The baseline is specified in relation to a regulatory target for the status of natural capital, the associated maintenance provisions for attaining this target, and a corresponding asset value.
- Meeting these obligations results in a greater asset value due to the enhanced condition of the natural capital, which was unforeseen when the baseline asset value was determined.
- At the accounting point (point B) a net gain in natural capital value is recognised, resulting from the current and expected asset value exceeding the baseline value.
- Note that the net gain however is substantially less than what would be recorded if the baseline was alternatively specified as a continuation of the status quo for the asset value at the account inception (point A).

3.2.5 Reporting gains and losses

Having determined the baseline, reporting of (expected) asset values may be expressed as either a gain or a loss relative to the baseline. An illustrative example is set out in Table 3.1:

- In the first year of reporting (account at Year 1), the baseline value is set at the current (actual) level of benefits delivered (£100k) and the status quo is taken as the basis for projecting the baseline over future years. The overall asset value is determined only by the baseline calculation.
- In subsequent years, the account picks up the effect of a deterioration in the condition of the natural capital. The account at Year 3 reports a fall in asset value to £60k (a £40k loss in value relative to the baseline), continuing the downward trend observed in Year 2.
- In response, a recovery plan is put in place (requiring further investment), which is incorporated into the forecast for the cumulative gain/loss for future years relative to baseline. It is expected that the baseline value will be restored by Year 7.

Table 3.1: Example of baseline, cumulative gains and losses (£k)*

(a) Account at Year 1	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
	Actual	Forecast	Forecast	Forecast	Forecast	Forecast	Forecast
Baseline value	100	100	100	100	100	100	100
Cumulative gain/(loss)	-	-	-	-	-	-	-
Asset value	100	100	100	100	100	100	100
(b) Account at Year 3	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7
	Actual	Actual	Actual	Forecast	Forecast	Forecast	Forecast
Baseline value	100	100	100	100	100	100	100
Cumulative gain/(loss)	0	(20)	(40)	(40)	(30)	(20)	0
Asset value	100	80	60	60	70	80	100

Note: * For simplicity of exposition, annual values are undiscounted.

As natural capital tends to change relatively slowly and given that a role for natural capital accounting is to help maintain asset values over the long term, the use of a baseline that is fixed for a relatively long time-frame is vital. Similarly, reporting gains or losses on a cumulative basis (rather than single year movements in isolation) informs more fully on the implications of current trends in the condition of natural capital and its implications for its long term sustainability.

3.2.6 Comparison with financial accounts

The corporate natural capital accounting framework differs from conventional financial accounts in both scope and approach to valuation. Consequently it will produce values that differ significantly from financial accounts. However comparing the two results is useful in several ways:

- Natural capital accounting aims to report the full value of the benefits (asset value), and the full maintenance costs (liabilities) associated with natural capital. Comparing these values with those reported under financial accounting illustrates the proportion of natural capital value and cost already captured by conventional accounts.
- Financial accounts aim to recognise the private value of tangible assets; comparing the financial net book value of land assets with the natural capital accounting private values demonstrates how much of this value is reported under financial accounts and opens up questions around the elements of value that financial accounting does not include.
- The difference between liabilities recognised under financial accounting and the natural capital maintenance liability reported under natural capital accounting highlights the extent to which full natural capital maintenance is missing from financial accounts.

The above points are made not to argue that financial accounting is flawed, but to highlight that these different systems are designed to answer different questions and have different objectives. Understanding the difference between the values produced by these two systems helps inform better approaches to managing assets. For these reasons the natural capital account will disclose the financial accounts data (asset value and liabilities) associated with natural capital assets wherever they are recognised in the financial accounts.

3.3 Boundary of natural capital account

In preparing a corporate natural capital account, an important initial step is to explicitly define the boundary of the exercise. The CNCA framework recognises two potential scopes for reporting:

1. **Core natural capital account:** this measures the direct value and costs associated with natural capital over which the reporting entity has a stewardship interest.
2. **Extended natural capital account:** this reports both (a) the material impacts of an organisation on other external natural assets (i.e. the impact on natural capital owned/under the stewardship of other private or public organisations, or completely ‘unowned’) and (b) the impact of external natural assets on those of the organisation.

The core account is simpler in scope as it does not consider or isolate the impacts of interactions with external natural assets. The extended account - which is described in Annex 4 - addresses this, although it is recommended that this analysis is limited to only the most significant interactions between an organisation and the ‘external’ natural environment.

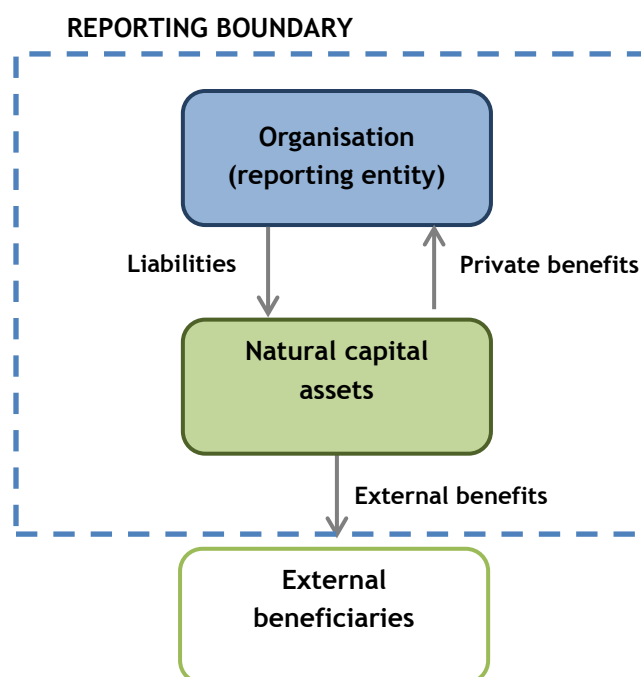
The basic natural capital account covers natural capital over which the organisation has a stewardship interest. The test of stewardship interest should take into account the following:

- Whether the organisation has a legal responsibility to care for the natural capital;
- The extent to which the organisation has a vested economic interest in the long term health of the natural capital;
- Whether the organisation owns the natural capital; and
- The extent to which the organisation (rather than any other party) has effective management control of the assets.

No single answer to any one question above can provide a clear criterion for inclusion within the organisation’s scope of reporting. But, on balance, the questions can help inform a decision as to which party has the most significant stewardship interest (e.g. a landowner or the tenant farmer).

For those areas of natural capital that the entity has a stewardship interest in, the boundaries for the core account can be characterised as shown in Figure 3.2. Within the scope of the core account, the benefits to be measured include: (i) the private benefits that flow to the organisation from the natural capital; and (ii) the external benefits that flow to all other external beneficiaries from that natural capital.

Figure 3.2: Scope of core natural capital account - asset values



3.4 Supporting schedules

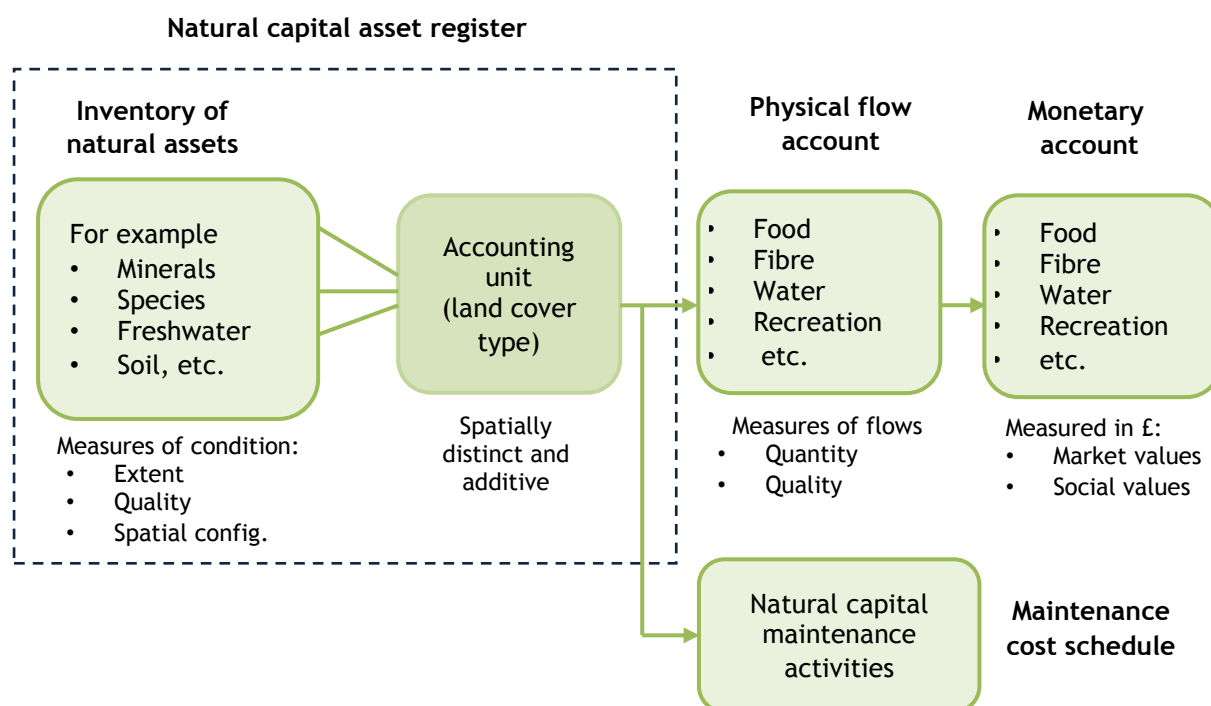
Following from Section 3.1 (Figure 3.1), four supporting accounting schedules underpin the CNCA framework and enable the reporting statements to be populated:

- Natural capital asset register;
- Physical flow account;
- Monetary flow account; and
- Maintenance cost schedule.

The framework is not prescriptive as to the exact form and data requirements of these schedules, because each natural capital situation is different and the particular data requirements to evaluate natural capital values and liabilities will vary accordingly. Here, the framework outlines the type of information required in order to support the values reported in the statements (Figure 3.3).

The respective schedules should be developed to the extent that they support the production of robust data and for reporting and providing insights into the health and productive capacity of the natural capital concerned.

Figure 3.3: CNCA supporting schedules



3.4.1 Natural capital asset register

The asset register is the repository of bio-physical metrics that measure and track the state of natural capital assets over time.

The basic entry in the asset register is the “accounting unit”, which is a delineated plot of land of a single land cover type. For each accounting unit, the following data may be defined and collected in the asset register:

- The boundary, extent and type of land cover (woodland, farmland, etc.);
- Major natural capital assets, (such as soil, species, freshwater, minerals etc.) that comprise the land cover;
- The condition of these assets as measured by quantity, quality and spatial configuration metrics; and
- Other important information about the natural function of the accounting unit, including major dependencies on other natural assets, critical thresholds, tipping points, non-linearities and capacities.

There is potential for a large amount of information to be collected for each accounting unit. Consequently, it is important to restrict the data requirements to those items that will provide the greatest insights into the health and productive capacity of natural capital assets. An example is shown in Table 3.2, whilst specific consideration of metrics for monitoring biodiversity is provided in Box 3.3.

Table 3.2: Example of natural capital asset register

	Indicator number	Indicator	Units	Baseline year (2010)	Reporting year (2014)
Accounting unit: Farmland					
	1	Area arable	Hectares	560	595
	2	Linear features (hedges, grass margins)	Km	30	32
Asset stock metrics:					
Species	3	Species per 10m hedgerow	Number / 10m	60	-
	4	Rare/protected species recorded	Number	12 Species	-
	5	Recorded farmland bird species	Number	12	-
	6	Plant species	Number of species	18	-
Soils	7	Number of earthworms/m ²	Number/m ²	64	-
	8	Carbon stored in top 20cm soil	tonnes/ha	65	-
	9	Depth top soil	Cm	65	-
	10	Inputs applied	kg fertiliser / ha/year	280	-
Water	11	Nitrate levels in adjacent water bodies	mg/l	-	-

Lack of data or gaps in scientific understanding may result in some values provided by natural assets being omitted from the monetary account. In addition, supporting services, such as the role of biodiversity in regulating service provision are not separately reported in a monetary account (for example to avoid potential double counting). The natural capital asset register therefore plays an important role in providing a broader understanding of the state of natural capital and the flows of benefits it supports. Over time, and with appropriate analysis, the data held within the account may help establish an improved understanding of the link between asset condition and the flow of goods and services from natural capital.

Box 3.3: Biodiversity metrics

The natural capital asset register is a fundamental component of the CNCA framework. It is where bio-physical metrics that measure and track the state of natural capital assets, including biodiversity, over time are reported.

Biodiversity describes the ‘diversity of life’ and is one component of ecosystems and natural capital. Ecosystem service provision is dependent on biodiversity as a ‘supporting function’ in processes such as disease regulation, soil formation, pollination, nutrient cycling. Biodiversity can also be a ‘final’ ecosystem service, such as the value derived from the direct appreciation of nature and enjoyment of activities such as bird watching.

Developing metrics that inform on the multi-faceted nature of biodiversity may pose a significant challenge. To provide a complete picture of the state of biodiversity, metrics that provide information on the quantity, condition, and spatial configuration of each of its components (i.e. species, ecological communities and assemblages, and ecosystem levels) should be developed.

In practice, data and scientific understanding of all components of biodiversity is usually incomplete and it is likely that surrogates and proxies will be required. BBOP (2012) provides some useful guidance in the context of offsets to prioritise the development of metrics including consideration of:

- Conservation significance, including irreplaceability and value to people;
- Ecological knowledge of the likely responses of different biodiversity components to different forms of human intervention;
- Geographic frame of reference, affecting the scale at which ecological evaluations need to be made; and
- Availability, quality, and spatial scale (extent and resolution) of existing data, and the feasibility of acquiring new data and tracking over time.

As with other elements of an account, it is likely that data and information concerning the biodiversity and its contribution to private and external values can be refined in an iterative manner.

3.4.2 Physical flow account

The purpose of the physical flow account is to identify and quantify the flow of goods and services provided by a natural capital accounting unit, or an aggregation of accounting units over time²⁹.

For a given accounting unit (in a specific location), not all flows from natural capital will be significant or worth evaluating. The ‘asset-benefits flow matrix’ (Section 4.2) can be useful in identifying the most relevant flows of services for further evaluation. Furthermore, although some services may be difficult to quantify in monetary terms, they may be important and, if possible recorded in physical terms. An example of a physical flow account is presented in Table 3.3.

²⁹ Aggregation relies on linking natural capital assets to the measures of physical flows, and to do this dynamically. Assets should be measured in relation to one another and not independently. In practice, this is likely to be challenging in some cases, resulting in the need for pragmatic assumptions to be made. Care should be taken to ensure these assumptions are explicit and reflected in any conclusions.

Table 3.3: Example of physical flow account

Service	Indicator number	Indicator	Units	Reference year (2010)	Reporting year (2014)
Food	12	Yield (by crop) per ha	Tonnes/ha	12.5	12.7
Recreation	13	Visits per year	Number per year	55,000	65,000
Climate regulation	14	Carbon stored in top 20cm soil/ha (see 8)	Tonnes/ha	65	-
	15	Carbon stored in above ground biomass	Tonnes/ha	-	-
	16	Carbon stored in below ground biomass	Tonnes/ha	-	-
	17	Tonnes of carbon sequestered per year (soils)	Tonnes/ha	-	-

There is likely to be some iteration between the development of physical measures of flow and the monetary account. For example, the method for valuing a benefit may determine the approach to how it should be measured in physical terms.

3.4.3 Monetary account

The purpose of the monetary account is to establish the value of the flow of benefits reported in the physical flow account. These should be based on the expected profile over time, with benefits/costs expressed in present value terms. Future values should be discounted according to the organisation's discount rate, reflecting the opportunity cost of capital. An example of a monetary account is shown in Table 3.4.

Table 3.4: Example of monetary flow account

Benefit	Indicator number	Measure	Units	Baseline year (2010) value	Reporting year (2014) value
Food	19	Value (by crop) per tonne	£/tonne	203.0	250.0
Recreation	20	Willingness to pay (WTP) per visit	£/visit	8.5	8.5
Climate regulation	21	Non-traded price of carbon	£ (2011)/t	55.0	58.0

The data set out in Table 3.4 would be used to construct the flow of benefits over time. The discounted sum of benefits is the value used for consolidation into the reporting statements. Note that the type of benefit dictates the appropriate valuation method that should be used. For example, private benefits, such as income from food production, may be valued based on future forecasts of output prices and input costs informed by recently observed market prices. Non-market benefits, such as recreation benefits, may be evaluated through primary research (using either stated preference methods or revealed preference methods) or by using evidence from the previous studies (via value transfer).

3.4.4 Maintenance cost schedule

The purpose of the maintenance cost schedule is to gather all the information necessary to calculate the cost of maintaining the natural capital benefit of an accounting unit. For each accounting unit there should be:

- A description of the natural capital maintenance activity required;
- Details of the level of activity required over time; and
- A profile of the costs incurred, split between those that are legal requirements and remaining costs necessary for full capital maintenance.

The cost profile is discounted at the organisation's discount rate to provide the natural capital maintenance liability for the natural capital balance sheet.

As highlighted in Section 3.2.4, a profile of natural capital maintenance activities should be established as part of the baseline specification (noting that this could entail objectives to enhance natural capital over status quo levels). In the absence of any intention or on-going activity to achieve or sustain natural capital above baseline level, this scenario would likely form the basis of natural capital maintenance cost schedule; i.e. the provisions should represent the costs of actions needed to meet the baseline condition of natural capital over time. However, if the organisation has legal obligations or intentions to invest in a higher level of maintenance or restoration than baseline, then these activities should be used as the basis for the schedule.

These activities could include recurring (land) management measures, for example, in cases where the baseline condition is currently being met and is not expected to be departed from in the future. In addition, if enhanced condition of natural capital is being achieved (i.e. higher than the baseline) and requires higher costs, these should also be recognised. Other ways in which natural capital maintenance liabilities may be discharged should also be considered (e.g. through environmental taxes - See Box 3.4).

If the condition of natural capital is below the baseline level - for instance in the case of an organisation working towards a regulatory target - then the restoration costs may need to be identified and included in the provisions. Alternatively, if failure to maintain assets or external impacts (e.g. disease) leads to increases in future costs to restore the natural capital to baseline condition, then these higher remediation costs need to be represented in the schedule in order to reflect the full liability.

Box 3.4: Treatment of environmental taxes

The core boundary of CNCA concerns the assets for which the entity has a stewardship interest. To the extent that environmental taxes directly relate to these assets, then it could be that an organisation will discharge some of the liability for the maintenance of natural assets via taxation; for example, in the case where taxes are used to make good losses for specific assets or maintain them. Note though that the tax - in principle - does not change the maintenance liability that should be recognised in the account, rather it is relevant to how much of the liability is discharged via taxation (and as such is a side issue to the CNCA account).

Where taxes are specific - i.e. the level of tax relates directly to the economic impacts of the activity to specific assets - the purpose of the tax may be relevant. For instance:

- If the tax is used to make good losses (such as a reparation fund) then it can be seen as discharging a CNCA liability;
- If the tax is used to compensate for externalities then it may be part of the extended account boundary (see Annex 4), depending on the circumstances; or
- If the tax used as an economic incentive not to pollute, then it is likely the case the tax is beyond the liabilities that would be recognised in a natural capital account.

As environmental taxes are typically general in nature (i.e. not specific to the direct impacts on any particular assets, and calculated on a simple formula, such as the aggregates levy) it is more likely to the case that obligation is interpreted as outside of any obligation to maintain specific natural capital assets. Hence unless a tax liability can be demonstrated to discharge/alleviate a specific natural capital liability then it should be interpreted as separate from the core liabilities that feature in an account. Whilst this therefore is not recognised on the balance sheet, it may be useful to include the tax liability in a note to the account.

3.5 Natural capital balance sheet

3.5.1 Format

The natural capital balance sheet reports the value of the (in-scope) natural capital (assets) and the ongoing costs of maintaining natural capital at the reporting date (liabilities). Structuring the balance sheet to separate natural capital asset values from maintenance liabilities follows the general accounting principle that mandates the full disclosure of each. For this reason, the natural capital balance sheet reports the two separately.

On the asset side, natural capital may have two components of value:

- Private value: representing the internal economic benefit of the natural capital to the company. This value should be assessed using existing and forecasted market prices.
- External value: reflecting the value that natural capital provides to all other beneficiaries.

These two elements of value are reported separately, as there are important differences in the economic incentives for the company with respect to each.

Asset values are also segregated between renewable and non-renewable resources, as these distinct types of natural resources are subject to very different management and utilisation

decisions. Non-renewable assets are taken as those that cannot be renewed in a meaningful management timescale (e.g. typically 100 years or so).

Finally, the costs associated with natural capital maintenance are disclosed as liabilities, segregated between legal liabilities and provisions for other maintenance costs.

These requirements determine the format for the balance sheet as shown in Figure 3.4. The balance sheet is essentially a statement of natural capital asset values and liabilities at the reporting date. It does not 'balance' in the sense that a conventional financial balance sheet does, since - more correctly - it is a schedule of consolidated natural capital assets and liabilities which net off to show a net natural capital value.

Figure 3.4: Natural capital balance sheet in year A

	Year A					Of which reported in fin. accts £'m
	Non-Renewables		Renewables		Total	
	Private	External	Private	External	Value	
	£'m	£'m	£'m	£'m	£'m	
Assets						
1 Baseline value	50	-	40	60	150	
2 Cumulative gains/(losses)					-	
3 Additions/(disposals or consumption)					-	
4 Revaluations and adjustments					-	
Gross asset value	50	-	40	60	150	40
Liabilities						
5 Legal provisions					(5)	(4)
6 Other maintenance provisions					(15)	
Total maintenance provisions					(20)	(4)
Total Net Natural Capital					130	

The balance sheet format is intended to:

- Highlight the baseline natural capital value and so show whether gross asset value is above or below this level;
- Disclose cumulative movements in natural capital value by major cause, such as changes in quality, quantity, or value. Quality movements are reported as gains or losses, quantity changes reported as additions, disposals, or in case of non-renewables as consumption, and valuation changes as revaluations or adjustments;
- Explicitly split natural capital value between renewable/non-renewable resources and between private and external benefits;
- Disclose natural capital maintenance requirements; and
- Allow comparison of the natural capital asset values with those recognised under reported financial accounts.

The content of the balance sheet is described in the following sub-sections.

3.5.2 Asset values

Asset values are disclosed as movements relative to the baseline value. There are several reasons why the actual asset value will differ from that defined in the baseline valuation. These are recorded in terms of differences in the quantity or quality of the asset, or changes in unit value. The driver of this change can be exogenous to the organisation, or endogenous. Examples of each are given in Table 3.6.

Table 3.6: Examples of causes of changes in asset value over the accounting period

Change	Renewable		Non-renewable	
	Exogenous	Endogenous	Exogenous	Endogenous
Quality	Disease, invasive species	Land management, investments	-	-
Quantity	Fire, storms, natural weather events	Land purchases or sales by the company	Natural losses	Extraction, consumption, or new discoveries
Valuations	Movement of local beneficiaries, exchange rates, changes in preferences	Change of use that results in different flow of ecosystem services	Adjustments arising from new estimates/data, market prices	Technology enhancements to value of basic resource

Three categories of change in asset value are identified:

- Quality of natural capital: driven by exogenous or endogenous changes and including any planned enhancement or deterioration. This is reflected in the cumulative gain or loss line. It is not envisaged that this will be applicable in the case of non-renewable resources.
- Quantity of natural capital: arising from additions, usually by way of acquisition, but possibly by creation/transformation or new discoveries, disposals of land (either by transfer or sale), or in the case of non-renewables by extraction/consumption.
- Valuations: arising from other changes impacting value of natural capital assets, typically exogenous changes (such as prices and market preferences), but can also include any adjustments such as major changes in valuation methodology, baseline assumptions or change to use(s) with different values.

It is important to emphasise that the categories above may not be material in all cases for any given asset. They are described here as there may be highly significant shifts in value in some instances and the methodology needs to identify the causes of these changes.

The asset line items 1-4 on the natural capital balance sheet (Figure 3.5) are defined in more detail below.

1. Baseline value

Baseline values are determined by the assumptions in the valuation baseline as described in Section 3.1. The baseline value will represent the value of the asset at an appropriate baseline date. This

valuation is the net present value (NPV) of the appropriate benefits (and dis-benefits), evaluated in perpetuity, and discounted at the organisation's opportunity cost of capital³⁰.

Item	Definition	Rationale
1a. Baseline Private Value	<p>The present value (PV) of expected revenue streams less all direct production costs (costs of sale) as assumed in the valuation baseline, calculated in perpetuity.</p> <p>This should be discounted using the organisation's commercial discount rate.</p> <p>This should exclude natural capital asset maintenance costs, which are reported separately and covered under liabilities.</p>	<p>It is useful to separate the value that provides the organisation with a direct economic benefit (private value) and the broader non-market benefits that accrue to others (external value).</p> <p>Values are accounted for in perpetuity to reflect the permanence of (renewable) natural capital assets.</p>
1b. Baseline External Value	<p>The present value (PV) of non-market benefits (or dis-benefits) as assumed in the valuation baseline, calculated in perpetuity.</p> <p>This should be discounted at the organisation's commercial discount rate.</p> <p>This should exclude natural capital asset maintenance costs, which are reported separately under liabilities.</p>	

2. Cumulative gains and losses

The purpose of this reporting line is to reveal how effectively the organisation is maintaining its existing natural capital assets, and as such it is a key natural capital maintenance performance indicator. It excludes asset value changes due to valuations (unit value changes), additions, or disposals, all of which are covered below (see items 3-4). It is not envisaged that this category would apply to non-renewable resources.

Understanding the current value of natural capital relative to the baseline is important; consequently the gain or loss in value is expressed relative to the baseline value (see Section 3.2.4) and in this respect it represents a cumulative gain or loss from the baseline value.

³⁰ In practice this requires asset values to be forecast over a reasonable time period, and a residual value to be assumed. If appropriate (given the condition of natural capital), the residual value can be assumed to represent the 'steady state' level of benefit/cost.

Item	Definition	Rationale
2a. Cumulative gain/(loss) - private value	The cumulative impact on the private value (in present value terms) arising from changes in asset condition (excluding additions, disposals and changes covered below).	It is important to highlight the loss of asset value, through failing to maintain natural capital assets (relative to the baseline).
2b. Cumulative gain/(loss) - external value	The cumulative impact on the external value (in present value terms) arising from changes in asset condition, (excluding addition, disposals or changes covered below).	Similarly, it is important to measure any recovery or enhancement in asset value arising from restoration or investment.

Natural capital assets can display a wide variety of characteristics and timescales in terms of a capacity to regenerate or susceptibility to degrade, in the absence of proper maintenance. For many assets, both natural regeneration and active management may be required in order to sustain natural capital asset condition and the flows of value derived over time. Given the practical difficulties of isolating the impact on value of these two processes, this item will measure any net change in asset value arising from its maintenance activities coupled with the natural processes of regeneration.

The assessment of value change will involve a periodic review (typically annually) of asset condition and any resulting impacts on long term value. To the extent that proper maintenance is not carried out, any reduction in value may be permanent or temporary. A permanent reduction may be due to an irreversible loss that will persist in the accounts; however a temporary loss may be reversed if additional restorative work is carried out. The intent of natural capital accounting is to record any temporary loss in full, and only realise any recovery when the remedial work has had its effect. This recovery may be gradual and each incremental improvement in the benefit level should be reflected by reducing the loss in the period concerned. Similarly, the improvement of the quality of any planned investment to natural assets above baseline levels should only be recognised once the investment is complete and then as the higher benefits realised.

3. Additions, disposals and consumption

The purpose of this line item is to record any quantity changes in natural capital. Quantity changes can arise from additions to natural capital, disposals, or (in the case on of non-renewables) from consumption.

There may be additions to the natural capital asset register, typically through acquisition of land, changes to land use or by expanding the scope of the natural capital asset register. In the case of non-renewables, new discoveries or increases in estimated reserves would be treated as an addition. All of the above may be seen as increasing the quantity of the asset base. Full details of additions would be expected to be detailed in a note to the accounts.

Any sale or transfer of land and its natural capital would be recorded as a disposal. In the case of non-renewable resources, reductions would also be recorded for extraction, sale or consumption of the resource. Full details of disposals would be expected to be detailed in a note to the accounts.

Item	Definition	Rationale
3a. Additions (disposals) and (consumption) - private value	Increases or (decreases) in private value (in present value terms) arising from asset additions, disposals or consumption.	It is important to capture changes in the quantity of natural capital (as distinct from the impacts of quality improvements covered under cumulative gains/losses).
3b. Additions (disposals) and (consumption) - external value	Increases or (decreases) in external value (in present value terms) arising from asset additions, disposals or consumption.	

4. Revaluations and adjustments

There are several other potential causes of changes in valuations associated with natural capital assets that warrant separate monitoring and reporting. These may include changes in economic variables, such as market prices or societal preferences, but it may also include changes in scientific knowledge or information that may lead to a revaluation. Additionally, there may be changes arising from a change of land use. Full details of any revaluations or adjustments would be expected to be disclosed in a note to the accounts for the year in which they occur. Justification should also be given for the reasons for treating the change under this reporting line, rather than under cumulative gains/losses.

Item	Definition	Rationale
4a.Revaluations and adjustments - private value	Changes to private value (in present value terms) due to changes other than condition or quantity, such as economic variables, valuation assumptions or methodology.	It is important to highlight changes in value that are attributable to changes in external factors, as distinct from the underlying losses or gains arising from the company's management of the assets.
4b.Reassessments and adjustments - external value	Changes to external value (in present value terms) due to changes other than condition or quantity, such as economic variables, valuation assumptions or methodology.	

Gross asset value

The sum of asset lines 1-4 provides the gross asset value of the natural capital recognised. Against this gross asset value, the maintenance liabilities should be considered in order to assess the net worth of the assets held.

Of which reported in financial accounts

This is the net book value held in the financial accounts for the tangible land assets that correspond to the natural capital that is in the scope of the corporate natural capital account. This value can be usefully compared to the private value of natural capital (See Section 3.2.5). Note though that financial accounts have different objectives, scope and measurement methods and hence they are expected to produce different results.

3.5.3 Liabilities

The main requirement for the liabilities section of the natural capital balance sheet is to highlight - as a minimum - the total cost of maintaining the condition of natural capital³¹. What this means in practice can depend on assumptions as to the use and management of natural capital that inform baseline that is specified in relation to the condition of natural assets and associated asset values.

As the baseline is a reference point that ideally is fixed for a prolonged period; circumstances may arise in which the liabilities may exceed the baseline minimum maintenance requirement. For example:

- Legal requirements to improve natural capital to higher standards; or
- New patterns of management that establish higher levels of maintenance and natural capital benefit.

In such cases, a higher level of liability should be recognised, reflecting either legal obligations or the current level of liability that matches the intended or currently achieved natural capital asset values.

The liabilities component of the balance sheet will also reflect any increases in the costs of maintenance in any period that may arise as a consequence of failing to perform adequate maintenance in previous period(s), or due to external (exogenous) impacts on natural assets (e.g. disease).

It is useful to split the total maintenance requirement into two levels of commitment, as this may reveal important motivations for carrying out the required maintenance work:

- Legal requirements: covering the proportion of the natural capital liability that the organisation is required by law or contract to perform.
- Other requirements: covering the cost of the remaining maintenance requirements (e.g. either to meet baseline or an enhanced condition of natural capital if this is being achieved).

To be consistent with the asset valuation side of the balance sheet, liabilities are valued in perpetuity using the company's opportunity cost of capital. These liabilities may be considered as similar to financial accounting provisions, but with the main difference that these are perpetual requirements and as such, may never be fully discharged. For each of the two categories of maintenance provision there are two aspects that may require disclosure on the balance sheet:

5 and 6: Legal provisions and other maintenance provisions

The organisation may have legal or contractual obligations to the preserve condition of natural capital, which may or may not be related to the private benefits of the natural capital. For example, maintaining public access to woodland is unrelated to the benefits of timber production. However, a water company with an obligation to improve water quality may find that the costs of watershed improvement also lead to reductions in treatment costs and hence enhanced private value.

Other maintenance provisions represent the remaining costs (above and beyond the legal obligations above) associated with natural capital maintenance that sustains the asset condition.

³¹ Note that this does not necessarily accord with maintaining both the private and external values at their baseline value as these can be influenced by external factors not directly associated with the condition of an organisation's natural assets (e.g. fluctuations in market prices).

These should relate to the additional costs to maintain natural capital to the baseline level (or enhancing it beyond this).

Item	Definition	Rationale
5. Legal maintenance obligations	The present value (PV) of expected costs associated with any legal or contractual obligations to preserve natural capital, calculated in perpetuity using the organisation's commercial discount rate.	This captures the minimum natural capital maintenance obligations on the organisation.
6. Additional provisions for maintenance	The present value (PV) of expected costs of maintenance or enhancement activities required to meet baseline (or enhanced) condition using the organisation's commercial discount rate.	This captures the remaining natural capital maintenance requirement on the organisation to sustain the planned natural capital asset values.

Total maintenance provisions

Total maintenance provisions are defined as the sum of the legal obligations, and the additional maintenance provisions. This figure should represent the full natural capital maintenance requirement of the company.

Of which reported in financial accounts

This is the value of the liabilities that are already reported in the organisation's existing financial accounts. This should be compared to the legal provisions section of the corporate natural capital account (See Section 3.2.5). Note though that financial accounts have different measurement methods and hence they are expected to produce different results.

Total net natural capital

Total net natural capital is defined as the gross natural capital asset value less total maintenance provisions. This is an indicator of the net worth of the natural capital assets captured within the balance sheet.

3.6 Changes in natural capital

The purpose of this statement is to highlight the changes in natural capital value and liabilities over the accounting period (Figure 3.5). It also provides some detail on the areas in which natural capital value has changed. For example, it can reveal that revaluation of outputs (item 3 below), offset a deterioration of natural capital condition (item 1). The statement also shows the movements for private and external values, so that any differences in the two aspects of value are explicit.

Figure 3.5: Statement of changes in natural capital

	Year A				
	Non-Renewables		Renewables		Total
	Private £'m	External £'m	Private £'m	External £'m	Value £'m
Movements in:					
1 Cumulative gains/(losses)	-	-	(10)	(10)	(20)
2 Additions/(disposals or consumption)	(5)				(5)
3 Revaluations and adjustments			20		20
4 Maintenance liabilities			(2)		(2)
Change in natural capital	(5)	-	8	(10)	(7)

Whilst a single accounting period may provide useful information on the change in value in that period, a review of the trends over longer periods will be more revealing. For this reason multi-period presentations of this statement should be more informative for tracking the changes in natural capital asset values.

Definitions of the reporting lines are given below:

Item	Definition	Rationale
1. Cumulative gains/(losses)	Movement in the balance sheet cumulative gains/losses line between the opening and closing accounting period dates.	Captures the underlying value movement due to the condition of natural capital.
2. Additions/(disposals or consumption)	Value of additions, disposals or consumption in the period.	Captures the impact of quantity changes on natural capital.
3. Revaluations and adjustments	Movement in the balance sheet 'valuations and adjustments' line between the opening and closing accounting period dates.	Captures the impact of revaluations and other changes on natural capital.
4. Maintenance liabilities	Movement in the balance sheet liabilities between the opening and closing accounting period dates.	Captures the impact of changes in liabilities on natural capital.

The total movement in natural capital is the sum of the above line items and represents the movement in the net natural capital line of the balance sheet over the accounting period.

4. PILOT ACCOUNTS

4.1 Developing pilot accounts

The aim of the piloting exercise has been to refine the corporate natural capital accounting framework by testing its application with real world data. A small group of organisations agreed to work with the Natural Capital Committee and project team to prepare pilot accounts. These case studies were prioritised based on their ability to test the framework and its practical application. As far as was possible, sites were chosen to reflect a diversity of business sectors, commitments to the maintenance of natural capital, land use and land cover types, as well as different aspects of natural capital.

The pilot accounts test the:

- **Practical application:** to refine the framework and develop accompanying guidance. Issues identified for consideration included: the scope of the accounts; ownership boundaries and recognisable stewardship obligations; the treatment of impacts on natural capital external to the organisation; and measuring changes in natural capital assets and flows of value. Others were raised during the pilot phase, such as the treatment of volunteer time and taxes and subsidies.
- **Resource implications:** to understand the data and information requirements of developing a natural capital account. The task of measuring and valuing natural capital asset valuations can imply a substantial undertaking. An objective of the pilots was to examine the trade-off between resources involved in seeking higher quality data and the precision of the results.
- **Impact on business decisions:** to examine the usefulness of the accounts for the organisation at strategic and operational levels. This is absolutely critical to the long-term success and implementation of natural capital accounting and the pilot organisations are still examining this aspect of the framework.

Pilot accounts were developed with four organisations: Lafarge Tarmac, National Trust, The Crown Estate, and United Utilities. The initial work to develop the pilot accounts commenced in February 2014 following the development of the draft framework. The project team worked with each organisation individually to prepare a pilot account. Table 4.1 sets out the key features of the four case studies.

In addition to the pilot testing, a workshop was held in July 2014 with representatives from the four pilot organisations as well as many representatives the NCC's Landowners Stakeholder Group. The purpose of the workshop was to: (1) share the work undertaken in developing and testing the CNCA framework; and (2) elicit feedback on how to develop and improve the framework and how to communicate its role and application to the target user group. A summary of the outcomes, which have informed both updates to the pilot accounts and the proposed framework, is provided in Annex 1.

Table 4.1: Summary of pilot organisations and cases studies

Organisation	Lafarge Tarmac	National Trust	The Crown Estate	United Utilities
	Construction industry	Conservation NGO	Statutory corporation	Water and sewerage utility
Pilot site	Mancetter, Warwickshire	Wimpole Hall Estate, Cambridgeshire	The Windsor Estate, Berkshire/Surrey	Fylde Coast, Lancashire
Business activity on-site	Hard rock quarry with restoration plans post extraction	Farm undergoing conversion from ELS to HLS and organic. Open for recreation	Farming and forestry activities. Open for recreation	Operation of sewerage infrastructure and permitted discharges
Pilot organisation relationship to site	Owner (land) and operator	Owner and land manager	Owner and land manager	Liability to limit pollution
Major land cover	Semi-natural grassland, woodland, open water bodies	Semi-ancient woodland, open parkland, semi-natural grassland, enclosed farmland, open water bodies	Farmland, woodland, parkland, open water bodies.	Coastal bathing waters
Significant services supported by natural capital	Non-renewable mineral extraction, carbon storage, water regulation, recreation, biodiversity	Climate regulation, food provision, recreation, and biodiversity	Food provision, timber, recreation, landscape amenity, climate regulation air filtration	Water quality regulation
Methodological aspects tested	Treatment of non-renewable asset. Significant investment resulting in land cover and land use change.	Site-specific data	Modelled data	Interactions with external assets

4.2 Establishing the scope of natural capital account

The initial engagement with the pilot organisations focused on defining the scope of the pilot natural capital account, identifying the land cover/habitat types present at the site, as well as the natural assets and associated services flowing from these assets (e.g. non-renewable resources, ecosystem services).

For illustration, Figure 4.1 presents the results of the scoping exercise at the Windsor Estate (The Crown Estate), which was prepared in discussion with the site manager. This is based on an ‘asset-benefits flow matrix’ that can be used to help establish the most important natural capital assets, accounting units and material benefits for inclusion in an account. In the example shown, non-renewable assets do not feature, so the scoping focused on the ecosystem services that were identified to be material to the natural capital account, based on a qualitative assessment of their level of provision from the site (‘significant’; delivered by the site but ‘not significant’; ‘not present’). The principal services underpinned by natural capital are:

- Provisioning services: commercial forestry and farming activities are undertaken at The Windsor Estate.
- Regulating services: the woodland provides local air quality regulation, reducing levels of air pollutants. The biomass and soils net sequester and store carbon, contributing to climate regulation. In addition, it was identified that the site provided flood water storage services, reducing the frequency and severity of flooding along the Thames.
- Cultural services: The Windsor Estate provides an enduring backdrop to the town of Windsor and surrounding area, which is valued by locals and visitors. The park also attracts about 3 million recreational visits per year.
- Biodiversity: the Park provides important habitat for biodiversity, with large areas designated as Sites of Special Scientific Interest (SSSI). It is particularly noted for its rare beetles and flies, with over 2,000 species of beetle being recorded onsite in recent years. The state of biodiversity supports the ecosystem services, such as regulating services, and enhances the recreation experience throughout the park.

Figure 4.1 also compares the scope of the natural capital account to the conventional financial account. As shown, the financial account is limited to reporting the costs of maintenance as well as some of the values of the ecosystem service benefits provided by the land, including revenue from forestry and farming. Access to the Park is largely open to the public free of charge although some receipts are collected for parking and admission to areas of the gardens. Therefore, the value of recreation is partially reflected in the financial accounts. In contrast, the natural capital account reflects a wider range of values associated with carbon sequestration, recreation, landscape amenity, and clean air.

Figure 4.1: Example of natural capital account scope ('asset-benefits flow matrix') - Great Windsor Park, The Crown Estate

	Ecosystem services ¹									
	Aesthetics	Clean Air	Clean Water	Energy	Equable climate	Fibre	Food	Hazard protection	Recreation	Wildlife
Scope of financial account										
Gardens	●	○	○	○	○	–	–	○	●	○
Agriculture	–	–	○	○	○	○	●	–	–	○
Parkland	●	–	○	○	○	–	●	○	●	●
Woodland	●	●	●	○	●	●	–	●	●	●
Scope of natural capital account										
Gardens	●	○	○	○	○	–	–	○	●	○
Agriculture	–	–	○	○	○	○	●	–	–	○
Parkland	●	–	○	○	○	–	●	○	●	●
Woodland	●	●	●	○	●	●	–	●	●	●

Key:

- Significant ecosystem service flow by habitat
- Potential but not significant ecosystem service flow
- No ecosystem service flow by habitat

●	Included in account
○	Partly included in account
–	Not included in account

Notes: ¹ Ecosystem service classification based on NCC (2014) (for illustrative purposes).

4.3 Preparing supporting schedules

Each pilot account differs in the emphasis on the collection of site level data and the use of models available for estimating the flow of services from natural capital. The use of models has the advantage of being relatively straightforward to apply and requires limited primary data collection. However, the application of a modelled approach involves the trade-off that it primarily focuses on populating the physical flow and monetary flow accounts, and does not provide detailed information on the condition of natural capital for reporting in the natural capital asset register. In addition the estimates of flow are subject to modelling error³².

In contrast, the Wimpole Hall Farm pilot largely made use of site level data to populate the natural capital asset register and physical flow account. Simplified versions of the supporting schedules for the Wimpole pilot are provided in Annex 2 (Tables A2.1 to A2.4). This includes the asset register along with the physical flow, monetary flow, and maintenance cost accounts. The metrics include indicators of natural capital asset condition that are not linked to the measured ecosystem service goods in the physical flow account and are not used in the monetary account. As discussed in Section 3.1, this data has great value in providing additional level of information on the state of natural capital, which monetary valuation data alone cannot provide.

On-site monitoring of soil carbon took place at Wimpole during 2014. As the final results of this study are still pending, estimates of carbon storage were calculated using the TESSA toolkit (Peh et al., 2014). A point of note is that interim data from the soil samples were similar to those estimated using the TESSA toolkit that relies on external data, even though this cannot be assumed to apply elsewhere.

Overall it was found that the pilot organisations had different quantities of data relating to natural capital. A key feature of this data in all cases was that it was not centrally held. Therefore, collating this data as an initial exercise required significant effort. However, the development of a data system underpins the way forward to measure condition and impacts on natural capital. While there could be significant initial set up costs, these should reduce over time. Ideally, a data system would include GIS capabilities and be coordinated with the financial accounting data system.

4.4 Summary of pilot accounts

The following provides a summary of the pilots, covering the background to the pilot, and the lessons learnt from working with the pilot organisations in terms of outcomes and results.

4.4.1 Wimpole Estate, National Trust

Background

National Trust is a conservation charity that works to preserve the buildings and land of significance for the benefit of society. The National Trust owns and manages over 250,000 hectares of land and 750 miles of coastline. It is the largest membership organisation in the UK and one of the largest charities in terms of income and assets.

The National Trust's interest in developing a pilot account was motivated on several levels, including to:

³² Utilising such models requires consideration of scale and sensitivity to local conditions. Results should be validated periodically using site-level data where possible.

- Improve reporting of environmental outcomes and link these to investments: while the National Trust has procedures to report and monitor progress on achieving its multiple objectives (social, environmental, and economic), the natural capital accounting framework provides an opportunity to align the reporting of environmental and financial outcomes.
- Improve process for internal budget allocations: for example, while the benefits of visitor facility improvements can be measured in monetary terms, the return on investments in natural capital is harder to compare to costs. The natural capital accounting framework could improve the processes for budgetary decisions involving natural capital.
- Support the National Trust's public policy discussions: the framework offers an opportunity to present the case for environmentally sensitive land management and policies that support it, such as making the case for subsidies.

The pilot site at Wimpole provided an opportunity to apply the framework to a lowland arable farm that is farmed in-hand and that had recently undergone changes in land management regimes. In 2008, the farm shifted from an intensive arable management regime, which is typical to the area, to an organic farm in Higher Level Stewardship (HLS). The change was motivated by an increased understanding that the natural capital (particularly soils) was degraded due to the use of heavy machinery and intensive crop rotation.

While the conversion is recent, data have begun to show improvements in the condition of natural capital stocks. The CNCA framework provides an opportunity to document these changes over time, including the financial impacts.

Outcomes and results

The Wimpole pilot shows how conversion to organic farming and HLS changes the financial income as well as non-market benefits as described in Box 4.1.

As demonstrated in Annex 2, the Wimpole Estate pilot developed all aspects of the framework, including the support schedules (asset register, physical flow account, monetary account, and maintenance cost account). This revealed the potential of the full framework to supplement the monetary values reported in the balance sheet, which is particularly useful with respect to biodiversity at Wimpole. Given that only a partial account of the value of biodiversity is identified in monetary terms, bio-physical measures are therefore useful to provide more insight into the state of biodiversity at the site and monitor changes over time.

Box 4.1: Wimpole Hall Estate Pilot

Wimpole Hall is situated in Cambridgeshire on an estate that covers 1,200 hectares of semi-ancient woodland, open parkland, semi-natural grassland, enclosed farmland, and open water bodies. The mosaic of habitats provides habitat for 25 nationally scarce species, including water vole, great crested newts, marsh harrier, and barbastelle bats. The site attracts over 270,000 visitors a year.

Wimpole Hall farm is the largest lowland farm managed in-hand by the National Trust. Prior to 2007, the management of the farm was contracted out and farmed at intensive levels. Informed by the poor results of a soil survey undertaken in 2008, the decision was made to take management of the farm in-hand, convert to organic farming and enter the Higher Level Stewardship (HLS) scheme. It is hoped that this change will improve the ability of soils to sequester, provide richer habitat for biodiversity, and enhance the visitor experience.

The commercial scale farm of over 400 hectares produces organic cereals, wheat, barley and oats in rotation with other crops, such as beans. The grassland is grazed by rare native breed livestock. While the farm has to be financially sustainable, it is not managed to maximise profits, but rather to maintain and enhance the Estate's agricultural history and landscape character.

The pilot provides a partial account of the Wimpole Estate natural capital assets with the account baseline set in 2008 and accounting year of 2013.

- **Food provision:** Net revenues of the two farming systems in 2008 and 2013 are based on consultation with the farm manager with appropriate adjustments applied to product prices and input costs. Net revenues from the two farming systems are expected to be approximately equal.
- **Recreation:** the whole estate attracts over 270,000 visitors a year. The CNCA reflects the value associated by the 30% of visitors who visit the parkland and farmland (not the Hall) without charge. A review of non-market recreation valuation literature suggests that a value of £2 per visit is a reasonable conservative estimate.
- **Carbon storage:** the soils at the estate, as well as the biomass above and below ground, sequester and store carbon. Soil surveys were carried out at Wimpole in 2008 and repeated in 2013, the results of which are still pending final review. In the interim, carbon storage is estimated using the TESSA (Peh et al., 2014). The interim results of the soil survey and the toolkit results are broadly similar. Annual net sequestration is not included in this version of the account, but will be added when data becomes available. Carbon has been in accordance with UK Government guidance, based on the non-trade price of carbon (DECC, 2013).
- **Wildlife:** an important component of the natural capital value derived at Wimpole is the support of wildlife and the associated landscape value. Through farming system conversion and participation in the HLS scheme, this value is likely to have been enhanced during the accounting period. Adequately accounting for this enhanced value is challenging. As a proxy, estimates derived from Boatman et al. (2010) have been applied. These represent the willingness to pay of households across England for the biodiversity supported for the Entry Level Stewardship (ELS) and HLS schemes, in aggregate terms. A per hectare value is calculated and applied to the land area at Wimpole under each scheme.

The balance sheet presented in Figure 4.2 reports changes in asset values and liabilities over the period of transition from conventional arable management to organic farming under HLS. The account shows that both private and external values are enhanced between 2008 and 2013. The private value gain (line 2) reflects a small increase in revenue from visitor receipts, an increase in subsidy receipts, and a small decline in income from crop production. Net revenues from the two farm management systems are expected to be roughly equal as although yields of higher value crops are expected to be lower, the price received for organic produce is higher and input costs are lower. Over the period, a tenanted farm was bought under National Trust management. The private and external benefits resulting from this increase in land area is reported on line 3.

Figure 4.2: Natural capital balance sheet - Wimpole Estate (2013)

				Year 2013			Of which reported in fin accts £'m
				Renewables		Total	
				Private	External	Value	
				£'m	£'m	£'m	
Assets							
1	Baseline value (2008)			14.1	12.3	26.4	
2	Cumulative gains/(losses)			1.7	4.4	6.1	
3	Additions/(disposals or consumption)			1.7	1.6	3.4	
4	Revaluations and adjustments					-	
Gross asset value				17.5	18.4	35.8	
Liabilities				Private	External		
5	Legal provisions						
6	Other maintenance provisions			(3.6)	(1.5)	(5.1)	
Total maintenance provisions						(5.1)	
Total Net Natural Capital						30.7	

The changes in land management resulted in enhancements to the external value of asset. This increase (line 2) reflects the enhanced visitor experience; societal preferences for wildlife outcomes of HLS farming and; improved capacity of the soils to store and sequester carbon. The external benefits supported by the new addition of the previously tenanted land are reported on line 3.

The farm receives income from subsidies through the Common Agricultural Policy and other schemes. These subsidies can be viewed as a payment by society to support the external values the farm provides. This is reflected in the account by subtracting the value of the subsidy from external values and adding it to the private value.

The private liabilities relate to the costs of maintaining the asset in perpetuity. Interestingly, the land management changes at Wimpole did not involve significant change in liabilities. The improvements in natural capital were supported by land management practices, such as the use of lighter machinery to avoid compaction and leaving stubble post-harvest, rather than costly

investments. It should be noted that the costs of complying with legal obligations have not been separated out from the costs of natural capital maintenance.

The account also captures the value of volunteer time, which is critical to the maintenance of natural capital at Wimpole as an external liability. Charitable organisations, like the National Trust, rely on the contributions of volunteer time to achieve their objectives. This gift enables work to be carried out that would not be possible due to budget constraints or frees up income to be spent on other activities. Volunteers' time for the maintenance of natural capital is valued using an adjusted cost of employment and is reported as a private liability in the balance sheet. The costs of supervising and training volunteers could be reported as a private liability, but data are not available.

Next steps

The Wimpole pilot has shown that the framework can be used practically. Feedback from the site manager has been very positive about its potential for wider use across the organisation. The main challenge to overcome is to minimise the effort involved in gathering the data. The next steps would be to consider streamlining the necessary data capture systems and the development of processes to capture the ecosystem services that are commonly supported by National Trust, such as recreation and biodiversity.

4.4.2 The Windsor Estate, The Crown Estate

Background

The Crown Estate is an independent property company set up under an Act of Parliament (1961). Its role is to make sure that the land and property it invests in and manages are sustainably worked, developed and enjoyed to deliver the best value over the long term. Its revenue surpluses are delivered to The Treasury for the benefit of the public finances.

The Crown Estate's rural portfolio, including the wider Windsor Estate, is around 146,000 hectares covering agriculture, forestry, minerals and property. The aim of their involvement in the pilot is to investigate a framework that would enable them to understand the total contribution of the non-financial benefits they deliver alongside financial costs and benefits in an accounting framework. The Crown Estate can use the information reported in the CNCA to demonstrate the important wider role that its assets play in maintaining natural capital for society.

The Windsor Estate provided an opportunity to pilot the framework on a site that is managed with a view to long-term benefits, and which is recognised to have high environmental and cultural value that is not fully reflected in the financial accounts. Its application across its whole portfolio would involve numerous sites and the resource consideration for doing this on a site by site basis was a concern. For this reason, a top-down approach using detailed GIS mapping and external ecosystem service valuation model (from the UK National Ecosystem Assessment), developed by Bateman et al. (2014) was chosen and rolled out with support from consultants, Route2Sustainability. The spatially explicit model estimates a selection of market and non-market ecosystem services.

Outcomes and results

A summary of the natural capital account for The Windsor Estate is provided in Box 4.2.

Box 4.2: The Windsor Estate pilot

For many centuries, the Windsor Estate was a private hunting ground of Windsor Castle. Retaining this historical connection, it now covers around 6,400 hectares of parkland, woodland, and gardens. The Park is nationally and internationally renowned for its biodiversity and is home to the largest collection of veteran oak trees in northern Europe, some of which are over 800 years old. The oaks and beech support a number of extremely rare and specialised insect species, some of which are unknown elsewhere in the British Isles, as well as nesting sites for hole-nesting birds.

The Park is managed for public enjoyment and The Crown Estate has a statutory duty to maintain its character as a Royal Park and forest. It is largely open to the public attracting around 3 million visitors a year.

The cost of maintaining the Park is partly offset by income from property, agriculture and forestry. Some income is also derived from visitors. The financial accounting, however, does not reflect the wider value generated by the Park, particularly in terms of the wider public benefits associated with its natural capital assets:

- The enjoyment of about 3 million visits to the Park annually, valued at an additional £1.9m per year.
- The role of the trees in filtering local air pollution and avoiding health impacts from respiratory diseases, valued at £0.4m per year.
- The enjoyment of people in the surrounding area from the view of the Park, valued at £0.6m per year.
- The soils and vegetation on site store and sequester carbon, contributing to a reduction in greenhouse gases and resulting climate change.

Due to data limitations the account does not include the value of all benefits provided by the site:

- The land area at the Windsor Estate most likely provides an important flood attenuation service, storing flood waters and reducing flood damage along the river Thames. At present, however, no data is available to quantify and value this service.
- The site is of internationally significant biodiversity value. This biodiversity underpins the natural function of the Park and therefore plays a role in all the services it delivers, such as carbon sequestration. It also has a significant value in its own right, even though this is not currently estimated.

Taking account of these wider social values, the Windsor Estate delivers a significant net benefit to society. This is equal to £4.4 million per annum gross external benefit and when delivered as a corporate natural capital account the asset value is £45.6 million (present value terms) over a 100 years. The reporting statements record the net benefits that accrue to The Crown Estate and the external values that the Park delivers to the local community, visitors, and globally.

Figure 4.3 presents the balance sheet for the Windsor Estate in 2013. The baseline is defined as the reporting year, reporting the present value of the flow of benefits from the asset if it is maintained at its current condition.

The account reveals the scale of societal benefits in contrast to the liabilities. This is a partial account as some benefits were not possible to express in monetary terms, including its role in reducing the frequency and severity of flooding along the Thames. If the future benefits are monetised, it can be expected that the external value reported in the account would increase further.

Figure 4.3: Natural capital balance sheet - The Windsor Estate (2013)

	Year 2013			Of which reported in fin accts £'m
	Renewables		Total	
	Private £'m	External £'m	Value £'m	
Assets				
1 Baseline value (2013)	3.3	49.0	52.3	
2 Cumulative gains/(losses)				
3 Additions/(disposals or consumption)				
4 Revaluations and adjustments			-	
Gross asset value	3.3	49.0	52.3	
Liabilities				
5 Legal provisions	(0.3)		(0.3)	
6 Other maintenance provisions	(6.4)		(6.4)	
Total maintenance provisions			(6.7)	
Total Net Natural Capital			45.6	

The use of an ecosystem services model has the advantage that it requires less onsite data and monitoring. However, this also limits the ecosystem service benefits that can be included, is less sensitive to changes over time, and is subject to modelling error. While the use of the model has limitations, the pilot shows that it can be used to provide estimates which can provide insights into the scale of benefits provided by investments in natural capital maintenance.

A key feature of the Windsor Estate is its permanence over hundreds of years. As additional year's data becomes available, the account should reflect the maintenance of natural capital value over time.

Next steps

The Windsor Estate pilot shows revealed that the natural capital account when populated with the support of the external models has the potential for external reporting. The high level analysis provided by the model could be supplemented by the further development of the asset register

reporting available site specific bio-physical data on the condition of natural capital stocks. The further addition of these metrics would provide a greater insight into the state of natural capital over time. It would also provide information on aspects of natural capital that are not at present adequately reflected in monetary valuation. However, this added value has to be balanced against the resource considerations involved.

The Crown Estate is exploring further application of CNCA across its portfolio. It is noted that the framework may provide information that could be useful in several ways. First, is its ability to communicate the total contribution of its assets. Second, the development of the full framework may be useful in budgetary discussion and allocation of resources across the organisation. It has also been noted that the framework would be a useful tool for performance management and could engage staff in different parts of the organisation, from site manager to centralised staff responsible for budgets and priority setting.

4.4.3 Mancetter Quarry, Lafarge Tarmac

Background

Lafarge Tarmac is a construction solutions provider, which supplies 45 million tonnes of aggregates, 7 million tonnes of asphalt and 4 million tonnes of cement a year. It has more than 330 operational sites, including over 100 quarries across the UK with 6,600 employees. Planning permission for its quarries often includes after-care conditions that require the company to restore the site to a pre-agreed condition. For example, an area of farmland may be dug to extract mineral rock, and then converted to habitat for biodiversity and recreation, or returned to farmland.

The CNCA framework offers an opportunity to report the costs and benefits of a site to the local planning authority, local population, and other stakeholders. A framework that can illustrate these broader benefits, as well as costs, was the primary interest for the involvement of Lafarge Tarmac in the pilot. Coupled with this, the framework highlights to site managers the benefits the company gets from natural capital and its importance in business operations, such as water use. There was also interest in the ability of the framework to establish the external benefits the site could deliver, providing a starting point for considering the development of new markets and revenue streams for the company.

The pilot also features non-renewable assets. The pilot site, Mancetter quarry in rural Warwickshire, was chosen as it is nearing the end of its license for extraction and will be restored. If a current planning application is approved, Lafarge Tarmac could potentially own and steward the land until 2031, when it is likely that the restored quarry would be 'sold' as a nature reserve with recreation facilities³³. The pilot provides an example of a site that involves significant capital investments in the natural capital asset and change of use and land cover. A description of the pilot site is given in Box 4.3.

³³ The company may also divest the site before this date, passing obligations that run with the land to any new owner/occupier.

Box 4.3: Mancetter quarry pilot

Mancetter is a hard rock quarry situated in a rural area close to Mancetter village in Warwickshire. The site's history dates back to 1873 and is currently licenced for extraction until 2016. An extension to the site is being sought, meaning that the quarry would be licenced for production until 2025, with aftercare conditions up until 2031. For the purposes of the pilot, the extension is assumed to be approved. While there is some uncertainty around final restoration, it was taken that once fully restored, the site will be open to the public for recreational use with improved connectivity of local bridleways and footpaths.

Data on non-renewable values and liabilities were provided by Lafarge Tarmac. This included data on restoration costs, maintenance costs, and extraction costs. The data on ecosystem service provision (carbon storage, biodiversity and recreation) was taken from a report conducted for Lafarge Tarmac by MSc students at Cranfield University entitled "An Integrated Assessment of the Mancetter Quarry Restoration" (May 2014). The range of ecosystem services delivered by the site is summarised below:

- **Carbon sequestration and storage:** the site in 2014 includes soils and vegetation that store and sequester carbon. The restored site will improve the site's ability to store and sequester carbon. Estimates of soil carbon storage are taken from the Cranfield study and valued following DECC (2013) guidance.
- **Habitat and biodiversity:** biodiversity related projects, including ecological restoration and habitat management have been underway at Mancetter since 1999. The partially restored site already provides an important habitat for many species including some species in decline, such as the dingy skipper butterfly. Biodiversity is valued using estimates presented in the Cranfield report.
- **Water provision:** The quarry relies on water for its operations. Where this is available (under license) from non-mains water sources, such as rivers, the company can improve the environmental sustainability and cost effectiveness of its operations. This represents a private value from the natural resource. Although, no site data was available on the quantity of use or avoided cost, an estimate of the value of this benefit is included in the account for illustrative purposes.
- **Recreation and amenity:** once fully restored and opened to the public, the site is expected to provide amenity value, particularly by enhancing local recreation opportunities. For example, the design considers improving the connectivity of bridleways and footpaths. Drawing on the estimates produced in the Cranfield study, recreation is valued using a combination of stated preference, travel cost and hedonic pricing studies. Values presented in the Cranfield study are applied in the account.
- **Water quality regulation:** a critical issue for the site is increased water acidity caused by interactions between uncovered minerals (particularly aluminium and iron). This increased acidity can directly affect aquatic life and permeate into surrounding soils with consequent impacts on vegetation and biodiversity. Planned restoration efforts at Mancetter are designed to improve water quality. This service is recognised as being significant, but due to data limitations no valuation is included.

Potential flood risk attenuation benefits are also not included within the pilot account due to a lack of data, but could merit consideration in the future.

Outcomes and results

To demonstrate how the framework would follow the evolution of the site, two accounts were prepared. The first for the baseline year of 2014 when quarrying is still in operation. A second

hypothetical account is prepared for the year 2032, when the stock of diorite rock has been exhausted and the company has discharged its legal liabilities to restore the site. The two balance sheets shown in Table 4.4 report very different assets and liabilities.

Since site level data was limited the population of the natural capital account was reliant on a top down approach with little information compiled for the supporting schedules. The results, however, demonstrate key features of the framework:

- In 2014, the significant value of the remaining mineral stock is reported as a private non-renewable value. Its depletion is reported as a loss in the subsequent balance sheet. It should be noted that unlike energy reserves which most commonly have one-off use (e.g. coal burnt in a power station), the mineral rock is likely to be combined with other inputs and transformed into another uses that underpin modern society, such as tarmac asphalt for roads or general building materials for development of hospitals, schools, homes, etc. The value of the material in use is not reflected in the balance sheet.
- The company's use of non-mains water is reported as a private renewable value. While the water resource remains in place, extraction activity has stopped and therefore, it currently has no value in use. This reduction in value is reported as a loss on the balance sheet.
- The restored site delivers significantly enhanced biodiversity and carbon sequestration values. As the site is assumed to be open-access, it also offers recreation benefits. The increase in these external values is reported as a gain on the balance sheet.
- The 2014 balance sheet reports the liabilities associated with ongoing maintenance in the site's current condition and the legal liabilities associated with restoration. In the 2032 account the restoration liabilities have been discharged and the present value of ongoing maintenance is reported.
- The 2032 account reveals the value of the benefits the site delivers, which are shown to be significantly greater than the maintenance costs.

Figure 4.4: Natural capital balance sheet - Mancetter quarry (2014 and 2032)*

Reporting year 2014						Of which reported in fin accts £'m	
Non-Renewables		Renewables		Total			
Private	External	Private	External	Value			
£'m	£'m	£'m	£'m	£'m			
Assets							
1	Baseline value	14.00	-	0.04	0.07	14.11	
2	Cumulative gains/(losses)	-	-	-	-	-	
3	Additions/(disposals, consumption)	-	-	-	-	-	
4	Revaluations and adjustments	-	-	-	-	-	
Gross asset value		14.00	-	0.04	0.07	14.11	
Liabilities							
5	Legal provisions					(2.50)	
6	Other maintenance provisions					(0.50)	
Total maintenance provisions						(3.00)	
Total Net Natural Capital						11.10	

Reporting year 2032						Of which reported in fin accts £'m	
Non-Renewables		Renewables		Total			
Private	External	Private	External	Value			
£'m	£'m	£'m	£'m	£'m			
Assets							
1	Baseline value	14.00	-	0.04	0.07	14.11	
2	Cumulative gains/(losses)	(14.00)	-	(0.04)	4.28	(9.76)	
3	Additions/(disposals or consumption)	-	-	-	0.09	0.09	
4	Revaluations and adjustments	-	-	-	-	-	
Gross asset value		0.00	-	0.00	4.44	4.44	
Liabilities							
5	Legal provisions					-	
6	Other maintenance provisions					(0.83)	
Total maintenance provisions						(0.83)	
Total Net Natural Capital						3.61	

Note: *Actual figures subject to adjustment and rounding to protect commercially sensitive information.

Next steps

The Mancetter pilot shows that the framework can be applied to renewable and non-renewable assets and could provide a useful tool for communicating with external stakeholders the additional benefit the company delivers to society. However, as noted above, the framework does not currently reflect the value of the non-renewable asset in use. There is interest in extending the use of the framework over further sites even though the resource implications need further consideration. The pilot used a combination of site level data and external models and there is interest in pursuing this balance.

The relative size of the non-renewable and renewable values highlights the importance in reporting these values separately. Feedback from Lafarge Tarmac indicated that the estimates of most additional interest related to renewable assets as the company has existing processes in place to monitor, value and report the values of the non-renewable asset. It was suggested that, while the non-renewable asset value may be reported at a company level, it would be less useful at a site level.

There is though a note of caution in that the reporting of external value of a site can put pressure on organisations to generate a commercial value. To overcome this, it was suggested that the proportion of external value that may be captured as private revenue may be estimated and reported. This could include selling carbon credits on voluntary markets, for example.

4.4.4 Fylde Coast, United Utilities

Background

United Utilities holds a licence to provide water and sewage services in North West England. It owns and maintains a network of water and wastewater infrastructure, which includes approximately 42,000 kilometres of water pipes and 76,000 kilometres of sewers, 569 wastewater treatment works, and 94 water treatment works. Services provided by United Utilities are regulated by the Water Services Regulation Authority (Ofwat) along with the Environment Agency and the Drinking Water Inspectorate. Company business plans and price limits are reviewed every five years by Ofwat.

United Utilities continually invests in the maintenance and enhancement of wastewater infrastructure to protect both public health and the quality of river and coastal environments. The statutory requirements that must be met for the treatment and discharge of sewage effluent, which are derived from European and national environmental legislation, can be interpreted as implying that United Utilities has a stewardship role with respect to the water environment. This remit includes removing and treating wastewater from properties, preventing pollution to rivers and coastal waters from sewers, preventing flooding of properties from sewers, and the drainage of rainfall from roads and other surface areas.

The pilot account tests the ‘extended’ boundary of the CNCA framework (Section 3.3 and Annex 4), and the impact of United Utilities’ investments and operations on natural assets that it does not own, nor has complete control over the quality of - with agricultural, industrial and maritime inputs also having an impact. The focus is the status of four designated bathing water sites on the Fylde Coast - Cleveleys, Bispham, Blackpool North and Blackpool Central - that lie within the Fleetwood sewage treatment works catchment (Box 4.4)³⁴. These are monitored under the Bathing Water Directive (76/10/EEC), which sets standards for water quality to safe guard public health. The original Directive has been replaced by the Revised Bathing Water Directive (2006/7/EC), which will introduce higher minimum standards when implemented in 2015.

Box 4.4: The Fylde Coast

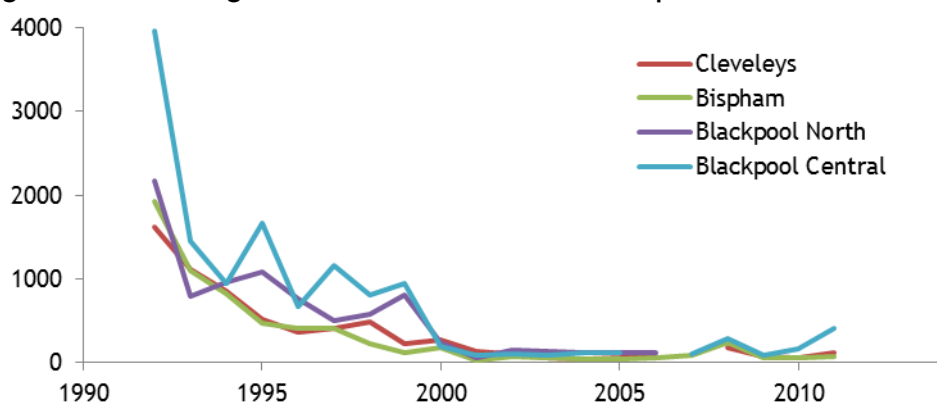
The Fylde Coast lies on the Irish Sea in Lancashire, between Morecambe Bay (to the north) and the Ribble estuary (to the south):



Source: Environment Agency Bathing Water Data Explorer <http://environment.data.gov.uk/bwq/explorer/index.html>

Historically (pre-1990) the bathing water quality - as measured under the Bathing Water Directive (76/10/EEC) - has been poor. Since the early 1990s, however, marked improvements have been observed:

Bathing water monitoring - faecal coliforms concentration per 100ml¹



Source: Environment Agency - Bathing Water bacterial samples and measurements from 1992 to 2014

³⁴ Note that the account focuses on these four bathing waters as they are primarily impacted by discharges from the Fleetwood sewage treatment works catchment. Other bathing waters on the Fylde Coast are impacted by additional sources including the River Ribble (Blackpool South and St. Anne's) and the River Wyre (Fleetwood).

Box 4.4 (cont.): The Fylde Coast

Bathing water quality is affected by a number of factors in addition to discharges from sewage treatment works and storm overflows, including rainfall patterns, run off from agricultural land, discharges from private sewers, and dog owners not cleaning up after their pets on beaches. The Environment Agency has undertaken DNA identification analysis to ascertain sources of pollution and estimates that around 50 - 60 percent of the pollution at the sites of interest can be apportioned to United Utilities' activities (namely discharge of treated effluent from sewage treatment works, and intermittent discharges of untreated sewage from storm overflows). While there are other sources of impacts on bathing waters, the improvement in bathing waters since the 1990s is mainly due to investment in the sewerage network and improved sewage treatment. This has included over £500m spent on the construction of storm storage tanks and upgrading pumping stations and Fleetwood sewage treatment works.

The pilot CNCA reports the liabilities associated with maintaining and improving bathing waters and the benefits supported by those investments.

The extended CNCA framework is particularly relevant to regulated organisations like United Utilities, which as a licensed water and sewerage services provider is required to manage and protect the water environment - including the quality of rivers, lakes, and coastal waters - by taking water for drinking supplies and returning treated wastewater in a sustainable way.

Outcomes and results

The extended CNCA boundary explicitly recognises the interactions between the activities of a regulated utility, such as United Utilities, and the natural capital assets that are not owned by it (or by any other organisation; i.e. 'unowned' assets). This may represent significant flows of value, both in terms of liabilities for maintaining those assets, and the benefits that are subsequently derived.

Figure 4.5 presents the extended natural capital balance sheet for the Fylde Coast. This is a supplementary reporting statement to the 'core' natural capital balance sheet presented in the three other pilot accounts (Sections 4.4.1 - 4.4.3). As with the core balance sheet, monetary values are reported in present value terms, as a flow of annual value into perpetuity³⁵. Liabilities record the natural capital maintenance obligations to protect and enhance bathing water quality that United Utilities are required to meet as part of the regulatory regime. Asset values record United Utilities' contribution to the external value that is derived from bathing waters that meet the current regulatory standards. This asset value is also influenced by other factors beyond United Utilities operations and control (e.g. urban run-off, discharges from private sewers), the liabilities of which are not incorporated within the account.

³⁵ Future values are discounted into perpetuity assuming an opportunity cost of capital of 3.7% for United Utilities. This is in line with recent guidance from Ofwat concerning the weighted average cost of capital (WACC) to be applied in water company Business Plans for the 2014 Price Review (Ofwat, 2014).

Figure 4.5: Extended natural capital balance sheet - Fylde Coast (2014)

Supplementary Statement	Year 2014				Of which reported In fin. acc.
	Impact on other assets		Impact from other assets		
	Private £m	External £m	Private £m	External £m	
Interactions with unowned assets					
1 Baseline value (2000-10)		194.9			
2 Cumulative gains/(losses)		(21.7)			
3 Revaluations and adjustments					
Gross asset value/impact		173.2			
Liabilities for unowned assets					
5 Legal provisions	(179.2)				
6 Other maintenance provisions					
Total maintenance provisions	(179.2)				
Net natural capital impact	(179.2)	173.3			

To account for influence of variability in weather patterns and other factors on bathing water quality, the baseline asset value is assessed as the average performance for bathing water status over the period 2000-10 for the current Directive, and is estimated to be approximately £195m in present value terms across the four bathing waters.

The value of bathing waters achieving the minimum standard is estimated based on customer valuation research undertaken by United Utilities to support its business planning³⁶. The value relates to the public good benefits that are supported by United Utilities' investments, in terms of the open access recreation benefits of designated bathing waters that meet the regulatory standards³⁷.

As noted in Annex 4, the purpose of the supplementary statement is to report the incremental impact of an organisation's activities on benefit levels - i.e. the contribution to/from the reporting organisation - rather than total benefits. In the Fylde Coast example it is reasonable to attribute the full value of external benefits to United Utilities' operations since, historically, public sewerage has been the biggest contributor to both pollution of coastal waters and investments to improve bathing water quality. Without this investment the condition of bathing waters would have not been improved to standards in line with regulatory requirements. In other applications, where the condition of natural capital assets is impacted by multiple stakeholders to a greater degree, it

³⁶ Estimates of the (monetary) value associated with bathing water quality are sourced from United Utilities' programme of customer valuation research (2012-13), which supported the development of the company's Business Plan submission to Ofwat for the 2014 Price Review. This applied stated preference methods to estimate customer willingness to pay for changes in water, wastewater and environmental service levels, including bathing water quality in terms of the proportion of bathing waters within the company region which met regulatory standards. Use of these values were also augmented by results from the Environment Agency's recent bathing water valuation study that reflects preferences for meeting different status levels for bathing waters under the revised BWD.

³⁷ It does not incorporate private values derived by other entities from, for example, tourism expenditure at bathing water sites. Notably Blackpool is the largest sea-side resort in the UK in terms of visitor numbers (over 10 million per year) and gross value added from tourism expenditure. Natural capital (including the quality of bathing waters) contributes to this level of economic activity but more detailed analysis would be required to isolate this contribution from other factors.

would be necessary to determine and report only the proportional contribution of the reporting entity.

The cumulative gain/loss line shows a loss of asset value of about £22 million in present value terms over the period 2011-14. This reflects the condition of bathing waters during the current 5-year asset planning and management cycle for United Utilities. This is due to an increased likelihood that the sites of interest will fail to meet the minimum standards of the current Directive³⁸. For the most part this was caused by variability in weather patterns and significant heavy rain and flood events leading to a higher level of storm discharges from sewers and other catchment sources impacting bathing waters.

The liabilities associated with maintaining and improving the quality of bathing waters within the Fleetwood wastewater catchment, include both capital expenditure for infrastructure maintenance and treatment works/network enhancement, and operating expenditure³⁹. In annual terms, liabilities associated with protecting the water environment and public health, through the treatment and disposal of sewage are around £6m. This is equivalent to about 1% of United Utilities' overall annual expenditure for the period 2010-15. All of these liabilities are attributed to legal provisions. Overall the total liability associated with maintaining bathing water quality at the four sites of interest is estimated to be approximately £179m in present value terms in perpetuity.

The focus of the account is on the liabilities and benefits that accrue to United Utilities customers, since all investments are funded via customer bills and asset values are aggregated over the United Utilities customer base. The asset valuation is, however, dependent on the contribution of other sectors to the status of bathing waters. Therefore the asset value recorded on the account for 2014 is not interpreted in the same manner as the changes in balance sheet asset values recorded on the core statement for other the pilots. Rather it represents the contribution of United Utilities to the overall asset value. In the case of the Fylde Coast bathing waters, this contribution is substantial and critical to the attainment of minimum regulatory standards.

Next steps

The application of the CNCA framework to the Fylde Coast shows how the approach can be applied to natural capital assets that the reporting organisation does not own or directly control. For a regulated utility, such as United Utilities, demonstrating the benefits associated with legal requirements for such stewardship obligations is an important aspect of the regulatory framework within which it operates. In particular, through the regulatory strategic planning process United Utilities is required to demonstrate the value that is delivered by investments that are ultimately funded by customers. Hence the extended framework provides a potential way for the company to

³⁸ Over the baseline period 2000-10 there were 40 observations for bathing water classification across the four bathing water sites. Of these, there were three occurrences where a site failed to attain the minimum standards of the current Directive for a bathing season. This implies an (approximate) average 90% likelihood that a site met the minimum standard. Over the period 2011-14 there were 15 observations for bathing water classification across the four bathing water sites. Of these, there were three occurrences where a site failed to attain the minimum standard of the current Directive for a season. This implies an (approximate) average 80% likelihood that a site met the minimum standard. This is a reduction in the likelihood of meeting minimum standards against the baseline. Note that the calculation of the likelihood excludes the status of Blackpool North for the period 2007-12 which was closed due to engineering work.

³⁹ Calculated liabilities are based on average capital and operating expenditure over the period 2006 - 2014. Guidance from United Utilities is that average expenditure over this period is expected to be representative of future costs. Liabilities are attributed to maintaining bathing water quality based on a 60:40 split for normal (60%) vs. high (40%) flow conditions. This is a simplifying assumption, although high flows result in overflows and hence the impacts on bathing waters from storm discharges. Hence 40% of costs are allocated to the maintenance of bathing waters.

report the asset value that is maintained or improved given the liabilities associated with statutory requirements.

In the Fylde Coast example it is reasonable to attribute the full value of external benefits to United Utilities' operations since, historically, public sewerage has been the biggest contributor to both pollution of coastal waters and investments to improve bathing water quality. Without this investment the condition of bathing waters would have not been improved. As noted, in other applications with multiple stakeholders impacting on the condition of natural capital assets, it will be necessary to determine and report only the proportional contribution of the reporting entity.

The current asset value reported on the extended balance sheet is only the value attributable to United Utilities customers. It excludes benefits derived by other visitors and the wider population. As a result and given the popularity of Fylde Coast as a visitor destination, and in particular Blackpool, the baseline value should be interpreted as a conservative estimate of external benefits.

The pilot account also highlights the challenge of attributing liabilities to individual natural capital outcomes, where financial inputs are not recorded in alignment with external asset values. In particular United Utilities' investment in sewage infrastructure has substantial public health and environmental quality benefits beyond bathing waters. Attempting to 'isolate' the expenditure that is related specifically to bathing water quality at specific sites is challenging. Whilst it is possible to directly attribute particular capital investments to improving coastal waters (e.g. dealing with point sources of pollution such as storm overflows), routine annual capital maintenance and operating expenditure for wastewater infrastructure is not readily attributable to specific outcomes. As noted this has wider benefits beyond maintaining bathing water quality, which are not captured in the pilot account, and in further analyses could be incorporated to reflect the overall public health and environmental quality benefits that are delivered.

The calculation of liabilities could be further refined to reflect future regulatory requirements. In particular implementation of the Revised Bathing Water Directive will necessitate further capital investments by United Utilities to ensure that designated sites attain the stricter minimum standards. These investments represent explicit provisions that should be recorded on the supplementary balance sheet, replacing the current assumption that historic investment is representative of future investment needed under the revised Directive.

Note also that implementation of the revised Directive should mean an enhanced asset value against the current baseline, if sites attain the higher minimum regulatory standard and continue to do so over time.

Overall, this pilot successfully demonstrates the potential for extending the boundary of the CNCA framework beyond the natural capital assets owned by the reporting organisation. Taking into account the above considerations, the pilot account results reported here should be interpreted as indicative and partial. Although the estimates of assets and liabilities are representative of the order of magnitude of values of maintaining/improving bathing water quality attributable to United Utilities, the estimates could of course be further refined.

4.5 Overall findings from pilot accounts

4.5.1 Pilot feedback

The feedback to the pilot testing was generally very positive, with all participating organisations interested in pursuing the application of the framework more broadly across further areas of their operations. The potential suggested uses for the framework included external reporting, evidence for public policy engagement, internal budget discussions, and performance appraisal.

The main barrier to wider implementation was identified as the resources required. There was considerable interest in the wider application of toolkits or models to populate natural capital accounts, reducing the resources needed for site level data collation. While further work is needed, it is anticipated that initial investment in data management systems as well as the development of standardised approaches to ecosystem services of high priority to the company could result in a practical way forward, while retaining the benefits of site level measurement.

An interesting insight provided by the pilots was the ability of the framework to have impact at different levels within the organisation. Feedback suggests that the framework can provide a tool that has impact at the local level while also having use at higher levels of decision-making and engaging the two.

Key feedback from the pilot organisations is the importance of positioning the framework in relation to financial accounts. While using the framework of balance sheets and changes in net assets as the starting point is useful to engage finance staff, it can also present areas of confusion.

There were several suggestions for further refinement and layers of analysis. For example, the separation of external values into that which may be captured by the company by engaging in markets, such as voluntary carbon markets or voluntary biodiversity offsets. There was also interest in separating external values into market and non-market values.

It was also noted that there was potential to expand the boundaries of the account, even though this would require further consideration. Examples may include the coverage of supply chain and product use/disposal inter-dependencies. The societal benefits that may arise from market goods that are derived from natural capital, such as aggregates and food, is also an area for further consideration.

4.5.2 Lessons learned

An overall summary of the key lessons learned during the pilot testing includes:

- **Proof of concept:** the purpose of the pilot exercise was to test the practical application of the CNCA framework. The pilot accounts, which cover varying land use and natural capital management objectives as well as the associated flows of private and external value, demonstrate proof of concept. They show that the practical application of the CNCA framework is feasible and provides useful results.
- **Data:** all the pilots show the potential of using ecosystem service valuation models to populate the monetary account without the need for complete on-site data. While there are limitations in the application of these models, as well as being subject to modelling error, the results provide useful insights into the relative benefits provided by the natural capital asset. There

are also benefits to undertaking compiling metrics for the asset register and physical flow account, even when these are not used in valuation.

- **Effort:** producing a complete account involves the collation of data from different sources within an organisation. Depending on existing data management systems this can be challenging. A significant part of the effort involved in populating the account was found to be in accessing relevant data from different parts of the organisation. The actual population of the account is, by comparison, relatively straightforward. It is expected that these costs would decline with each iteration or application of the account.
- **Consistency of application:** the framework establishes the principles (e.g. calculate present value of future flows) that should be applied in compiling an account, but does not prescribe the methodologies for valuation. This implies scope for different accounts to be framed around different sets of assumptions and methods. This has the potential to be a significant hurdle to the acceptance of accounts by organisations if they are used for external reporting. While this is noted as an area that requires more consideration, it is also stressed that consistency and comparability should be a longer term goal and should not be a barrier to an individual organisation wishing to produce an account for internal management aims.
- **Missing values:** The monetary account and resulting balance sheet presents the values associated with natural capital that can be estimated. This risks shifting the focus towards those benefits that are more amenable to valuation than others. For example, while climate regulation is relatively easy to provide estimates for, the valuation of biodiversity benefits is far more complex. This stresses the need to compile and present bio-physical metric data alongside monetary valuations.
- **Communication:** understanding the functioning of the CNCA framework compared to financial accounting needs to be well communicated. The fundamental differences need to be established to avoid potential confusion. Understanding the forward-looking nature of the asset and liability valuations is vital to interpreting the information provided by an account.

5. CONCLUSIONS

5.1 Summary

The purpose of corporate natural capital accounting is to produce a set of reporting statements that can be used to monitor and measure the health and value of natural capital. The framework set out here is designed mainly for private land owners and managers along with quasi-private sector organisations with nature and land conservation objectives. These organisations own or manage a significant proportion of England's natural assets. Compiling natural capital information in a coherent and comparable format will enable better informed decisions to be made about the management of natural capital assets, to the benefit of these organisations and society more generally.

The CNCA framework covers both biotic (living) and abiotic (physical condition and non-living) components of natural capital, and therefore includes ecosystem service provision along with renewable energy and non-renewable resources. It is concerned with the capacity of natural capital to generate future benefits, rather than reporting the actual benefits delivered historically. Since the aim is to promote long term maintenance of natural capital, maintaining natural capital values is more important than tracking short term fluctuations in benefits or costs. Notwithstanding this point, the framework enables degradation or enhancements to future benefits to be clearly identified by overall cause.

The combination of monetary values and bio-physical metrics that are compiled in the supporting schedules (the asset register, physical flow account, monetary flow account, and maintenance cost account) addresses the challenge of comprehensively capturing all natural capital inter-dependencies and impacts. This may be interpreted as a demanding set of requirements for preparing an account, but the structure reflects the evolving conceptual understanding of the natural capital. Hence, it is intended to help an organisation capture the breadth of information that is needed to enable an appropriate and rigorous assessment of natural capital.

5.2 Application of framework

The application of the CNCA framework has been tested through the pilot accounts. On the whole these provide 'proof of concept'. The case studies demonstrate that the framework can be applied to varying land use and natural capital management objectives, as well as the associated flows of private and external value.

It is evident that the usefulness of an account is almost entirely dependent on the quality of the data and information available. This is likely to be the main hurdle for application of the framework by an organisation as producing a complete account is highly data demanding. However, the development of a natural capital account should be viewed as an ongoing and iterative process, with improved information and data gaps being addressed over time. Indeed the inception of an account and its initial outputs should be the stimulus for streamlining existing and new data collection efforts. A significant gain for an organisation can be in the task of drawing together seemingly disparate information; a lesson from the pilot accounts is that much of the effort is related to the compilation and organisation of data. Population of an account is, by comparison, relatively straightforward.

It is noted that the CNCA framework is not intended to be highly prescriptive. This is to reflect the potential diversity of organisations and natural capital assets and their uses, to which the

framework could be applied. It is recognised therefore, that the potential for flexibility in the application of the framework may imply different treatments by different organisations. Where a partial account is developed this should be made clear, avoiding the risk of presenting results that are not substantiated by data. However, foremost, the intention is for the framework to help individual organisations improve the management of natural capital. Facilitating comparisons between different organisations should be viewed as secondary, particularly given the framework is at the inception stage. Consistency and comparability across organisations may be a future goal and subject to ongoing review and refinement. Initial efforts should focus on establishing the consistent use of the framework within an organisation.

The potential uses of the framework by an organisation are varied, as demonstrated by the pilot accounts. The first step for an organisation will be to understand how it can be applied to different business objectives - for example: strategy and natural capital risks and opportunities; land use/investment decisions; new revenue opportunities; stakeholder communications; and governance - and establish which of these the framework should support.

As highlighted in this report, whilst the natural capital balance sheet and statement of changes in net assets are similar in appearance to financial accounting, they do require careful interpretation. Hence a natural capital account must be recognised as a 'free-standing' tool that can be applied by an organisation. Given the definition of natural capital and underpinning concepts, the valuations reported on the balance sheet differ markedly from those on financial balance sheets. Overall the CNCA framework compliments and enhances an organisation's management systems; it does not replace any current tools or methods.

5.3 Recommendations for users of the framework

The work started by this study should be expanded and refined through wider application. The following recommendations are provided for potential users of the framework:

1. Focus on 'quick' wins.

Next applications should prioritise topics or locations that are of high relevance for an organisation or important for natural capital maintenance. Applications that concentrate on one issue or site (like the pilots) or broad and shallow applications across an entire business could be considered. Like any new initiative, complete application of CNCA will require a long-term plan and adequate resources.

2. Focus on core natural capital assets.

An asset could be described as 'core' for an organisation if it provides a significant proportion of benefits to business and/or poses a significant risk to its sustained profitability. These assets may not be the easiest to include in a CNCA (e.g. may not have the most data or best understanding associated with them) but even an incomplete application can be useful in terms of furthering the decision making process.

3. Improve the supporting data and knowledge inputted to CNCA.

There is a vast amount of environmental data already collected and management systems already in use by organisations. Their application in the context of CNCA will need to be further explored. This will be an iterative and evolving process, with the task of preparing an account helping to identify data needs, and updated data facilitating revisions of an account.

4. Support the improvement of the framework.

Methodological aspects of the framework and its application to address the needs of different businesses will benefit from further testing. This will make CNCA relevant to more organisations and improve general guidance that can be provided to the future users.

5. Consider extending the framework to include supply chain impacts.

CNCA is complementary to tools currently used by organisations to assess supply chain impacts. There may be opportunities to explore how to integrate these analyses to better understand an organisation's overall impact on natural capital.

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ANNEX 1: PROJECT WORKSHOP SUMMARY

A1.1 Introduction

The purpose of the project workshop, held on the 4th July 2014, was to:

1. Share work to date on developing and testing a framework for corporate natural capital accounting (CNCA); and
2. Listen to views of the NCC's Land Owners Group to understand how to develop and improve CNCA and how to communicate its role and application to the target user group.

Participants included representatives from the four pilot organisations as well as many from the Land Owners Group. The appendix to this annex provides the full participants list.

The first half of the workshop focused on the developing CNCA framework. The project team presented the background to the CNCA framework and its main features, including the key guiding principles, its potential uses, and the practical methodology for its application that has been tested in the pilot accounts. The presentation by the project team was supplemented by contributions from the pilot organisations, which provided an overview of the experience to date with pilot account, and more generally accounting for and measuring natural capital. Each pilot organisation reflected on: (a) why natural capital is important to their organisation; (b) how the CNCA framework could be useful to them; (c) what challenges they foresee; and (d) where natural capital currently sits within their organisation's priorities.

The second half of the workshop featured breakout groups. Facilitated by a member of the project team these groups discussed: (a) opportunities and motivations for using the framework; (b) potential barriers and limitations to the use of the framework; and (c) recommendations for the further development and communication of the framework. Each group reported their main discussion points in a concluding wrap-up session.

A1.2 Summary of group discussions

The questions and discussions from the breakout groups are summarised below. The summary records the issues raised by participants; it does not, however, necessarily represent either their views or those of organisations they represent.

A1.2.1 *Opportunities and motivation*

i) Who is the CNCA framework for?

- It is important for the NCC to define who this framework is for, and who it wants to undertake natural capital accounting.
- The framework could be of great benefit to policy development - it could identify who benefits from using natural capital, who should/could pay for its damage, and could also help the Government identify the key benefits from infrastructure plans.
- CNCA could be of benefit to the public sector.
- There was a general sense that CNCA could well happen down the line and that the work undertaken so far was an important step forward. Some of the organisations present at the workshop want to continue to be at the forefront of the process.

ii) Why should an organisation undertake CNCA?

- It is important to answer this question; and why should investors be interested in an organisation that does? It would be more difficult to make the case for a smaller company, like a family run farm. There were questions around the benefits for companies like this.
- CNCA could help organisations, who manage land on behalf of others, demonstrate the additional value of their management.
- For organisations whose land management is partly co-funded (by Government for example) CNCA can help report the full value of this investment.
- The purpose of investing in natural capital may be different for different organisations, but this framework potentially supports each of them. It is a way to justify to different representatives of consumers (taxpayers, utility customers or wider society for a 'license to operate' for those who manage assets) the responsibilities that organisations have in a wider context. Capturing these values in monetary terms helps communicate them and to support existing budgets.
- CNCA could help organisations balance the constraints of acceptable environmental performance with (shareholder) profit. Currently, this is done intuitively by staff in the process of doing business.
- Management and decision-making:
 - Existing accounting and reporting systems are not always fit for purpose. For example, existing accounting systems yield conclusions that are known to be "wrong". For example, the value of seabed was reported to be negligible until recently. Tools to inform decisions, such as whether to invest in man-made capital versus improvements in natural capital are also known in certain circumstances to yield the "wrong" answer.
 - Currently, data systems tend to favour measurement of assets or asset characteristics that are rare, regulated or financially material. The CNCA approach enables a consistent approach across a broader range of costs and benefits and will improve upon existing reporting and decision-making frameworks. Natural capital is no longer simply seen as a qualitative 'add-on' or ignored by an increasing number of organisations.
- Long-term business strategy
 - CNCA could help an organisation understand and articulate its resilience and risk - these two concepts are key concerns for organisations and can mean different things.
 - CNCA may also reveal new opportunities, for example:
 - Current markets are incomplete to enable organisations to realise external values. To what extent can the framework help develop and complement new markets, such as biodiversity offsetting and Payment for Ecosystem Services (PES) schemes?
 - Can the framework help channel new investment into natural capital?
 - Will the framework enable organisations to claim financing for additional services that their assets provides such as carbon sequestration, flood defence or biodiversity?
- Reporting:
 - There is a trade-off between a prescriptive framework that enables comparisons between organisations and a tailored framework that is highly relevant to each company. It was noted that the relative importance of relevance and comparability depends on the use of the framework. If it is used for reporting, comparability is key. However, it should be noted that financial accounting also incorporates flexibility and different interpretations but that is accepted with accompanying notes that ensure transparency. The point was made that in the medium term the use of the CNCA framework should be flexible but transparent.
 - CNCA could provide a useful communication tool. Organisations may want to be able to bring to life the contribution they make to natural capital. The CNCA will enable an organisation to communicate how they are developing corporate value.
 - CNCA could also help communicate the broader benefits of natural capital, such as health benefits. The point was raised that it could help raise the profile of these wider benefits, and broaden the debate around the value of nature to the wider economy and society.

- The framework could be used to articulate common interests between an organisation and their stakeholders or other similar organisations. It could help build relationships and facilitate closer working on shared priorities. CNCA will also be useful as an internal communications tool for broadening discussions between those working on the ground and central finance, sustainability and administrative teams.
- Governance:
 - The framework may be used to motivate staff. For example, longer serving staff have years of experience to teach about long term planning. The CNCA framework is one way of communicating this to staff with less experience.
 - The framework can help organisations to think in a different way, for example it can help to shift to a mind-set which takes into account what natural capital is and why it's important (for corporate leaders, employees and customers).

A1.2.2 Barriers and challenges

i) Securing buy-in

- In order to undertake CNCA, it was felt that buy-in is needed at several layers. It was seen as critical to have interest at the Chief Financial Officer (CFO) level but also wider communication across the organisation is necessary. The ability to link sustainability and finance teams in larger organisations is fundamental.
- A question was raised as to what the motivation for a CFO to commit resources to this would be:
 - The driver will differ by organisation. One break out group reported that, currently, neither investors nor consumers are asking for this.
 - Bio-carbon is closest to having a developed market. Such a market would help bring part of a theoretical natural capital account forward by giving it a real link with financial accounts and provide the incentive to undertake CNCA.
- Pilots highlighted the need for buy-in across the organisation as data may be held by different individuals and departments who may have never spoken to each other.

ii) Incomplete markets

- How can an organisation actually increase revenue streams from undertaking CNCA and see any financial benefit? Many external values are far from having a developed market to realise value.

A1.2.3 Resources required to undertake natural capital accounting

- Feedback from a pilot organisation indicated that: (a) it is necessary to know what data is needed to undertake CNCA; (b) it may then be necessary to find a proxy; and (c) then actually need to get hold of the data. The third step was more difficult than anticipated and it is clear that it requires commitment from across the organisation. An organisation may think they have lots of data, but it might not be the right data or easily accessible.
- Concern was raised that these data issues will be even more significant when dealing with tenanted land.
- It is not necessarily clear from the pilots what scaling-up to an overall corporate level would involve.
- At a corporate level it might be useful to do the 'broad and shallow' assessment first, followed by 'narrow but deep' assessment of key areas.
- The benefit compared to financial accounts is that effort can be equally apportioned between the years, it does not require a large amount of effort at the end of the financial year.

A1.2.4 Valuation

- Valuation may be interpreted by some stakeholders to imply permitted trade-offs between ecosystem service benefits. For example, carbon sequestration traded for biodiversity habitat. It should be clear that valuation purely enables comparability.
- There is also a concern about limitations for including biodiversity. Carbon for example is relatively easy to include, but species conservation (which is a priority for several participant organisations) is not. Species conservation, non-use values, and water values are less easy to estimate and monetise and the account could therefore result in a partial account that requires careful interpretation. This is one reason that the asset register is an integral part of the account.
- CNCA could face resistance if seen to be used by organisations to increase costs for a service provided, for example adding 'biodiversity costs' to a utility bill.
- The above issues with valuation should not hold this approach back.
- CNCA will not alter processes on non-renewable assets (these are well-established, they will not change, and could dominate a natural capital account in terms of contribution to net value).

A1.2.5 Other risks

- Shifting to a new system of recording or accounting, such as that offered by the CNCA, may risk undermining current existing work.
- This is an evolving area and the point was raised that the NCC is currently time limited. Should organisations 'watch and see' or jump and invest resources into something that may not materialise? The point was raised that there needs to be an ongoing NCC, and longer term direction that does not change with politics.

A1.3 Recommendations

- The trade-off between consistency and comparability needs attention.
- There is a need for simple language if this is going to succeed. There is also a need to be able to communicate this to finance colleagues.
- There was a plea to "just get going"; while the CNCA framework may not be perfect, it is good enough and should get out there and learn from experience. Complexity should not get in the way.
- Should engage with manufacturers in order to complete the picture.

Appendix to Annex 1: List of workshop participants

Organisation	Name
Country Land And Business Association	Damian Testa
Crown Estate	Mark Gough
Crown Estate	Daniel Lopez Diaz
Forestry Commission	Jonathan Spencer
Greater London Authority	Andrew Jones
Lafarge Tarmac	David McCabe
Lafarge Tarmac	Andy MacIntosh
Lafarge Tarmac	Daniel Marchant
National Trust	Patrick Begg
National Trust	Sue Cornwell
NFU	Diane Mitchell
RSPB	Paul Morling
South West Water	Martin Ross
United Utilities	Jonathan Dobson
Wildlife Trusts	Paul Wilkinson
Wildlife Trusts	Sarah Jane Chimbwandira
Wildlife Trusts	Estelle Bailey
Woodland Trust	Frances Winder
Project team and NCC Secretariat	
eftec	Allan Provins
eftec	Ian Dickie
PwC	Victoria Cox
PwC	Will Evison
PwC	Andrew Thurley
RSPB	Katie Bolt
NCC Secretariat	Alastair Paton
NCC Secretariat	Gillian Smyth

ANNEX 2: EXAMPLE SCHEDULES AND STATEMENTS

Table A2.1: Partial asset register (Wimpole Hall Farm pilot)

Natural capital stock	Indicator	Units	Reference year (2008)	Reporting year (1) (2014)	Source:	Notes
Accounting unit: Farmland						
	Area Farmland	Hectares	117	117	1	-
	Years since organic conversion began	Years	2	6	1	-
	Years since full organic conversion	Years	0	4	1	-
Natural capital stock metrics:						
Species	Rare/protected species recorded	Number	201	-	2	Numbers for whole estate
	Variety of species	Number	3594	-	2	Numbers for whole estate
	Rating of SSSI area that is farmed	Rating	Favourable	-	3	
	% arable land contains buffer strips or field margins	Percent	76-100	-	3	
	% arable area left as overwintered stubble or wild bird cover	Percent	1-25	-	3	
Soils	Soil compaction rating	Rating	Poor	-	4	Expert judgment at site Long Ropes (TL34435116)
	Soil structure rating	Rating	Poor	-	4	As above
	Soil type	Series	Lawford Series	-	4	As above
	Soil Organic Matter levels	Rating	Maintained	-	3	increasing, decreasing, maintaining
	Nitrogen balance (kg)	kg	45,234	-	3	
	Phosphorous balance (Kg)	kg	-1,813	-	3	
	Potassium balance (Kg)	kg	-1,199	-	3	

Sources:

1. National Trust (2009) Nature conservation evaluation: Wimpole, Cambridgeshire
2. National Trust (2013) Wimpole Conservation Map.
2. OCIS Public Goods Data Collection (undated)
4. Burton (2004) The Soil Resource

Table A2.2: Partial physical flow account (Wimpole Hall Farm pilot)

Account. unit by service	Indicator	Units	Reference year (2008)	Reporting year (1) (2014)	Years from reporting year*				Source	Notes
					1-5	6-15	16-50	51-100		
Climate regulation										
Farmland	Carbon stored	Tonnes/h ectare	57	62	62	62	62	62	Estimate using TESSA	Site data is pending
Farmland	Net carbon sequestration	Tonnes/h ectare/year		As above
Recreation										
Whole Estate	Visits to parkland per year	Number	95,038	133,067	133,067	133,067	133,067	133,067	Visitor survey visitor	Visits to estate including Parkland
Food Provision										
Farmland	Tonnes wheat/ha	Tonnes	1136	1136	1136	1136	1136	1136	Consultation with the farm manager	Data available for other crops
Farmland	Ha wheat	Hectares	62	62	62	62	62	62	Consultation with the farm manager	As above

Table A2.3: Partial monetary account (Wimpole Hall Estate pilot)

Service flow by account. unit	Indicator	Units	Reference year (2008)	Reporting year (1) (2014)	Years from reporting year				Source	Notes
					1-5	6-15	16-50	51-86		
Climate regulation										
Whole Estate	Value per tonne carbon	£ (2014) /tonne carbon	56.01	59.18	64.46	72.39	202.21	330.86 (years 51-86)	DECC (2013)	Converted to 2014 prices using GDP deflator
Farmland	Total value of carbon stored	£ (2014) mn	9.03	12.9	-	-	-	-	Estimate	Stock value
Recreation										
Parkland	WTP per visit	£ (2014) /visit	2.50	2.50	2.50	2.50	2.50	2.50	Based on a review of literature	-
	Total value recreation	£ (2014) '000	171	240	240	240	240	240	Estimate	Parkland only
Food Provision										
Farmland	£/tonne grade 1 wheat	£ (2014) /tonne	150	192	192	192	192	192	John Nix Management Handbook 2013	Estimate informed with farm manager
	Total net revenue	£ (2014)	76,400	53,072	53,072	53,072	53,072	53,072	As above	As above
Biodiversity										
	WTP/ ha managed ELS	£/ha	47	47	47	47	47	47	Boatman et al (2010)	Average of lower and upper values.
	WTP/ ha managed HLS	£/ha	237	237	237	237	237	237	Boatman et al (2010)	As above.
	Value of biodiversity	£ (2014) '000	30.4	140.2	123.2	123.2	123.2	123.2	Estimate	

Table A2.4: Partial maintenance cost account (Wimpole Hall Farm pilot)

Accounting unit by Ecosystem Service	Indicator	Units	Reference year (2008)	Reporting year (1) (2014)	Years from reporting year*				Source	Notes
					1-5	6-15	16-50	51-100		
Woodland										
Forester's Cost	NC Maintenance	£k	70	70	70	70	70	70	Wimpole accounts	Pers. comm. farm manager
	Operating	£k	0	0	0	0	0	0		
Farmland										
Fixed cost of the Farm	NC Maintenance	£k	30	30	30	30	30	30	As above	As above
	Operating	£k	140	140	140	140	140	140	As above	As above
Whole Estate										
Visitor and management	NC Maintenance	£k	25	25	25	25	25	25	As above	As above
	Operating	£k	215	215	215	215	215	215	As above	As above

ANNEX 3: VALUATION OF EXTERNAL BENEFITS

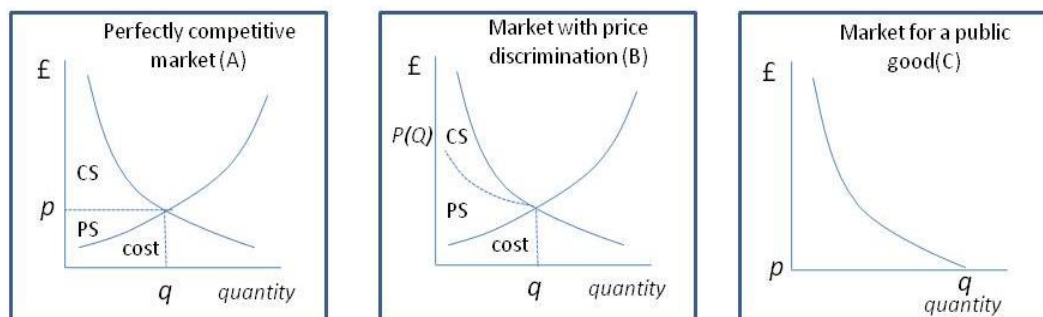
Section 3.2.3 highlights that private values associated with natural capital will typically be measured in terms of market exchange prices, or where natural capital confers a direct benefit to an organisation (e.g. private water supply), in relation to the replacement cost (e.g. sourcing an alternative water supply).

By definition, however, exchange prices are not observed for non-market benefits that are external to an organisation. The challenge, therefore, for including the monetary value of external benefits in an account is to establish the value that would occur if the external services/goods were freely traded. In this regard, non-market (economic) valuation techniques are well-developed to estimate surrogate values (e.g. revealed preference and stated preference methods). However, their focus is typically on estimating changes in welfare rather than exchange prices. Estimating exchange values requires additional assumptions about the market mechanism (free market, auction, monopoly, etc.) that would be in place to set the price. Consequently the degree to which welfare and exchange values are different is determined by assumptions regarding the market mechanism. As set out in Box A3.1, exchange and welfare values may be equal if an auction style market mechanism is assumed. Hence unless there is compelling reason to assume a different market set-up, there is nothing logically inconsistent with using welfare estimates to reflect exchange values in an accounting context.

In addition the potential margins of error associated with the application of non-market valuation also mean that, in practice, the assumptions regarding the market mechanism are unlikely to have a material impact. For example results from primary valuation studies can be demonstrated to be robust and reliable according to appropriate protocols for their design and analysis, but ultimately various assumptions will be required (e.g. the coverage of benefits, the assumed beneficiary population, etc.) which imply that valuations are best interpreted in relation to the scale and order of magnitude of benefits, rather than as precise estimates. Where these results are subsequently applied in value transfer applications, then further assumptions are entailed which reinforce this interpretation. Given this, as well as the potential conceptual argument that there need not be a theoretical inconsistency between welfare and exchange values, it is not proposed that applications of the CNCA framework consider adjustments to welfare estimates found in the literature for external benefits. There will, however, be other valid reasons to adjust values to account for differences in good characteristics, location, and types of beneficiary, in line with conventional good practice protocols for value transfer (for example, see eftec 2010).

Box A3.1: Exchange and welfare values

Under the conditions of a perfectly competitive market, the price in a market is determined at the intersection of the demand and supply scheduled (a simplified example is shown in panel A, below). In this scenario, over the whole market, producers enjoy benefits equal to the producer surplus (PS), which is the difference between the price they receive and the price they would have been willing to sell at. Consumers enjoy a benefit, which summed over all consumers is equal to the consumer surplus (CS). This reflects the difference in the value that consumers were willing to pay above and beyond the market price.

Prices and market institutions

Source: Day (2013)

Day (2013) points out that the assumption of perfectly competitive markets rarely holds in the real world. Other institutional settings are observed and the resulting prices are included in standard accounts without further consideration. He provides the example of a market defined by an auction setting (depicted in panel B in Figure 3.2). In this institutional setting, there is price discrimination and the buyers pay what they bid. The observed marginal price is not constant, but represented by $p(Q)$. This change in institutional setting affects the share of surplus between the producer and the consumer, demonstrating the point that marginal prices are as much a function of the institutional setting in which the market trades, as the underlying preferences and costs.

This is relevant in the case of non-market and public goods, as the institutional setting of a public good returns a marginal price of zero (shown in panel C above). Day proposes that one response to dealing with this is to assume a set of prices that perfectly follows the demand curve. This would not be logically inconsistent with accounting principles if an institutional setting that would deliver this could arise in the real world. Therefore, he argues, there is nothing logically inconsistent with valuing the benefits derived from public goods by measuring consumer surplus if an institutional setting can be envisaged that could deliver this.

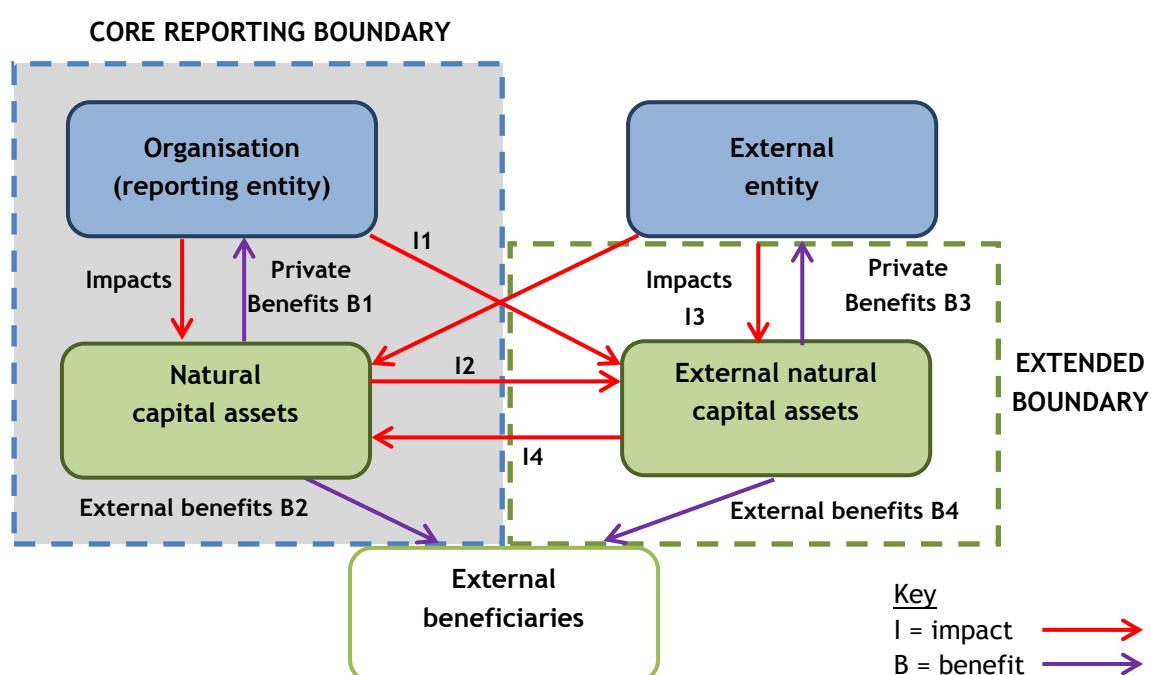
ANNEX 4: EXTENDED NATURAL CAPITAL ACCOUNT

Section 3.3 of the Main Report describes the boundary of the ‘core’ natural capital account. This is concerned with measuring the direct value and costs associated with natural capital over which the reporting entity has a stewardship interest. In some cases, it may be important to recognise wider natural capital asset interactions via an ‘extended’ natural capital account.

The extended account reports on both: (a) the material impacts of an organisation on other external natural assets (i.e. the impact on natural capital owned/under the stewardship of other private or public organisations, or completely ‘unowned’); and (b) the impact of external natural assets on those of the organisation.

In Figure A4.1, the core reporting boundary is as described in the Main Report (see Figure 3.2). The extended boundary is selected to encompass those external assets that have a significant interaction with the core boundary assets and/or the reporting organisation. Note that an ‘extended’ boundary for a natural capital account should only be considered where such interactions are material to the business or society.

Figure A4.1: Scope of extended natural capital account - asset values and external interactions



As shown, the operations of an organisation may have external interactions with natural capital via a number of pathways:

- The activities of the organisation may have positive or negative impacts on external natural capital in two ways:
 - I1: The organisation’s (day-to-day) activities may directly impact upon external natural capital. For example, industrial processes may discharge pollution/emissions into water bodies and impact upon downstream rivers and lakes.

- I2: The state of natural capital as managed by the organisation may have impacts on natural capital that is not under the company's stewardship. For example management actions concerning the organisation's natural capital may have implications for the condition and status of natural capital held by others (e.g. an upland bog may regulate the water flow to a downstream plot of land affecting land productivity).
- External parties can have impacts on the organisation's natural capital in various ways:
 - I3: External operations can directly impact upon the health of core natural capital (e.g. farmers' use of pesticides may degrade the water quality in the catchment and increase water treatment costs).
 - I4: The state of external natural capital may impact upon the health, benefits and costs of core natural capital. For example, an adjacent plot of external land that is rich in pollinators may reduce costs and improve productivity of an owned orchard.

There may be many such impacts identified in any given situation. For the extended analysis what is important is to determine the aggregate impact on the benefits of the reporting organisation and on those of external entities, that is:

- B1: the private benefits of core natural capital (e.g. the productivity of the reporting organisation's arable land, improved by better external upland farm stewardship).
- B2: the external benefits of core natural capital, (e.g. the recreational value of a woodland reduced by mining activities on an adjacent site).
- B3: the private benefits of external natural capital, (e.g. the increase in downstream fishing income arising from reduced water pollution by the reporting organisation.)
- B4: the external benefits of external natural capital, (e.g. the reduction in the recreational value of coastal bathing waters, arising from the waste water discharges of the reporting organisation).

The impact of these complex interactions can be reported in two supplementary statements:

- **The impact of the reporting entity on external natural capital:** this would evaluate the positive or negative contribution to the benefits (B3 and B4) arising from impacts (I1 and I2).
- **External impacts on core reported natural capital:** this would evaluate the positive or negative contribution of impacts (I3 and I4) on the core reported benefits (B1 and B2).

Note these statements should report the incremental impacts on benefit levels - i.e. the contribution to/from the reporting organisation - rather than total benefits (B1 to B4) and as such may be difficult to isolate. For example, a water company (reporting organisation) may identify degradation to water quality arising from two external sources: diffuse pollution from upland farmers and, industrial pollution from an upstream paper mill. The extended report does not isolate the loss of benefit due to each of these two sources, but evaluates the aggregate impact of the two sources on the core benefit levels, in this case possibly valued by the increase in treatment costs to remove pollutants.