Australia's National
Science Agency

The Natural Capital Handbook

A practical guide to corporate natural capital accounting, assessment, risk assessment and reporting

2023

Acknowledgements

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Important disclaimer

Acronyms

AASB	Australian Accounting Standards Board
BSI	British Standards Institution
CDSB	Climate Disclosure Standards Board
CICES	Common International Classification of Ecosystem Services
ESG	Environmental, Social and Governance
GRI	Global Reporting Initiative
IAS	International Accounting Standards
IASB	International Accounting Standards Board
IFRS	International Financial Reporting Standards
IIRC	International Integrated Reporting Council
ISO	International Organization for Standardization
ISSB	International Sustainability Standards Board
IUCN	International Union for Conservation of Nature
IUCN-GET	IUCN Global Ecosystem Typology
NCFA	Natural Capital Finance Alliance
NCP	Natural Capital Protocol
NPV	Net Present Value
SASB	Sustainability Accounting Standards Board
SDGs	Sustainable Development Goals
SEEA	UN System of Environmental-Economic Accounting
SEEA-CF	SEEA – Central Framework
SEEA-EA	SEEA – Ecosystem Accounting
SNA	System of National Accounts
TCFD	Task Force on Climate-related Financial Disclosures
TNFD	Taskforce on Nature-related Financial Disclosures
TEEB	The Economics of Ecosystems and Biodiversity

Contents

Executive summary

This handbook provides guidance on natural capital accounting, impact and dependency assessment, risk/opportunity assessment, and reporting for organisations (private, public, and non-profit). It addresses a current lack of practical guidance that brings together and harmonises the many different standards, frameworks and example approaches that have been developed in each of these areas. It does not seek to replicate guidance that is adequately provided elsewhere, but to provide a practical 'how-to' guide which points towards such resources and also helps to make sense of occasional divergence between different approaches, so that organisations can make informed decisions about the approach that will best suit their own needs.

The natural capital approach extends the economic notion of capital (resources that enable economic production) to the natural environment. The term '**natural capital'** conceptualises nature as assets: stocks of resources such as clean air, water, soil and living things which produce flows of **ecosystem services** that have value because they **benefit** humans (households or firms).

The guidance in this handbook is applicable to organisations of different sizes and types (private, public and non-profit organisations). The main intended audiences are organisations that own or control significant natural capital assets (e.g., forest growers, farmers, mining companies, government, and non-government organisations with substantial landholdings) that are seeking to prepare natural capital accounts and/or natural capital impact, dependency, and risk/opportunity assessments. The natural capital accounts and assessments aim to provide useful information for both internal use by managers of organisations, and external use by their stakeholders, such as investors, lenders, certification bodies, regulators, and the general public.

Although aimed at organisations, the concepts and principles in this report could be applied at different scales, such as in the development of regional or sector level accounts or assessments. The natural capital accounting guidance in this handbook is designed to be consistent with national-level accounting under the UN System of Environmental-Economic Accounting (SEEA) framework, but has been simplified and streamlined for organisational level application, with the addition of some features unique to reporting natural capital accounting information from an organisational perspective.

While there is guidance available for each of these activities in isolation, what has been missing until now is guidance that covers all these different activities together, and that explains how they relate to each other. The key features of this handbook are:

- A **clear differentiation** between **natural capital accounting** (which is principally relevant to reporting entities that own or control natural capital assets) and **natural capital impact, dependency and risk/ opportunity assessment** (which any reporting entity can use to understand and report on their interactions with natural capital, regardless of ownership or location of that natural capital);
- Acknowledgement of a **central role for natural capital risk/opportunity assessment**, which applies to all reporting entities and builds on the core elements common to any natural capital assessment (i.e. assessment of natural capital impacts and dependencies);
- Identification of **five key disclosure statements** that together can form a complete picture of an reporting entity's interactions with natural capital:
  - 1) a **natural capital balance sheet** and 2) associated **natural capital income statement** (principally applicable to reporting entities that own or control natural capital assets); and
  - 3) a **natural capital impact statement**, 4) **natural capital dependency statement** and 5) **natural capital risk/opportunity statemen**t (applicable to any reporting entity).
- **Alignment with existing corporate reporting**: the natural capital balance sheet and income statement are closely aligned with their financial equivalents (i.e. the balance sheet or statement of financial position as at the end of the period, and the income statement or statement of profit or loss and other comprehensive income for the period), while the natural capital risk statement is aligned with the corporate risk statement, and the impact and dependency statements are aligned with sustainability disclosures. Importantly, the natural capital income statement as defined here covers the same set of natural capital assets as the natural capital balance sheet, in the same way that the financial income statement and financial balance sheet have the same scope.

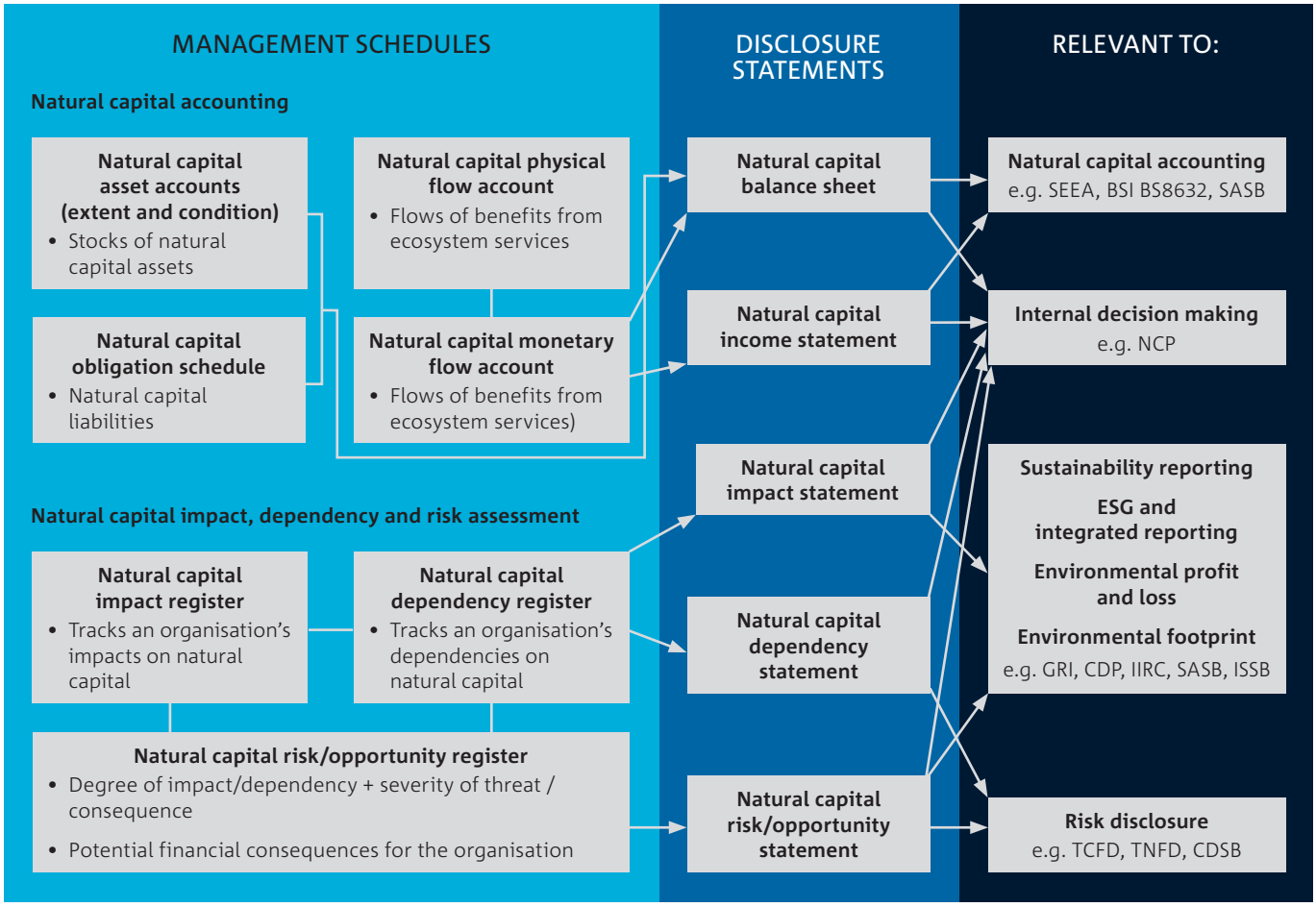

Figure 1 Corporate natural capital accounting, assessment, risk assessment and reporting

What are natural capital accounts, and natural capital impact, dependency and risk/ opportunity assessments?

Natural capital accounting identifies and records consistent and comparable information on natural capital assets and the services provided to the reporting entity and other users (e.g. society). It includes information on the state (quantity and quality, or extent and condition) of natural capital assets, the flows of natural resources (e.g. minerals or water) and ecosystem services (e.g. biomass provisioning or flood mitigation services) that these assets provide, and associated monetary values (if desired, and where it is feasible to identify such values). For organisations, natural capital accounting can be seen as a logical extension of management and financial accounts, bringing the structure and rigour to natural capital that is already applied to manufactured and financial capital. Unlike financial accounting frameworks—which are well established and often mandatory—natural capital accounting is currently a voluntary and flexible process for organisations. An international standard, the System of Environmental-Economic Accounting (SEEA), exists for natural capital accounting at a national government level (United Nations, 2021, United Nations et al., 2012), but its application at local or organisational scale is still at an early stage (Barker 2019). This handbook adopts SEEA-compatible concepts and approaches wherever possible in order to promote consistency between natural capital accounting and reporting at different scales.

A standard for natural capital accounting for organisations has recently been released by the British Standards Institution (BSI, 2021). The BSI standard offers useful guidance on the process of preparing natural capital accounts for organisations but has some disadvantages insofar as it combines aspects of natural capital accounting with impact and dependency assessment without clear separation between the two. In this handbook we attempt to reconcile these differences by referencing relevant sections of the BSI standard in relation to these two separate activities.

Clarifying differences in viewpoint: the natural capital income statement

Differences in viewpoint have in the past led to the term 'environmental profit and loss' (PUMA, 2011, Kering, 2020) being used for what is essentially a natural capital impact statement, as opposed to a statement of comprehensive income from owned/ controlled natural capital assets. Similarly, the BS 8632:2021 standard (BSI, 2021) adopts the term 'natural capital income statement' for a statement of the reporting entity's impacts on (any) natural capital. A major disadvantage of this approach is that it breaks the fundamental relationship that exists in financial accounting between the balance sheet and the income statement, where income is defined as increases in assets or decreases in liabilities, and therefore both statements should focus on the *same* set of natural capital assets, i.e. those that the reporting entity owns or controls. We therefore propose that the term 'natural capital income statement' is reserved for a statement of the comprehensive (positive and negative) flows of benefits from natural capital assets that a reporting entity owns or controls, while the term 'natural capital impact statement' is used for any statement of the reporting entity's impacts (positive and negative) on natural capital in general. Viewed in this way, natural capital balance sheets and income statements have the reporting entity's natural capital *assets* as their focus; whereas natural capital impact and dependency statements have the *reporting entity's* wider relationship with natural capital as their focus.

Natural capital impact and dependency assessment identifies and records consistent and comparable information on the reporting entity's relevant (material) impacts and dependencies on natural capital (whether those natural capital assets are owned/controlled by the reporting entity, or not). **Natural capital impacts** can include negative impacts, such as land degradation, emissions or pollution, and positive impacts, such as carbon sequestration or ecological rehabilitation.[1] **Natural capital dependencies** can include any material reliance on or use of natural capital, such as reliance on adequate rainfall or groundwater resources, or the services provided by insect pollinators. In some cases, the relevant dependency might be the *absence* of conditions that would otherwise be unfavourable (such as extreme weather or pests and diseases) – which can be conceptualised as 'negative' dependencies. Relevant existing guidance includes the **Natural Capital Protocol** (Natural Capital Coalition, 2016). The Natural Capital Protocol provides a generic framework for reporting entities to identify their natural capital impacts and dependencies, and then to measure and value what is relevant, without prescribing how such measurement or valuation should be done or how it should be used or disclosed.

Natural capital risk/opportunity assessment identifies and records consistent and comparable information on the material risks, and associated opportunities, to the reporting entity (and/or society) arising from their natural capital impacts and dependencies and how these are projected to change in the future (e.g. through management changes, climate change or changes in social preferences and regulation). Broadly speaking, physical changes such as climate change or habitat loss that affect natural capital dependencies can be thought of as 'physical risks', while changes in social responses to natural capital impact are often driven by society's transition towards a lower-impact state, hence 'transition risks'. However, in principle, transitions can also affect natural capital dependencies (e.g. by increasing demand for some forms of natural capital and reducing demand for others), while physical risks can also affect the context and social consequences of impacts (e.g. climate change may increase water scarcity in a region, hence increasing the impacts of water consumption, which may lead to greater regulation or higher pricing).

Relevant existing guidance includes the **Taskforce on Nature-related Financial Disclosures (TNFD)** draft recommendations (TNFD, 2023), **Natural Capital Finance Alliance (NCFA**) methods and tools for portfolio-level natural capital risk assessment (NCFA and PwC, 2018, NCFA and UN Environment World Conservation Monitoring Centre, 2018) and individual asset-level risk assessment in agriculture (Ascui and Cojoianu, 2019).

Natural capital reporting or disclosure involves the communication of natural-capital-related information to external stakeholders, such as shareholders, regulators, and civil society. A number of different voluntary standards and guidance have covered the disclosure of various aspects of natural-capital-related information by organisations, published by organisations including the Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), Climate Disclosure Standards Board (CDSB), International Integrated Reporting Council (IIRC), the Task Force on Climate-related Financial Disclosures (TCFD) and the Taskforce on Nature-related Financial Disclosures (TNFD) (TCFD, 2017, CDSB, 2019, CDP et al., 2020, GRI, 2011). In November 2021, a new International Sustainability Standards Board (ISSB) was formed by the International Financial Reporting Standards (IFRS) Foundation, which also oversees the International Accounting Standards Board (IASB) which sets corporate financial accounting standards. The ISSB will set standards for disclosure of sustainability-related information that is material to company value, building on the existing SASB, CDSB, IIRC and TCFD standards and guidance and consistent with IASB standards, while the GRI will likely continue to provide a framework for voluntary reporting of sustainability-related information that is more broadly relevant to society. IFRS standards are not, in themselves, mandatory, but they have been adopted into mandatory reporting requirements for listed companies in 144 jurisdictions (including Australia), and they are often followed voluntarily by companies not subject to these requirements. Therefore, while natural capital reporting has been entirely voluntary in the past, reporting of natural capital information that is material to company value is likely to become increasingly expected, if not mandatory, for many organisations in the near future.

1 In this handbook we use the terms 'positive' and 'negative' for impacts that generally improve or degrade natural capital, respectively. However, this is a complex topic and impacts could be positive for some aspects of natural capital and negative for others, and/or viewed differently from different value perspectives or by different stakeholders. It is up to the reporting entity to clarify the basis on which any distinction between 'positive' and 'negative' impacts is made, particularly if using these concepts to report 'net' impacts.

Why conduct natural capital accounting?

Natural capital accounts are principally **relevant for organisations that own or control natural capital assets**, e.g. forest growers, farmers, mining companies, government, and non-governmental organisations with substantial landholdings. They provide information for internal decision-making (similar to conventional management accounting information) and external reporting/disclosure (aligned with financial or annual reporting).

Natural capital accounting: measure and report on owned or controlled natural capital assets:

Step 1: Develop natural capital accounts for internal management use:

- Natural capital asset accounts (including extent and condition accounts)
- Natural capital physical flow account (including a schedule of projected future flows)
- Natural capital monetary flow account (including a schedule of projected future flows)
- Natural capital obligation schedule

Step 2: Develop natural capital accounting statements for external reporting:

- Natural capital balance sheet
- Natural capital income statement

Step 3: Synthesise in a natural capital report or integrate alongside financial accounts.

Why conduct natural capital impact, dependency, and risk/ opportunity assessments?

Natural capital impact, dependency and risk assessments are **relevant for all reporting entities.**

Natural capital impact and dependency assessments provide information for external reporting/disclosure, aligned with the reporting entity's sustainability reporting (which may take the form of environmental, social, and governance (ESG) reporting, Sustainable Development Goals (SDG) reporting or integrated reporting). They can also inform how reporting entities manage their operations, configure their value chains, identify strategic opportunities and risks and make investment decisions.

Natural capital risk/opportunity assessments provide a structured and consistent way for reporting entities to integrate natural capital risk management into their decision-making and risk reporting, aligned with the reporting entity's corporate risk reporting, and with disclosure frameworks such as the Task Force on Climate-Related Financial Disclosures (TCFD) and Taskforce on Nature-Related Financial Disclosures (TNFD). Changes in the availability of natural capital and the ecosystem services that a reporting entity depends on can threaten the productivity, profitability or even viability of the reporting entity. Natural capital impacts can also affect the financial position of a reporting entity, for example when society responds to natural capital impacts through regulation (such as fines) or changes in consumer acceptance (such as restricted access to certain markets in the absence of sustainability certification).

Natural capital impact, dependency, and risk/ opportunity assessment: measure and report on natural capital impacts, dependencies and risks/ opportunities:

Step 1: Develop natural capital impact, dependency and risk/opportunity registers for internal management use:

- Natural capital impact register
- Natural capital dependency register
- Natural capital risk/opportunity register (including materiality assessment)

Step 2: Develop natural capital impact, dependency and risk statements for external reporting:

- Natural capital impact statement
- Natural capital dependency statement
- Natural capital risk/opportunity statement

Step 3: Synthesise in a natural capital report or integrate into non-financial/sustainability reporting or corporate risk statements.

What to expect in this handbook

This handbook

- Delivers practical guidance on how to undertake natural capital accounting, and natural capital impact, dependency, and risk/opportunity assessment
- For both internal management and external reporting purposes
- For use by any reporting entity, but with particular applicability for reporting entities that own or control significant natural capital assets, such as forest growers, farmers, mining companies, government, and non-government organisations.

Structured into two main parts

- Part 1: Natural capital accounting
- Part 2: Natural capital impact, dependency, and risk/opportunity assessment
- Each part is in turn divided into separate sections for accounts, registers or schedules (oriented towards internal users) and associated statements (oriented towards external users).

Additional detail

- Further details on example natural capital risks and opportunities are contained in the Appendix.

An emerging area of accounting and reporting practice

- It is important to emphasise that, because this is still an emerging area of accounting and reporting practice, the guidance provided in this handbook should be viewed as a starting point and should be subject to review as new evidence, approaches and standards emerge.

How to use this guide

- The main body of text in the handbook provides, for each natural capital account, register, schedule or statement, a summary of what it is, why it is relevant to a reporting entity, and a step-by-step explanation of how the account, register, schedule or statement is constructed. This is followed by simplified worked examples for a hypothetical reporting entity.

The sidebars

- Provide brief summaries of key concepts that may be useful to understand alongside the main text and example accounts, registers, schedules and statements. The sidebars also provide cross-references to existing standards and guidance, and provide commentary, especially where guidance from different sources is conflicting.

Steps for natural capital accounting, assessment, and reporting

The generic steps for undertaking and reporting on natural capital accounting, impact and dependency assessments and risk assessments are shown here.

Natural capital accounting: measure and report on owned or controlled natural capital assets:

STEP 1	STEP 2	STEP 3
Develop natural capital accounts for internal management use: • Natural capital asset accounts (including extent and condition accounts) • Natural capital physical flow account (including a schedule of projected future flows) • Natural capital monetary flow account (including a schedule of projected future flows) • Natural capital obligation schedule	**Develop natural capital accounting statements for external reporting:** • Natural capital balance sheet • Natural capital income statement	**Synthesise in a natural capital report or integrate alongside financial accounts.**

Natural capital impact, dependency, and risk/opportunity assessment: measure and report on natural capital impacts, dependencies and risks/opportunities:

STEP 1	STEP 2	STEP 3
Develop natural capital impact, dependency and risk/ opportunity registers for internal management use: • Natural capital impact register • Natural capital dependency register • Natural capital risk/opportunity register (including materiality assessment)	**Develop natural capital impact, dependency and risk statements for external reporting:** • Natural capital impact statement • Natural capital dependency statement • Natural capital risk/opportunity statement	**Synthesise in a natural capital report or integrate into non-financial/sustainability reporting or corporate risk statements.**

1 Natural capital accounting

What?

- **Natural capital accounting** identifies and records consistent and comparable information on stocks of **natural capital assets** and the flows of **benefits (ecosystem services and abiotic flows)** provided to the reporting entity and to other users. Natural capital accounting is also known as environmental-economic accounting (particularly when done at the national level).
- At an organisational level, natural capital accounting usually focuses on the natural capital assets that the reporting entity owns or controls (see sidebar). This is because ownership or control means that the organisation has, as a result of institutional arrangements, a particular relationship with the benefits flowing from these natural capital assets – typically an exclusive or first right to obtain the benefits. Information about these assets and benefits is therefore of more relevance to both internal managers and external stakeholders than information about other assets and benefits.
- However, in principle, natural capital accounting can be undertaken for any natural capital assets, regardless of ownership or control. If any natural capital accounting information is presented about natural capital assets that are *not* owned or controlled by the reporting entity, it is recommended that such information is clearly differentiated and explained. For example, separate accounts and statements could be produced for natural capital assets owned or controlled by the reporting entity, denoted 'Scope 1', and other natural capital assets, denoted as 'Scope 2' (BSI, 2021).
- **If a reporting entity does not own or control any natural capital assets, or wish to account for any other natural capital assets, they should turn to section 2, 'Natural capital impact, dependency and risk/opportunity assessment'.**

Why?

- Natural capital accounting provides information relevant for internal decision-making and external reporting/disclosure, aligned with financial and annual reporting.
- It is particularly (but not exclusively) relevant for reporting entities that own or control natural capital assets, such as forest growers, farmers, mining companies, government, and non-government organisations.

CONCEPTS

Stocks and flows

It is important to distinguish between stock and flow concepts. Natural capital refers to stocks of natural assets, which can be measured at a selected point in time (see section 1.1). Ecosystem services and abiotic flows are flows of environmental goods or services that provide benefits, which can be measured over a selected time period (see sections 1.2 and 1.3).

Ownership and control

In financial accounting, an asset is "a present economic resource controlled by the entity as a result of past events", where an economic resource is defined as "a right that has the potential to produce economic benefits" (IASB, 2018). Although ownership is often considered to be the defining feature of an asset, it is actually the bundle of rights to obtain economic benefits that are encapsulated in ownership which make it an asset. Many assets may not involve ownership of any physical object, such as a right to use intellectual property or to receive goods or services from another party. Rather, it is control that determines whether an economic resource is an asset for a given entity, where control is defined as "the present ability to direct the use of the economic resource and obtain the economic benefits that may flow from it (IASB, 2018).

In order for a reporting entity's natural capital accounting to be consistent with its financial accounting, we recommend that a similar approach is taken to definition of the entity's natural capital assets. This means that the reporting entity should consider not only those natural capital assets that it owns (e.g. areas of land), but also any other rights to obtain economic benefits that it controls (e.g. a right under a licence to take a specified number of wild animals from public land). It should be noted that in some cases, such as the latter example, the asset that should ultimately be measured and reported is not the entire natural capital asset (e.g. the area of public land), but rather the proportion of that asset that provides the flow of benefits that the entity controls. Nevertheless, it may only be possible to arrive at this quantity by first accounting for the entire natural capital asset.

How?

Natural capital accounting requires the development of the following accounts and schedules:

- **Natural capital asset accounts (including extent and condition accounts)**
- **Natural capital physical flow account**
- **Natural capital monetary flow account**
- **Natural capital obligation schedule**

Which can be used to produce two reporting statements:

- **Natural capital balance sheet**
- **Natural capital income statement**

We show how to organise natural capital information in the subsequent sections, including example accounts and statements.

Before starting a natural capital accounting exercise, it is recommended to identify the purpose of the exercise, and any applicable legal or voluntary requirements. For example, if the purpose is to produce natural capital accounting data that is consistent with national accounting, then it is advisable to follow SEEA guidelines.

Types or levels of natural capital accounting

There are two types of natural capital accounting, one more closely connected to the governmental System of National Accounts, and the other to the management and financial accounts of organisations:

1. **National natural capital accounting** has been formalised in internationally adopted standards such as the United Nations System of Environmental-Economic Accounting (SEEA) Central Framework (SEEA-CF) and SEEA- Ecosystem Accounting (SEEA-EA). The scale of such accounts typically ranges from national to regional.
2. **Corporate or organisational natural capital accounting** is less standardised, but a variety of organisations have experimented with producing such accounts and the British Standards Institution (BSI) has produced a standard, BS 8632:2021 *Natural Capital Accounting for Organizations – Specification* (BSI, 2021). The scale of corporate or organisational natural capital accounts is defined by corporate or organisational boundaries.

Relationship with existing guidance

The recommendations and example natural capital accounts proposed in this handbook are designed to strike a balance between practical applicability and consistency with the SEEA framework, while also being broadly consistent with international financial accounting standards.

For example, this handbook recommends the development of two external reporting statements (the natural capital balance sheet and the natural capital income statement) which are closely aligned with financial reporting statements, but largely based on information contained in SEEA-compatible internal management accounts.

They are designed to reflect the same underlying purpose and principles behind the following two key financial statements:

a) **the balance sheet** – which reports on the reporting entity's assets, liabilities, and shareholders' equity at a specific point in time; and

b) **the income statement** – which reports on the reporting entity's income and expenses over a specified accounting period, usually a year, representing the flows from economic activity of the reporting entity.

BS 8632:2021 for natural capital accounting (BSI, 2021) has different definitions of the natural capital balance sheet and natural capital income statement. BS 8632:2021 defines a natural capital balance sheet as an account of "the dependencies of the organization and its value chain on natural capital assets" and a natural capital income statement as an account of "the positive and negative impacts of the operations of the organization and its value chain on natural capital assets". We recommend that these definitions are taken instead as appropriate definitions of the natural capital dependency statement and natural capital impact statement, respectively (see sections 2.2 and 2.1 of this handbook, respectively).

1.1 Natural capital asset accounts

What?

- Natural capital asset accounts keep track of the quantity, quality and value of the natural capital assets that the reporting entity owns or controls.
- Natural capital assets are called **environmental assets** in the SEEA framework, defined as "the naturally occurring living and non-living components of the Earth, together constituting the biophysical environment, which may provide benefits to humanity." (SEEA-CF 2014, para. 2.17). The SEEA-CF deals with individual components of the environment that provide economic benefits, such as minerals, land, water and timber; whereas the SEEA-EA deals with **ecosystem assets** (areas of specific ecosystem types where individual ecosystem assets interact). Ecosystem assets are therefore a type of environmental or natural capital asset that is made up of many individual environmental or natural capital assets interacting as a single functional unit.
- As most individual environmental assets are generally already considered as assets within corporate financial accounting standards[2], the remainder of this handbook will focus on accounting for ecosystem assets. Where there is overlap (e.g. areas of land or water resources can be both environmental assets and ecosystem assets) then care should be taken to avoid double-counting, especially when different accounting methods are used for individual components versus the ecosystem as a whole. In general, ecosystem assets are usually valued using the net present value of future ecosystem service flows (see natural capital monetary flow account), whereas individual assets are more often valued on the basis of similar market transactions (e.g. the market value of land based on IAS 16 *Property, Plant and Equipment*). If transparently described, the difference between two such values may be instructive, for example, in highlighting that the market for land assets does not currently value certain ecosystem services appropriately.
- Ecosystem asset extent and condition accounts track the quantity and quality of ecosystem assets owned or controlled by a reporting entity.

Why?

- Ecosystem asset extent and condition accounts provide information on the status and changes in the extent and ecological condition of ecosystem assets, thus helping to understand the outcomes of management activities. An ecosystem asset's extent and condition both influence the asset's capacity to provide flows of ecosystem services.

CONCEPTS

Environmental assets

Asset stock accounts for environmental assets (resources such as minerals, water and timber) are covered in the SEEA-CF. The SEEA-CF asset accounts record the opening and closing stocks of the relevant individual resource and then the various additions and reductions in stock (SEEA-CF 2014, s.5) Additions to stock can come from 1) Growth in stock (e.g. for biological resources); Discoveries of new stock (e.g. new mineral resource discoveries); Upward reappraisals (e.g. new information on the size or quality of a stock); and Reclassifications (i.e. changes of one type of stock to another). Reductions in stock can come from 1) Extraction (physical removal or harvest of a stock); 2) Normal reductions in stock (e.g. natural deaths of biological resources); 3) Catastrophic losses; 4) Downward reappraisals; and 5) Reclassifications (see SEEA-CF 2014, s. 5.3.2).

A typology of typical individual environmental assets is provided in the SEEA-CF, Table 5.1. Physical accounts for environmental assets are usually compiled separately for each type of environmental asset, as the units of measurement may be different (e.g. cubic metres for natural gas resources versus tonnes for mineral resources). However, they may be combined as long as the units are clearly identified, and dissimilar units are not added together.

Ecosystem typology for ecosystem assets

The UCN Global Ecosystem Typology (IUCN GET) is a global typological framework that applies an ecosystem process-based approach to ecosystem classification for all ecosystems around the world. It is the recommended ecosystem typology in SEEA-EA and using it may enable the data to be more easily scaled up and to be comparable to regional, national or international assessments (IUCN Global Ecosystem Typology). For forestry, plantations would be classified under "T7.3 Plantations", while native forest in Australia can be classified in a variety of IUCN-GET ecosystem functional groups including "T1.1 Tropical-subtropical lowland rainforests", "T2.3 Oceanic cool temperate rainforests", "T2.4 Warm temperate laurophyll forests", "T2.5 Temperate pyric humid forests", "T2.6 Temperate pyric sclerophyll forests and woodlands" and "T4.4 Temperate woodlands." Rivers and streams can likewise be classified in various ecosystem functional groups such as "F1.1 Permanent upland streams" or "F1.4 Seasonal upland streams."

2 E.g. IAS 41 *Agriculture* applies to the harvested produce of an entity's biological assets, such as felled timber from trees in a plantation; IAS 16 *Property, Plant and Equipment* and IAS 40 *Investment Property* apply to land owned by an entity.

How?

Step 1: Identify and list all relevant natural capital assets, divided into individual environmental assets and ecosystem assets. Ecosystem assets are contiguous areas of a given ecosystem type. A variety of classification systems exist. Using the IUCN Global Ecosystem Typology (IUCN GET), adopted by SEEA-EA, may promote comparability with other natural capital accounts or national-level data. However, a reporting entity may wish to use more industry-relevant classifications. For example, for forestry it might be relevant to separate softwood plantations from hardwood plantations, or for agriculture, to differentiate sown pastures by pasture type.

Consider natural capital assets owned or controlled and classify in a way that is most useful to the reporting entity.

Step 2: Measure opening and closing **ecosystem extent**: the size of each ecosystem asset in terms of spatial area (see additional explanation in sidebar). Produce an ecosystem extent account.

Changes between opening and closing extent can be reported as additions and/or reductions, each of which can be further sub-divided into managed and unmanaged changes.

The reasons for reported changes (e.g. conversions of ecosystem type, purchase or disposal of land, natural increase/decrease or reappraisals) can be explained in notes.

Step 3: Consider appropriate **ecosystem condition variables, indicators or indices** for each natural capital asset and measure opening and closing values of each selected condition metric (see additional explanation in sidebar). Produce an ecosystem condition account.

Consider how condition is related to the ecosystem services the asset provides. However, note that a given condition may support some ecosystem services and not others, and there is not always a one-to-one relationship between condition and capacity to provide ecosystem services.

Step 4 (optional): Produce a combined ecosystem extent and condition account.

This requires a single condition ecosystem condition variable, indicator or index to be used to stratify the total area of each ecosystem asset into areas falling into discrete condition categories (e.g. 'Good', 'Fair' and 'Poor' categories based on selected ranges for the chosen variable, indicator, or index).

As with extent accounts, changes between opening and closing extent can be reported as additions and/or reductions, each of which can be further sub-divided into managed and unmanaged changes, and the reasons for reported changes can be explained in notes.

Measuring ecosystem extent

Ecosystem extent is "the spatial area of an ecosystem asset" (SEEA-EA 2021, para. 2.13). Although usually measured in two-dimensional area, ecosystem assets may be measured in one dimension (e.g. stream length) or three dimensions (e.g. water body volume). Care must be taken not to add quantities expressed in different dimensional units.

Measuring ecosystem condition

Ecosystem condition is "the quality of an ecosystem measured in its abiotic and biotic characteristics" (SEEA-EA 2021, para. 2.13).

Ecosystem condition can be measured using ecosystem condition variables, indicators or indices. **Ecosystem condition variables** are quantitative biophysical metrics describing individual characteristics of an ecosystem asset (SEEA-EA 2021, para. 5.41). **Ecosystem condition indicators** are ecosystem condition variables which have been normalised on a common scale relative to a reference level (SEEA-EA 2021, para. 5.60). Variables and indicators can be weighted and aggregated to composite **ecosystem condition indices** (SEEA-EA 2021, para. 5.81).

The SEEA Ecosystem Condition Typology (SEEA-EA 2021, Table 5.1) provides a useful guide to systematically considering different types of condition characteristics, including abiotic characteristics (physical and chemical state, e.g. % soil organic carbon), biotic characteristics (compositional, structural and functional state, e.g. species richness, forest age class, disturbance) and landscape level characteristics (e.g. connectivity and fragmentation). Further examples are given in SEEA-EA 2021, Table 5.6. The Natural Capital Measurement Catalogue (http://www.naturalcapitalmeasurement.org) also contains example condition metrics and measurement methods.

Ecosystem extent/condition change matrices

Ecosystem extent/condition change matrices can be produced to show additional detail related to conversions between ecosystem types or condition categories: for example, see SEEA-EA 2021, para. 4.3.2.

Example:

- There are numerous ways to compile ecosystem asset extent and condition accounts. The examples below show options for presenting separate extent and condition accounts (using condition variables, condition indicators and condition indices) and an option for presenting a combined extent and condition account (using generic good/fair/poor condition categories, which could be defined using single condition variables, condition indicators or condition indices). Combining information may not be feasible or desirable for all reporting entities, and separate tables may enable a higher level of detail to be captured. Other relevant information such as identified critical thresholds, tipping points, non-linearities and capacities could also be documented, if known.
- The example accounts show potential ecosystem asset condition measures, but these will vary depending on the priorities of the reporting entity and their stakeholders.

Other examples

Additional example extent and condition accounts and guidance are available in the British Standard on natural capital accounting for organisations (BS 8632:2021, section 6.7.1.2, p21) and SEEA-EA, section 4 and 5.

Further examples include:

- Forestry England Natural Capital Accounts (Forestry England Asset Register).
- Experimental natural capital accounts for the forestry industry in the Green Triangle (Stewart et al., 2020a).
- Experimental natural capital accounts for cotton (Stewart et al., 2020b).
- Experimental natural capital accounts for the prawn-fishing industry in the Wallis Lake estuary (Ware et al., 2020).
- Central Highlands experimental ecosystem accounts (Keith et al., 2017).

EXAMPLE ECOSYSTEM EXTENT ACCOUNT

Ecosystem Functional Group		T7.3 Plantations	T7.6 Temperate pyric sclerophyll forests and woodlands	T7.5 Derived semi-natural pastures and oldfields	F.1.1 Permanent upland streams	T7.4: Urban and industrial ecosystems	
Ecosystem type	**Units**	**Plantation forest[a]**	**Native forest[b]**	**Upland streams[c]**	**Native pastures[d]**	**Infrastructure and other[e]**	**Total**
Opening extent (baseline / previous year)	ha 000's	20	30	7	40	3	100
Additions	ha 000's	-	1	-	-	-	1
Reductions	ha 000's	-	-	-	1	-	1
Closing extent (reporting year)	ha 000's	20	31	7	39	3	100
Net change	ha 000's	-	1	-	-1	-	-

[a] Plantation forest corresponds to Ecosystem Functional Group T7.3: Plantations. The plantation forest column shows no change in the overall extent of plantation forests of 20,000 hectares.

[b] Native forest corresponds to Ecosystem Functional Group T7.6: Temperate pyric sclerophyll forests and woodlands. The native forest column shows an increase in the overall extent of native forest from 30,000 hectares to 31,000 hectares, representing the conversion of 1,000 hectares of native pastures to native forest.

[c] Upland streams corresponds to Ecosystem Functional Group F.1.1: Permanent upland streams. The upland streams column shows no change in the overall extent of upland streams of 7,000 hectares.

[d] Native pastures corresponds to Ecosystem Functional Group T7.5: Derived semi-natural pastures and oldfields. The native pastures column shows a reduction in overall extent of 1,000 hectares, representing the conversion of 1,000 hectares of native pastures into native forest.

[e] The infrastructure and other column corresponds to Ecosystem Functional Group T7.4: Urban and industrial ecosystems. It describes additional land owned by the reporting entity, including land used for roads, buildings and other infrastructure. The infrastructure and other column shows no change in the overall extent of 3,000 hectares.

EXAMPLE ECOSYSTEM CONDITION VARIABLE ACCOUNT

Ecosystem asset	SEEA ecosystem condition typology class: Variable (units)	Opening condition (baseline / previous year)	Closing condition (reporting year)	Net change
Plantation forest	Structural state: Forest age class distribution (% mature)	50	60	10
	Structural state: Crown cover (%)	83	88	5
	Chemical state: Carbon stock (above ground) (tC/ha)	70	65	-5
	Chemical state: Carbon stock (below ground) (tCha)	40	40	0
Native forest	Chemical state: Carbon stock (above ground) (tC/ha)	140	158	18
	Chemical state: Carbon stock (below ground) (tC/ha)	116	124	8
	Compositional state: Threatened species (Number)	67	67	0
Upland streams	Physical state: Water turbidity (Nephelometric Turbidity Unit NTU)	4.5	5.0	0.5
Native pastures	Physical state: % bare ground (%)	20	15	-5

EXAMPLE ECOSYSTEM CONDITION INDICATOR ACCOUNT

Ecosystem asset	SEEA Ecosystem Condition Typology Class: Variable (units)	Opening condition (baseline / previous year)	Closing condition (reporting year)	Reference level (lower)	Reference level (upper)	Indicator value (baseline / previous year)	Indicator value (reporting year)	Indicator value (net change)
Plantation forest	Structural state: Forest age class distribution (% mature)	50	60	0	100	0.5	0.6	0.1
	Structural state: Crown cover (%)	83	88	0	100	0.83	0.88	0.05
	Chemical state: Carbon stock (above ground) (tC/ha)	70	65	0	80	0.88	0.81	-0.07
	Chemical state: Carbon stock (below ground) (tCha)	40	40	0	200	0.2	0.2	0
Native forest	Chemical state: Carbon stock (above ground) (tC/ha)	140	158	0	180	0.78	0.88	0.1
	Chemical state: Carbon stock (below ground) (tC/ha)	116	124	0	200	0.58	0.62	0.04
	Compositional state: Threatened species (Number)	67	67	0	150	0.45	0.45	0
Upland streams	Physical state: Water turbidity (Nephelometric Turbidity Unit NTU)	4.5	5.0	50	0	0.91	0.9	-0.01
Native pastures	Physical state: % bare ground (%)	20	15	100	0	0.8	0.85	0.05

EXAMPLE ECOSYSTEM CONDITION INDEX ACCOUNT

Ecosystem asset	SEEA Ecosystem Condition Typology Class: Variable (units)	Indicator value (baseline / previous year)	Indicator value (reporting year)	Indicator weight	Index value (baseline / previous year)	Index value (reporting year)	Net change
Plantation forest	Structural state: Forest age class distribution (% mature)	0.5	0.6	0.25	0.125	0.15	0.025
	Structural state: Crown cover (%)	0.83	0.88	0.25	0.208	0.22	0.013
	Chemical state: Carbon stock (above ground) (tC/ha)	0.88	0.81	0.25	0.22	0.203	-0.018
	Chemical state: Carbon stock (below ground) (tCha)	0.2	0.2	0.25	0.05	0.05	0
	Plantation forest condition index			**1.0**	**0.603**	**0.623**	**0.02**
Native forest	Chemical state: Carbon stock (above ground) (tC/ha)	0.78	0.88	0.33	0.257	0.29	0.033
	Chemical state: Carbon stock (below ground) (tC/ha)	0.58	0.62	0.33	0.191	0.205	0.013
	Compositional state: Threatened species (Number)	0.45	0.45	0.33	0.149	0.149	0
	Native forest condition index			**1.0**	**0.597**	**0.644**	**0.046**
Upland streams	Physical state: Water turbidity (Nephelometric Turbidity Unit NTU)	0.91	0.9	1.0	0.91	0.9	-0.01
	Upland streams condition index			**1.0**	**0.91**	**0.9**	**-0.01**
Native pastures	Physical state: % bare ground (%)	0.8	0.85	1.0	0.8	0.85	0.05
	Native pastures condition index			**1.0**	**0.8**	**0.85**	**0.05**

EXAMPLE COMBINED ECOSYSTEM EXTENT AND CONDITION ACCOUNT							
Ecosystem Functional Group		**T7.3 Plantations**	**T7.6 Temperate pyric sclerophyll forests and woodlands**	**F.1.1 Permanent upland streams**	**T7.5 Derived semi-natural pastures and oldfields**	**T7.4: Urban and industrial ecosystems**	
Ecosystem type	**Units**	**Plantation forest[a]**	**Native forest[b]**	**Upland streams[c]**	**Native pastures[d]**	**Infrastructure and other[e]**	**Total**
Opening extent (baseline / previous year)	ha 000's	**20**	**30**	**7**	**40**	**3**	100
Good	ha 000's	9	15	2	20	N/A	N/A
Fair	ha 000's	9	10	4	15	N/A	N/A
Poor	ha 000's	2	5	1	5	N/A	N/A
Additions	ha 000's	**10**	**1**	**2**	**2**	-	15
Good	ha 000's	2	-	2	2	N/A	N/A
Fair	ha 000's	2	-	-	-	N/A	N/A
Poor	ha 000's	6	1	-	-	N/A	N/A
Reductions	ha 000's	**10**	**-**	**2**	**3**	-	15
Good	ha 000's	6	-	-	-	N/A	N/A
Fair	ha 000's	2	-	2	2	N/A	N/A
Poor	ha 000's	2	-	-	1	N/A	N/A
Closing extent (reporting year)	ha 000's	**20**	**31**	**7**	**39**	**3**	100
Good	ha 000's	9	15	4	22	N/A	N/A
Fair	ha 000's	11	10	2	13	N/A	N/A
Poor	ha 000's	-	6	1	4	N/A	N/A
Net change	ha 000's	**-**	**1**	**-**	**-1**	-	-
Good	ha 000's	-	-	2	2	N/A	N/A
Fair	ha 000's	2	-	-2	-2	N/A	N/A
Poor	ha 000's	-2	1	-	-1	N/A	N/A

[a] Plantation forest corresponds to Ecosystem Functional Group T7.3 Plantations. The plantation forest columns show no change in the overall extent of total plantation forests of 20,000 hectares. 6,000 hectares of 'good' condition forest has been harvested and this land will be replanted, so is reclassified as 'poor' condition forest. In addition, 2,000 hectares of 'fair' condition forest has matured and been reclassified as 'good' condition forest. Finally, 2,000 hectares of 'poor' condition forest condition has changed to 'fair condition'.

[b] Native forest corresponds to Ecosystem Functional Group T7.6 Temperate pyric sclerophyll forests and woodlands. The native forest columns show an increase in the overall extent of total native forest from 30,000 hectares to 31,000 hectares, representing the conversion of 1,000 hectares of native pastures to native forest, shown as a 1,000 hectare increase in 'poor' condition native forest.

[c] Upland streams corresponds to Ecosystem Functional Group F.1.1 Permanent upland streams. The upland stream columns show no change in the overall extent of total upland stream of 7,000 hectares. However, 2,000 hectares of upland streams that was in 'fair' condition has improved to 'good' condition.

[d] Native pastures corresponds to Ecosystem Functional Group T7.5 Derived semi-natural pastures and oldfields. The native pastures columns show a reduction in overall extent of 1,000 hectares, representing the conversion of 1,000 hectares of 'poor' condition native pastures into 'poor' condition native forest. In addition, 2,000 hectares of 'fair' condition native pasture has improved to 'good' condition.

[e] The infrastructure and other column corresponds to Ecosystem Functional Group T7.4: Urban and industrial ecosystems. It describes additional land owned by the reporting entity, including land used for roads, buildings and other infrastructure. The infrastructure and other column shows no change in the overall extent of 3,000 hectares. No ecosystem condition is reported for this ecosystem type.

1.2 Natural capital physical flow account

What?

- The natural capital physical flow account records physical flows of **ecosystem services** as well as **abiotic flows** provided by natural capital assets over time, to the reporting entity and (if desired) to society. It includes information on historical actual flows and expected future flows. Technically, the information on historical, actual flows constitutes the 'account' while the information on projected future flows is a separate 'schedule', but for convenience in this handbook we will refer to a single 'account' covering both.
- The flows are measured in the most relevant biophysical units of measurement, with monetary values documented separately in the monetary flow account.

Why?

- A natural capital physical flow account provides information for tracking flows of ecosystem services and abiotic flows to the reporting entity and from the natural capital assets owned or controlled by the reporting entity. It underpins valuation of ecosystem services in the monetary flow account, which in turn provides a key input to the values reported in the natural capital balance sheet and the natural capital income statement.

How?

Step 1: Consider which ecosystem services and abiotic flows are most material to the reporting entity (usually, the services providing the greatest and/or most critical benefits). Decide whether or not to include any applicable **ecosystem disservices** (see sidebar). Consider the appropriate physical metrics for these ecosystem services and abiotic flows.

Step 2: Consider the extent to which the beneficiary of each ecosystem service/abiotic flow is the reporting entity or another user (e.g. rest of society).

CONCEPTS

Ecosystem services

Ecosystem services are "the contributions of ecosystems to the benefits that are used in economic and other human activity" (SEEA-EA 2021, para. 2.14).

Ecosystem services are typically classified into three broad categories: provisioning services, regulating and maintenance services, and cultural services:

- **Provisioning services** are "those ecosystem services representing the contributions to benefits that are extracted or harvested from ecosystems." Examples include provision of crops, wood, pasture, or wild animals.
- **Regulating and maintenance services** are "those ecosystem services resulting from the ability of ecosystems to regulate biological processes and to influence climate, hydrological and biochemical cycles, and thereby maintain environmental conditions beneficial to individuals and society." Examples include water purification, water flow regulation, climate regulation and flood regulation.
- **Cultural services** are "the experiential and intangible services related to the perceived or actual qualities of ecosystems whose existence and functioning contributes to a range of cultural benefits." Examples include recreation, visual amenity, research, education, spiritual and cultural services (SEEA-EA 2021, para. 6.51).

An additional category of supporting ecosystem services is sometimes used, where such supporting services underpin other services. These may be important from an ecological perspective, but are excluded from SEEA as they do not directly contribute economic benefits.

A distinction is also made between intermediate and final ecosystem services, where **intermediate ecosystem services** are "those ecosystem services in which the user of the ecosystem services is an ecosystem asset and where there is a connection to the supply of final ecosystem services" and **final ecosystem services** are "those ecosystem services in which the user of the service is an economic unit – i.e., business, government or household" (SEEA-EA 2021, paras. 6.24 and 6.26).

In other words, final ecosystem services have direct and immediate consequences for productive activities in the economy, and intermediate ecosystem services underpin the output of final ecosystem services. However, the distinction is not always straightforward. The same environmental good or service may act as both an intermediate and a final ecosystem service (e.g., clean water could be regarded as a final ecosystem service if used for drinking, but as an intermediate ecosystem service from the perspective of recreational fishing) (Boyd and Banzhaf, 2007, Fisher et al., 2009).

A reference list of selected ecosystem services is provided in SEEA-EA 2021, Table 6.3 and examples of metrics for selected ecosystem services are given in SEEA-EA 2021, Annex 6.1. A longer list of ecosystem services can be found at the Common International Classification of Ecosystem Services (CICES) (Haines-Young and Potschin, 2017).

Step 3: Measure the historical flows of each ecosystem service/abiotic flow in appropriate biophysical units. Measured flows should generally be the physical quantities that are actually used by an economic unit (e.g. the reporting entity, or society). In some cases, e.g. where the reporting entity has significantly contributed to a flow of services (e.g. by adding fertiliser to a native pasture), it may be appropriate to recognise only some proportion of the total physical quantity used as the ecosystem contribution. However, such apportionment is often difficult to implement in practice.

Step 4: Estimate the future flows of each ecosystem service/abiotic flow in appropriate biophysical units. Estimates of future flows should incorporate planned management decisions and any foreseen changes in flows due to natural capital threats to those services (see section on natural capital risk assessment), and any assumptions should be documented.

Step 5: Complete the natural capital physical flow account using the measures from steps 3 and 4.

Example:

- The example below combines information on the historical and forecast period covering all the priority natural capital assets, ecosystem services and abiotic flows in our example scenario.

Abiotic flows

Abiotic flows are "contributions to benefits from the environment that are not underpinned by or reliant on ecological characteristics and processes" (SEEA-EA 2021, para. 6.35). Abiotic flows include geophysical sources (flows related to geophysical processes including abstraction of water and use of wind, solar, geothermal and similar sources of energy) and geological resources (e.g. extraction of fossil fuels, mineral ores, sand and gravel).

Ecosystem disservices

Ecosystem disservices "arise in contexts in which the outcomes of interactions between economic units and ecosystem assets are negative from the perspective of the economic units" (SEEA-EA 2021, para. 6.75). Ecosystem disservices can be thought of as providing negative benefits, or disbenefits, to the economy. Examples might include the provision of habitat for pests or the production of pollen which causes asthma. Ecosystem disservices are excluded from SEEA for various reasons, one being that SEEA assumes comprehensive accounting such that the effects of ecosystem disservices would be taken into account in the measurement of benefits received by the affected economic unit. However, it is acknowledged that when valuing individual ecosystem assets, deducting ecosystem disservices may be informative insofar as these disservices are understood to have a negative effect on the value of the asset in terms of its contribution to society (SEEA-EA 2021, para. 12.50). If ecosystem disservices are included, they should be clearly identified as such and care should be taken to avoid any double-counting (e.g. if the ecosystem disservice reduces another ecosystem service – e.g. pests destroying crops before harvest – the ecosystem disservice should not be shown separately, unless the flow of the ecosystem service is estimated as it would have been in the absence of the ecosystem disservice).

Physical flow metrics

The Natural Capital Measurement Catalogue (http://www.naturalcapitalmeasurement.org) contains example physical flow metrics and measurement methods.

Supply and use tables for ecosystem services

A key focus in national natural capital accounting (SEEA guidance) is reconciling the supply and the use of ecosystem services across multiple ecosystem assets and multiple users. As such SEEA recommends compiling 'ecosystem services supply/use tables' (see SEEA-EA, section 7.1, p.161 for details). Comprehensive supply/use tables are more applicable to government organisations compiling accounts at national or regional levels. However, the historical flows in our example natural capital physical flow account can be regarded as part of an ecosystem services supply/use table, simplified to show only two users: the reporting entity and society.

Projecting future flows of benefits

Reporting entities may want to present multiple scenarios for flows of future benefits, using a range of assumptions about the future.

Other examples

Additional guidance on physical flow accounts is available in the British Standard on natural capital accounting for organisations (BS 8632:2021, section 6.7.1.4, p22) and SEEA-EA (Section 7.1 p161).

Forestry England Natural Capital Accounts provide an example (Forestry England Physical Flow Account).

EXAMPLE NATURAL CAPITAL PHYSICAL FLOW ACCOUNT

				2021	
Natural capital asset	**Ecosystem service (ES) or abiotic flow (AB)**	**Physical metric**	**Units**	**Flows to reporting entity**	**Flows to rest of society**
Plantation forest	**ES: Wood provisioning**	Timber harvested[a]	m^3 000's	350	-
	ES: Global climate regulation	Carbon sequestered and stored[b]	Tonnes CO_2e 000's	-	700
Native forest	**ES: Wild animals, plants and other biomass provisioning**	Seeds and plants harvested[c]	Tonnes 000's	20	-
Upland streams	**ES: Recreation**	Recreational fishing visits[d]	Visits 000's	-	15
	AB: Water abstraction	Water abstracted[e]	ML 000's	150	-
Native pastures	**ES: Grazed biomass provisioning**	Forage for livestock[f]	Tonnes dry matter (DM) 000's	40	-

[a] The timber account shows 350,000 m^3 harvested in 2021 and expectations that harvest will decrease to 325,000 m^3 in 2022 and remain at that level in future. The harvest benefit goes to the reporting entity.

[b] The carbon sequestration account shows the overall (net) accumulation or reduction of carbon stored in trees, debris and soil in the plantation estate, with total net sequestration of 700,000 tCO_2e in 2021, projected to reduce to 660,000 tCO_2e in 2022 and remain at that level in future. The schedule shows that the benefit mainly goes to society, but from 2023 the reporting entity expects to get some benefit from the carbon sequestration by selling carbon credits (10,000 tCO_2e out of the total 660,000 tCO_2e).

[c] The seeds and plants account shows 20,000 tonnes harvested in 2021 and expectations that that will remain constant in 2022 before increasing to 30,000 tonnes in 2023, remaining at that level in future years. The seeds and plants benefit goes to the reporting entity.

[d] The recreational fishing account shows 15,000 visits in 2021 and expectations of an increase in the future to 17,000 in 2022 and 18,000 visits in 2023, remaining at that level in future. The benefits go to society because the upland streams are available for open access opportunities for fishing. If there were private recreation sites with an access fee then they could be recorded as a benefit to the reporting entity.

[e] The water abstraction account shows 150,000 ML abstracted in 2021 and expectations of a decrease in the future to 140,000 ML in 2022 and 130,000 ML in 2023, remaining at that level in future. The benefits go to the reporting entity as water is sold by the reporting entity to the local water utility for use as drinking water.

[f] The forage for livestock account shows 40,000 tonnes of dry matter forage produced in 2021 and expectations of a decrease in the future to 38,000 t DM in 2022 and 34,000 t DM in 2023, remaining at that level in future. The benefits go to the reporting entity as the forage is consumed by livestock owned by the reporting entity.

[g] The forecast period covers 2022 to 2050. For simplification in this example, it is assumed that flows remain constant after 2023. However, the reporting entity should produce a schedule for the whole accounting period or a written justification for their expectations about future ecosystem service flows and abiotic flows.

	2022 forecast		2023 forecast		2050 forecast[9]	
	Flows to reporting entity	Flows to rest of society	Flows to reporting entity	Flows to rest of society	Flows to reporting entity	Flows to rest of society
	325	-	325	-	325	-
	-	660	10	650	10	650
	20	-	30	-	30	-
	-	17	-	18	-	18
	140	-	130	-	130	-
	38	-	34	-	34	-

1.3 Natural capital monetary flow account

What?

- The natural capital monetary flow account records monetary values of the benefits from flows of ecosystem services and abiotic flows provided by natural capital assets over time, to the reporting entity and (if desired) to society. It includes information on historical actual flows and expected future flows. It is the monetary equivalent of the physical flow account. As with the physical flow account, technically, the information on historical, actual flows constitutes the 'account' while the information on projected future flows is a separate 'schedule', but for convenience in this handbook we will refer to a single 'account' covering both.
- It records separately **the value to the reporting entity** (the costs and benefits to the reporting entity, also referred to as internal or private value (NCP 2016, p. 124)) and **the value to society** (the costs and benefits to wider society, also referred to as external or public value (NCP 2016, p. 124)).
- Monetary flows are measured in units of currency, in prices corresponding to the accounting period (i.e. nominal values – SEEA-EA 2021, para. 9.11).

Why?

- A natural capital monetary flow account provides information for tracking the monetary value of flows of ecosystem services and abiotic flows to the reporting entity and from the natural capital assets owned or controlled by the reporting entity. It underpins the monetary values reported in the natural capital balance sheet and the natural capital income statement.

How?

Step 1: Consider and decide on the appropriate value concepts to be used: **exchange values** or **welfare values** (see sidebar).

Whichever values are chosen should be applied consistently, reported separately and never added together.

It is recommended to differentiate between flows which have been valued using **market values** (the amount for which something can be bought or sold in a given market (NCP 2016, p. 124)) versus those which have been valued using **non-market values** (values of goods and services that are not traded in markets but instead valued based on an estimate of what people would be willing to pay for them).

CONCEPTS

Values

Monetary valuation provides a common metric through which benefits can be aggregated and compared.

While the terms 'value', 'price' and 'cost' are commonly used interchangeably, they are not in fact equivalent. Nature is clearly a source of great value, yet many of the services that come from nature are not bought or sold in markets and therefore do not have market prices. The value of a natural asset may therefore be quite different from its market price. Similarly, the value produced by a natural asset may be quite different to the costs associated with maintaining or enhancing it.

Exchange values are "the values at which goods, services, labour or assets are in fact exchanged or else could be exchanged for cash" (SEEA-EA 2021, para. 8.13). Exchange values represent the contribution of a good or service to the economy, regardless of its broader impact on human welfare. Exchange values are consistent with SEEA and the System of National Accounts, and are usually relatively easy to obtain from market prices (**market values**), or estimated using various techniques 'as if' a market existed (**non-market values**). See SEEA-EA 2021, s. 9.3 for detailed explanation of non-market value estimation techniques.

Welfare values reflect the total contribution of a good or service to human welfare. Welfare values include any consumer surplus (the difference between consumers' maximum willingness to pay and the price they actually pay, which is typically smaller). Hence welfare values are typically greater than exchange values. Welfare values are often used in economic cost-benefit analysis and are appropriate for measuring the costs of impacts from a social perspective. Welfare values can be estimated using a variety of techniques, some of which are similar to techniques used to estimate exchange values, with adjustments to consider total welfare. A database of welfare values is available at https://www.esvd.net.

Exchange values and welfare values should be applied consistently, reported separately and never added together, due to their different meanings.

Step 2: Determine the appropriate physical flow quantities, unit values and users for each ecosystem service or abiotic flow. The physical flow quantities should be consistent with the physical flow account. However, there may be some exceptions, such as the following. Any such differences should be noted and explained.

- Some ecosystem services or abiotic flows measured in physical terms in the physical flow account may be difficult or impossible to value in monetary terms, and hence not included, or not given a value, in the monetary flow account.
- Flows of intermediate ecosystem services (i.e. services used by ecosystem assets) may be recorded in the monetary flow account, but if so, a corresponding use of these services by the relevant ecosystem asset(s) must also be recorded. Alternatively, the monetary flow account could only include final ecosystem services.
- The reporting entity may choose to put a monetary value only on flows used by the reporting entity, and not on flows used by other users, such as the rest of society.
- Some physical flows may need to be disaggregated into quantities with different unit values, e.g. due to differences in quality or spatial configuration (such as recreation services closer to urban areas having higher value than the same services in more remote locations).

Unit values should represent the value of the ecosystem contribution to benefits, which may be less than the value of the benefits in the economy, due to the addition of human inputs. For example, the stumpage price paid by a logging company to a forest owner for the right to harvest standing timber from an unmanaged native forest is a directly observable market value for the ecosystem contribution, whereas the mill-door price represents the value of harvested timber in the economy, with non-ecosystem value added through harvesting and transport. In this example, if a mill-door price was the only directly observable unit value, then it could be converted to a price per unit of gross harvested biomass by adjusting for changes in quantity (harvesting losses) and deducting harvesting and transport costs, to infer a unit value for the ecosystem contribution. Note that in the case of managed forests, the stumpage price would still include the value of prior human inputs such as planting, fertiliser, thinning etc., so these costs should be deducted to estimate a unit value for the ecosystem contribution. Unit values should also be expressed net of any applicable taxes and subsidies.

If any ecosystem disservices have been included in the physical flow account, they may be valued using a negative unit value representing the ecosystem contribution to disbenefits.

The allocation of monetary flows to different users (e.g. the reporting entity and society) should be consistent with the allocation of the physical flows in the physical flow account.

Examples of unit values for ecosystem contributions (exchange values)

For harvested plantation timber: a stumpage price expressed in $/m^3$ of standing timber.

For grazed biomass (forage for livestock): an agistment price for pastures of similar productivity, in $/t DM (noting that agistment prices may be expressed in different units, e.g. $/ha, but can be converted to match physical flow units such as tonnes dry matter as they will assume as certain minimum level of biomass production).

For net carbon sequestration and storage: prices from a relevant carbon trading scheme, or data on marginal abatement costs, or an estimate of the social cost of carbon if derived from models consistent with the exchange value concept, in $/tCO_2e$.

For recreation visits: entry fees in $/visit. For recreation visits which do not involve payment of any fees, it is possible to derive welfare values using the travel cost method, from which exchange values can be estimated using the simulated exchange value method (see SEEA-EA 2021, s. 9.3).

Production costs

BS 8632:2021 uses the term 'production costs' to describe "*costs that are necessary to incur to realize the flow of benefits at a point in time*" and states that "The cost of producing the market and non-market goods and services (regardless of whether they benefit the organization or the rest of the society) shall be deducted from the gross value to reflect the net value of the flow of benefits due to natural capital." (BS 8632:2021, s. 6.7.1.5).

This is a valid approach if unit values are used that include human inputs in addition to the ecosystem contribution, but care should be taken not to deduct production costs from monetary flows calculated using unit values that reflect only the ecosystem contribution to benefits.

Step 3: Estimate the future flows of each ecosystem service or abiotic flow in monetary terms, following the same valuation principles as in step 2. Estimates of future flows should incorporate planned management decisions and any foreseen changes in flows resulting from natural capital threats to those services (see section on natural capital risk assessment), and any assumptions should be documented. Note that estimates of future flows should be expressed in nominal values, i.e. including estimates of future inflation (however, for simplicity, the example account below assumes no inflation).

Step 4: Complete the natural capital monetary flow account using the measures from steps 2 and 3.

Example:

- The example below follows the format of the natural capital physical flow account in the previous section.

BS 8632:2021 differentiates production costs from what it calls *'maintenance costs', defined as "costs that are necessary to incur to sustain the quality and quantity of natural capital assets to sustain the flow of benefits over the accounting period"* (BS 8632:2021, s. 6.7.1.6). While it can be helpful to distinguish between different types of costs, the over-riding principle for deriving unit values for ecosystem contributions from unit values that include human inputs should be to deduct all costs associated with human inputs that are *necessary* for that production. This may include certain maintenance costs, overheads and financing costs, where these can be justified as necessary for production. Examples could include the costs of thinning activities undertaken to enhance timber production, or soil amelioration activities undertaken to enhance crop production (in each case, these costs should be spread over the years of production expected to be affected by the activity in order to calculate an appropriate unit value).

If the costs associated with legal or voluntary obligations to restore, maintain, or enhance natural capital assets are recorded separately as recommended in the natural capital obligation schedule, they should NOT also be included in any deductions to arrive at unit values for ecosystem contributions to benefits, otherwise they will be double counted.

Other examples

Additional guidance on monetary flow accounts is available in the British Standard on natural capital accounting for organisations (BS 8632:2021, s. 6.7.1.5, p22) and SEEA-EA (s. 7.1 p161).

Forestry England Natural Capital Accounts provide an example (Forestry England Monetary Flow Account).

EXAMPLE NATURAL CAPITAL MONETARY FLOW ACCOUNT

Natural capital asset	Ecosystem service (ES) or abiotic flow (AB)	Indicators	Units	2021 Flows to reporting entity	2021 Flows to rest of society
Plantation forest	**ES: Wood provisioning**	Value of timber harvested[a]	$ 000's	17,500	-
	ES: Global climate regulation	Value of carbon sequestered and stored[b]	$ 000's	-	14,000
Native forest	**ES: Wild animals, plants and other biomass provisioning**	Value of seeds and plants harvested[c]	$ 000's	4,000	-
Upland streams	**ES: Recreation**	Value of recreational fishing visits[d]	$ 000's	-	225
	AB: Water abstraction	Value of water abstracted[e]	$ 000's	3,750	-
Native pastures	**ES: Grazed biomass provisioning**	Value of forage for livestock[f]	$ 000's	8,000	-

[a] Timber harvest value is calculated using a unit value of $50/m^3 (based on the stumpage price paid by logging companies for the right to harvest standing timber) – with the price assumed to remain constant into the future. The value of the timber is a benefit to the reporting entity.

[b] Carbon sequestration and storage value is calculated using a unit value of $20/t$CO_2$e (based on the average price paid for carbon credits in the relevant carbon market) – with the price assumed to remain constant into the future. The value of carbon sequestration and storage all goes to society except for 2023 onwards where the reporting entity receives carbon credits worth $200,000 per year (shown in the benefit to reporting entity column).

[e] Seed and plant harvest value is calculated using a unit value of $200/tonne (based on prices paid for similar products, less production costs) – with the price assumed to remain constant into the future. The value of the seeds and plants is a benefit to the reporting entity.

[d] Recreational fishing value is calculated based on a unit value of $15/visit (based on prices paid for recreational visit fees in similar locations) – with the value assumed to remain constant across space and into the future. The value of recreational fishing all goes to society, as the upland streams are open access.

[e] Water abstraction value is calculated based on a on a unit value of $25/ML in 2021 (based on the average price paid for water allocations in the relevant water market) – and a forecast unit value of $20/ML from 2022 to 2050. The value of water abstraction is a benefit to the reporting entity.

[f] Forage for livestock value is calculated based on a on a unit value of $200/tonne dry matter (DM) (based on prices paid for agistment on pastures of similar quality and productivity) – with the price assumed to remain constant into the future. The value of forage for livestock is a benefit to the reporting entity.

[g] The forecast period covers 2022 to 2050. For simplification in this example, it is assumed that flows remain constant after 2023. However, the reporting entity should produce a schedule for the whole accounting period or a written justification for their expectations about future ecosystem service flows.

	2022 forecast		2023 forecast		2050 forecast[9]	
	Flows to reporting entity	Flows to rest of society	Flows to reporting entity	Flows to rest of society	Flows to reporting entity	Flows to rest of society
	20,000	-	16,250	-	16,250	-
	-	13,200	200	14,000	200	14,000
	4,000	-	6,000	-	6,000	-
	-	255	-	270	-	270
	2,800	-	2,600	-	2,600	-
	8,000	-	8,000	-	8,000	-

1.4 Natural capital obligation schedule

What?

- The natural capital obligation schedule documents the cost of restoring, maintaining, or enhancing the quantity and/or quality of natural capital assets in accordance with the reporting entity's legal or voluntary responsibilities. It therefore primarily concerns monetary information, although associated physical quantities may also be recorded (e.g. the cost to rehabilitate a wetland of a particular extent and condition).
- The natural capital obligation schedule does not have a direct equivalent in the SEEA framework. However, there are some similarities with 'environmental protection expenditure accounts' described in the SEEA-CF (s. 4.3.2).

Why?

- A natural capital obligation schedule provides information for tracking the reporting entity's natural capital **obligation costs**. The net present value of the reporting entity's natural capital obligation costs is shown as the entity's natural capital liability in the natural capital balance sheet.
- Because the concept of a natural capital obligation is consistent with the concept of an obligation in international financial accounting standards, the financial value of natural capital obligations should already be included in the reporting entity's financial accounts. However, disaggregating natural capital obligations from other obligations enables direct comparison of the value of the reporting entity's natural capital assets and its natural capital liabilities.

How?

Step 1: Consider any natural capital obligations (legal or voluntarily adopted). Note that while obligations often relate to natural capital assets that the reporting entity owns or controls, they may also relate to other natural capital assets.

Step 2: Record the costs associated with settlement of each obligation in the current reporting period (if applicable).

Step 3: Estimate the future costs associated with settlement of each obligation. Document any assumptions.

Step 4: Complete the natural capital obligation schedule using the measures from steps 2 and 3. It may be helpful to keep legal and voluntary obligation costs separate. Likewise, it may be helpful to report separately on obligation costs relating to the reporting entity's natural capital assets versus other natural capital assets.

Example:

- The example natural capital obligation schedule combines information on current and future expected obligations the reporting entity has regarding natural capital assets, and the economic cost of meeting those obligations. Reporting entities should be explicit about which natural capital asset(s) the obligations refer to.

CONCEPTS

Liabilities, obligations, obligation costs and maintenance costs

According to IAS 137 *Provisions, Contingent Liabilities and Contingent Assets*, a liability is "a present obligation of the entity arising from past events, the settlement of which is expected to result in an outflow from the entity of resources embodying economic benefits." The standard furthermore distinguishes between 'legal obligations' and 'constructive obligations', such as those created by an established pattern of practice or publication of policies stating that the entity accepts certain responsibilities. These definitions are equally applicable to natural capital obligations and liabilities.

The BSI (BSI, 2021) uses the term 'maintenance costs' to describe:

"*...the cost of restoring, maintaining or enhancing the quantity and quality of natural capital assets as per the organization's responsibility (legal or voluntary).* (BS 8632:2021)."

Here we use the term **'natural capital obligation costs'** to clarify that the relevant costs are those that are necessary to meet specific legal or voluntary (constructive) natural capital-related obligations for the reporting entity. A **natural capital liability** is stated on the natural capital balance sheet based on the present value of future natural capital obligation costs.

A*ctual* expenditure on maintenance may or may not be sufficient to meet a reporting entity's obligations with respect to natural capital assets, hence we recommend not using the term 'maintenance costs'. However, actual expenditure on maintenance may be a guide or proxy for calculating true obligation costs.

These obligation costs are distinct from any other costs of restoring, maintaining, or enhancing natural capital that the reporting entity does not have a legal or constructive obligation to incur. We do not recommend that production costs are classified as liabilities as shown in Table 2 of BS 8632:2021 (BSI, 2021).

Other examples

Additional guidance is available in the British Standard on natural capital accounting for organisations (BS 8632:2021, section 6.7.1.6, p23).

EXAMPLE NATURAL CAPITAL OBLIGATION SCHEDULE						
	Obligation	**Units**	**2021**	**2022 Forecast**	**2023 Forecast**	**2050 Forecast[g]**
Plantation forest	Clean up contaminated land to meet regulatory requirements[a]	$ 000's	-110	-70	0	0
Native forest	Native forest regeneration activities to meet certification requirements[b]	$ 000's	-950	-950	-950	-950
	Greenhouse gas emissions reduction to meet net zero commitment[c]	$ 000's	-65	-85	-150	-150
Upland streams	Planting and maintenance of riparian vegetation to meet water quality regulatory requirements[d]	$ 000's	-150	-120	-80	-80
Native pastures	Maintain >50% ground cover[e]	$ 000's	0	0	0	0
Other natural capital assets	Contribute to downstream wetland rehabilitation[f]	$ 000's	-200	-200	-200	0
	Total obligation costs	**$ 000's**	**-1,475**	**-1,425**	**-1,380**	**-1,180**

[a] The plantation forest asset is subject to regulatory requirements to clean up contamination. The schedule shows obligations of $110,000 in 2021 and $70,000 in 2022, with no further costs expected into the future.

[b] The native forest asset is subject to the reporting entity's voluntary commitments to regenerate after harvest. The schedule shows obligations of $950,000 in 2021, which will remain constant through to 2050.

[c] The native forest asset is also subject to the reporting entity's voluntary commitments to maintain and enhance carbon storage in their native forest. The schedule shows obligations of $65,000 in 2021 that will increase to $85,000 in 2022 and $150,000 in 2023 – remaining constant to 2050.

[d] The upland streams asset is subject to the reporting entity's regulatory obligation to enhance riparian vegetation. The schedule shows obligations of $150,000 in 2021 that will decrease to $120,000 in 2022 and $80,000 in 2023 – remaining constant to 2050.

[e] The native pastures asset is subject to a regulatory requirement to maintain at least 50% ground cover. The schedule shows zero cost associated with this obligation, as the reporting entity does not foresee any additional expenditure being required to maintain this level of ground cover.

[f] The reporting entity has made a voluntary commitment to contribute $200,000/year to downstream wetland rehabilitation in 2021, 2022 and 2023 (downstream wetlands are natural capital assets belonging to government). At this point, no further commitments are envisaged.

[g] The forecast period covers 2022 to 2050. For simplification in this example, it is assumed that obligations remain constant after 2023. However, the reporting entity should produce a schedule for the whole accounting period or a written justification for their expectations about future ecosystem service flows.

1.5 Natural capital balance sheet

What?

- The natural capital balance sheet reports on the monetary value of the reporting entity's natural capital assets and liabilities, calculated as the sum of discounted future benefit flows (for assets) and the sum of discounted future obligation costs (for liabilities). The difference between the value to the reporting entity of its natural capital assets and natural capital liabilities can also be thought of as the reporting entity's **natural capital equity**.
- The natural capital balance sheet can also show whether the value from natural capital assets owned or controlled by the reporting entity goes to the reporting entity itself or to the rest of society.

Why?

- The natural capital balance sheet summarises information relevant for both internal decision making and external reporting/disclosure, aligned with financial and annual reporting (analogous to a financial balance sheet).

How?

Step 1: Consider and decide on appropriate asset lifetimes and discount rates. Liabilities should be considered over the same lifetime, using the same discount rate.

Step 2: Calculate the net present value of each natural capital asset using the sum of discounted future monetary flows from the natural capital monetary flow account.

Step 3: Calculate the net present value of any natural capital liabilities using the sum of discounted future obligation costs from the natural capital obligation schedule.

Step 4: Complete the natural capital balance sheet using the measures from steps 2 and 3.

CONCEPTS

Valuing stocks of natural capital

The value of the stock of natural capital assets is calculated as the discounted (i.e. present value) sum of the projected benefit flows over the accounting period. The benefit is net of any costs of producing those benefits. This is consistent with the SNA and SEEA guidance on valuing assets where no market exists.

The net present value (NPV) asset valuation method requires three steps: first, an estimation of the values of ecosystem services provided by natural capital assets; second, an estimation of the expected future flows of values from those ecosystem services discounted to the present; and third, a decision about an appropriate discount rate.

The NPV asset valuation method therefore depends on factors such as the asset's future condition, pressures or environmental changes, natural regeneration, sustainable rate of usage, and the long-term viability of the asset. This requires either detailed knowledge or it requires the valuer to make bold assumptions such as calculating value based on current patterns of use and condition (Hein et al., 2016).

Asset lifetime considerations are also relevant. Most environmental economists agree that for environmental long-lived assets a discount rate based on market rates is not appropriate as markets are essentially driven by short term considerations. For ecosystem assets an accounting lifetime of 100 years may be considered reasonable, together with a lower discount rate. For example, for such long-lived assets that may involve intergenerational wealth transfers, the UK Treasury recommends a discount rate of 3.5% for the first 50 years and further declining discount rates thereafter.[3]

Accounting for biological assets

The existing international financial accounting standard on the valuation of biological assets (IAS 41) provides some basis for valuing natural capital assets. Accounting for the fair value of standing trees often suffers from a lack of market prices and therefore it is common for forestry companies to use the net present value of expected future cash flows to estimate the fair value of their standing trees.

3 https://www.gov.uk/government/publications/green-book-supplementary-guidance-discounting

Example:

- The example natural capital balance sheet below summarises the monetary value of natural capital assets and liabilities.
- The net present value (NPV) calculations for the natural capital asset values use the projected future benefit flows from each asset in the monetary flow account and discount them back to a present value. For the example below we value the assets over a 30-year period (to 2050) using a long-term discount rate of 3.5%. As with traditional financial statements, including the previous reporting year's information is likely to be useful (i.e. the results of NPV calculations made for the previous reporting year). Example values for the previous year are shown on the right of the statement.
- The NPV calculations for the natural capital liabilities use the projected future costs for each liability in the natural capital obligation schedule and discount them back to a present value, using the same timeframe and discount rate as the natural capital asset NPV calculations.

Other examples

Additional guidance on natural capital balance sheets is available in the British Standard on natural capital accounting for organisations (BS 8632:2021, section 6.7.1.7, p23) and SEEA-EA on extended balance sheets (Section 10.3 p240).

Forico's natural capital report 2021 provides an example natural capital balance sheet for forestry (Forico, 2021 p34).

Forestry England Natural Capital Accounts provide another example (Forestry England Balance Sheet).

EXAMPLE NATURAL CAPITAL BALANCE SHEET

Net present value over 30-year period Discount rate: 3.50% Date: 31/12/2021				2021		2020 Previous statement	
	Ecosystem service (ES) or abiotic flow (AB)	Item	Units	Value to reporting entity	Value to rest of society	Value to reporting entity	Value to rest of society
Natural capital asset							
Plantation forest	**ES: Wood provisioning**	NPV timber harvested[a]	$ 000's	293,081	-	294,289	-
	ES: Global climate regulation	NPV carbon sequestered and stored[b]	$ 000's	3,414	234,658	3,227	235,618
Native forest	**ES: Wild animals, plants and other biomass provisioning**	NPV seeds and plants harvested[c]	$ 000's	106,282	-	104,415	
Upland streams	**ES: Recreation**	NPV recreational fishing visits[d]	$ 000's	-	4,870	-	4,826
	AB: Water abstraction	NPV water abstracted[e]	$ 000's	46,893	-	48,004	-
Native pastures	**ES: Grazed biomass provisioning**	NPV forage for livestock[f]	$ 000's	123,416	-	124,549	-
Total natural capital assets			**$ 000's**	**573,087**	**239,528**	**574,485**	**240,444**
Natural capital liabilities							
Plantation forest		NPV plantation forest liabilities[g]	$ 000's	68	-	172	-
Native forest		NPV native forest liabilities[h]	$ 000's	19,777	-	19,697	-
Upland streams		NPV upland streams liabilities[i]	$ 000's	1,482	-	1,548	-
Native pastures		NPV native pastures liabilities[j]	$ 000's	-	-	-	-
Other natural capital assets		NPV other natural capital assets liabilities[k]	$ 000's	380	-	560	-
Total natural capital liabilities			**$ 000's**	**21,706**	**-**	**21,976**	**-**
Natural capital equity			**$ 000's**	**551,381**	**239,528**	**552,509**	**240,444**

[a] NPV timber harvested value is based on the net present value of flows of benefits over a 30-year time period, using a 3.5% discount rate. The value of timber harvested is $293.081M for the reporting entity, which is a decrease in value of $1.208M compared to the previous year's statement.

[b] NPV carbon sequestered and stored value is based on the net present value of flows of benefits over a 30-year time period, using a 3.5% discount rate. The value of carbon sequestered and stored is $3.414M for the reporting entity and $234.658M for society, which is an increase in value of $187k for the reporting entity and a decrease of $960k for society compared to the previous year's statement.

[c] NPV seeds and plants harvested value is based on the net present value of flows of benefits over a 30-year time period, using a 3.5% discount rate. The value of seeds and plants harvested is $106.282M for the reporting entity, which is an increase in value of $1.867M compared to the previous year's statement.

[d] recreational fishing value is based on the net present value of flows of benefits over a 30-year time period, using a 3.5% discount rate. The value of recreational fishing is $4.870M for society, which is an increase in value of $43k compared to the previous year's statement.

[e] NPV water abstracted value is based on the net present value of flows of benefits over a 30-year time period, using a 3.5% discount rate. The value of water abstracted is $46.893M for the reporting entity, which is an increase in value of $1.111M compared to the previous year's statement.

[f] NPV forage for livestock value is based on the net present value of flows of benefits over a 30-year time period, using a 3.5% discount rate. The value of forage for livestock is $123.416M for the reporting entity, which is an increase in value of $1.133M compared to the previous year's statement.

[g] NPV plantation forest liabilities value is based on the net present value of the obligation to clean up contaminated land over a 30-year time period, using a 3.5% discount rate. The NPV of plantation forest liabilities is $68k, which is a decrease in liabilities of $104k compared to the previous year's statement.

[h] NPV native forest liabilities value is based on the net present value of the obligation to regenerate native forest and meet net-zero carbon commitments over a 30-year time period, using a 3.5% discount rate. The NPV of native forest liabilities is $19.777M, which is a decrease in liabilities of $80k compared to the previous year's statement.

[i] NPV upland streams liabilities value is based on the net present value of the obligation to plant and maintain riparian vegetation over a 30-year time period, using a 3.5% discount rate. The NPV of upland stream liabilities is $1.482M, which is a decrease in liabilities of $66k compared to the previous year's statement.

[j] NPV native pastures liabilities value is based on the net present value of the obligation to maintain >50% ground cover over a 30-year time period, using a 3.5% discount rate. The NPV of native pastures liabilities is zero, as the reporting entity does not foresee any additional expenditure being required to maintain this level of ground cover, and shows no change compared to the previous year's statement.

[k] NPV other natural capital assets liabilities value is based on the net present value of the obligation to contribute to downstream wetland rehabilitation over a 30-year time period, using a 3.5% discount rate. The NPV of other natural capital liabilities is $380k, which is a decrease in liabilities of $180k compared to the previous year's statement.

1.6 Natural capital income statement

What?

- The natural capital income statement reports on the flows of benefits from natural capital assets that a reporting entity owns or controls, any associated disbenefits from ecosystem disservices (if applicable), costs of discharging current natural capital liabilities, and gains or losses in the value of those natural capital assets.

Why?

- The natural capital income statement summarises information for both internal decision-making and external reporting, aligned with financial reporting (analogous to a financial income statement).
- Importantly, it explains changes from one reporting period to the next in the natural capital balance sheet.

How?

Step 1: Take the current monetary value from the natural capital monetary flow account for each ecosystem service or abiotic flow. 'Negative' flows of disbenefits or ecosystem disservices can be included in addition to 'positive' flows of benefits.

Step 2: Calculate any revaluations on natural capital assets (compared with the previous reporting period).

Optional: Separate out revaluations into those based on physical changes in the asset (for example, unexpected changes in future growth of biomass or carbon sequestration, e.g. due to catastrophic loss from fire or disease) and those based on changes in monetary values (for example, changes in timber or carbon prices). If desired, further disaggregation of changes in value can follow SEEA definitions of ecosystem enhancement/degradation; ecosystem conversions; catastrophic losses; reappraisals; and revaluations (see sidebar).

Step 3: Take the costs associated with the discharge of current obligations (i.e. obligations settled since the previous reporting period) from the natural capital obligation schedule.

Step 4: Complete the natural capital income statement using the measures from steps 2, 3 and 4.

CONCEPTS

Consistency of terminology for natural capital income statements

The BS 8632:2021 standard (BSI, 2021) adopts the term 'natural capital income statement' for a statement of a reporting entity's operations impacts (positive and negative) on (any) natural capital. Here, we propose that the term 'natural capital income statement' is reserved for a statement of the comprehensive (positive and negative) flows of benefits from natural capital assets that a reporting entity owns or controls.

Comprehensive natural capital income

In order to be comprehensive, the natural capital income statement should include:

- The flows of positive benefits from owned/controlled natural capital assets over the reporting year;
- If relevant, the flows of negative disbenefits from owned/controlled natural capital assets over the reporting year (also known ecosystem disservices, e.g. health impacts from pollen); and
- Accrued gains or losses resulting from fluctuations in the value of the reporting entity's natural capital assets.

Attributing changes in natural capital asset value to types of value change

A change in natural capital asset value occurs when the net present value of the estimated future flows of benefits yields a different result at the start and end of an accounting period. It can be helpful to disaggregate this change in value according to different causal factors, such as:

- **Ecosystem enhancement (degradation)** is the increase (decrease) in the value of an ecosystem asset over an accounting period that is associated with an improvement (a decline) in the condition of the ecosystem asset during that accounting period (SEEA-EA 2021, paras.10.15 and 10.21). Such changes in value may be estimated from changes in condition reported in the natural capital asset (condition) accounts, or from more sophisticated ecosystem modelling, if available.
- **Ecosystem conversions** refer to situations in which, for a given location, there is a change in ecosystem type involving a distinct and persistent change in the ecological structure, composition and function which, in turn, is reflected in the supply of a different set of ecosystem services and different expected future returns (SEEA-EA 2021, para. 10.30). Such changes in value may be estimated from changes in extent (additions/reductions) reported in the natural capital asset (extent) accounts.

Example:

- The example natural capital income statement summarises 'natural capital income' and 'natural capital expenses' to reveal 'net natural capital income'.
- Natural capital income shows the flows of benefits realised in the current time period from the information documented in the natural capital monetary flow account.
- Natural capital expenses would include any flows of disbenefits (ecosystem disservices – not included in this example) plus any costs associated with the discharge of current obligations from the natural capital obligation schedule.
- The difference between natural capital income and natural capital expenses is 'net natural capital income'.
- In addition, the example natural capital income statement shows any gains or losses on natural capital assets value under 'other natural capital income' as the revaluation increment (decrement). The revaluation due to physical changes in the asset is documented separately to the revaluation due to any monetary value changes.
- The value to the reporting entity is shown separately to the value to the rest of society. As with traditional financial statements, including the previous year's values is likely to be useful. Example values for the previous year are shown on the right of the statement.

- **Catastrophic losses** refer to decreases due to large scale, discrete and recognisable events that cause a significant decline in the condition of an ecosystem asset, i.e., significant losses in structure, function or composition, and hence affect the future flows of ecosystem services in physical terms (SEEA-EA 2021, para. 10.37). Examples include earthquakes, bushfires, cyclones and industrial disasters.
- **Reappraisals** should be recorded when updated information emerges that permits a reassessment of the expected condition of the ecosystem assets or the future demand for ecosystem services, such that the expected pattern of future returns at the end of the accounting period is different from the pattern that had been expected at the start of the accounting period (SEEA-EA 2021, para. 10.38). Examples include changes in demographic projections that affect future demand for ecosystem services, or changes in zoning of land that affect projections of future flows of ecosystem services.
- **Revaluations** are "changes in the value of ecosystem assets over an accounting period that are due solely to movements in the unit prices of ecosystem services which underpin the derivation of the net present value of ecosystem assets" (SEEA-EA 2021, para. 10.41). Revaluations can be estimated based on changes in unit values in the natural capital monetary flow accounts.

This level of disaggregation could be shown within the natural capital income statement, or it could be detailed in a supplementary ecosystem change statement.

Other examples

Forico's natural capital report 2021 in their 'environmental profit and loss statement' provide an example which has elements of the natural capital income statement described here (noting that it also includes elements which refer to the reporting entity's impacts on natural capital, which we cover in the 'natural capital impact statement') (Forico, 2021 p32).

EXAMPLE NATURAL CAPITAL INCOME STATEMENT

Flows from natural capital assets over the accounting period: 01 Jan 2021 to 31 Dec 2021

Date: 31/12/2021

				2021		2020 Previous statement	
		Item	**Units**	**Value to reporting entity**	**Value to rest of society**	**Value to reporting entity**	**Value to rest of society**
Natural capital income	**Value**	Timber harvested	$ 000's	17,500	-	15,500	-
		Carbon sequestered and stored	$ 000's	-	14,000	-	15,000
		Seeds and plants harvested	$ 000's	4,000	-	3,000	-
		Recreational fishing visits	$ 000's	-	225	-	225
		Water abstracted	$ 000's	3,750	-	2,700	-
		Forage for livestock	$ 000's	8,000	-	8,000	-
Total natural capital income			**$ 000's**	**33,250**	**14,225**	**29,200**	**15,225**
	Ecosystem disservices	N/A					
	Expenses associated with discharge of current obligations	Plantation forest	$ 000's	110	-	-	-
		Native forest	$ 000's	1,015	-	1,100	-
Natural capital expenses		Upland streams	$ 000's	150	-	40	-
		Native pastures	$ 000's	-	-	-	-
		Other natural capital assets	$ 000's	200	-	-	-
Total natural capital expenses			**$ 000's**	**1,475**	**-**	**1,140**	**-**
Net natural capital income			**$ 000's**	**31,775**	**14,225**	**28,060**	**15,225**
Other comprehensive natural capital income	**Revaluation increment (decrement)**	Plantation forest: timber harvested (physical changes)[a]	$ 000's	(1,208)	-	-	-
		Plantation forest: timber harvested (value changes)	$ 000's	-	-	-	-
		Plantation forest: carbon sequestered and stored (physical changes)[b]	$ 000's	187	(960)	-	-
		Plantation forest: carbon sequestered and stored (value changes)	$ 000's	-	-	-	-
		Native forest: seeds and plants harvested (physical changes)[c]	$ 000's	1,867	-	-	-

EXAMPLE NATURAL CAPITAL INCOME STATEMENT							
Flows from natural capital assets over the accounting period: 01 Jan 2021 to 31 Dec 2021							
Date: 31/12/2021				2021		2020 Previous statement	
		Item	**Units**	**Value to reporting entity**	**Value to rest of society**	**Value to reporting entity**	**Value to rest of society**
		Native forest: seeds and plants harvested (value changes)	$ 000's	-	-	-	-
		Upland streams: recreational fishing visits (physical changes)[d]	$ 000's	-	43	-	-
		Upland streams: recreational fishing visits (value changes)	$ 000's	-	-	-	-
		Upland streams: water abstracted (physical changes)[e]	$ 000's	-	-	-	-
		Upland streams: water abstracted (value changes)	$ 000's	(1,111)	-	-	-
		Native pastures: forage for livestock (physical changes)[f]	$ 000's	(1,133)	-	-	-
		Native pastures: forage for livestock (value changes)	$ 000's	-	-	-	-
	Decrease (increase) in natural capital liabilities	Revaluation of net natural capital liabilities[g]	$ 000's	271	-	-	-
Total comprehensive natural capital income			**$ 000's**	**30,647**	**13,309**	**28,060**	**15,225**

[a] The value of plantation forest: timber harvested shows a decrease of $1.208M, due to changes in physical flow assumptions, which is therefore shown in the revaluation (physical changes) row. No revaluation changes are shown for the previous statement because 2020 was the reporting entity's first natural capital reporting year.

[b] The value of plantation forest: carbon sequestered and stored shows an increase of $187k (value to the reporting entity) but a decrease of $960k in value to society, due to changes in physical flow assumptions, which is therefore shown in the revaluation (physical changes) row. No revaluation changes are shown for the previous statement because 2020 was the reporting entity's first natural capital reporting year.

[c] The value of native forest: seeds and plants harvested shows an increase of $1.867M, due to changes in physical flow assumptions, which is therefore shown in the revaluation (physical changes) row. No revaluation changes are shown for the previous statement because 2020 was the reporting entity's first natural capital reporting year.

[d] The value of upland streams: recreational fishing visits shows an increase of $43k (value to society), due to changes in physical flow assumptions, which is therefore shown in the revaluation (physical changes) row. No revaluation changes are shown for the previous statement because 2020 was the reporting entity's first natural capital reporting year.

[e] The value of upland streams: water abstracted shows a decrease of $1.111M (value to the reporting entity), due to changes in unit value assumptions, which is therefore shown in the revaluation (value changes) row. No revaluation changes are shown for the previous statement because 2020 was the reporting entity's first natural capital reporting year.

[f] The value of native pastures: forage for livestock shows a decrease of $1.133M (value to the reporting entity), due to changes in physical flow assumptions, which is therefore shown in the revaluation (physical changes) row. No revaluation changes are shown for the previous statement because 2020 was the reporting entity's first natural capital reporting year.

[g] The value of natural capital obligations shows a net decrease in liabilities of $271k (value to the reporting entity). No revaluation changes are shown for the previous statement because 2020 was the reporting entity's first natural capital reporting year.

2 Natural capital impact, dependency and risk/ opportunity assessment

What?

- Natural capital impact, dependency and risk/ opportunity assessments identify and record consistent and comparable information on the reporting entity's relevant (material) **impacts** and **dependencies** on natural capital and the associated **risks** (and **opportunities**) for the reporting entity, including how these are projected to change in the future.
- The focus is on the reporting entity and covers their impacts and dependencies on natural capital, and associated risks and opportunities, whether that natural capital is owned/controlled by the reporting entity, or not.
- Natural capital impact, dependency and risk/ opportunity assessments are relevant for all types of reporting entity.

Why?

- Natural capital impact and dependency assessments provide information relevant for internal decision-making and external reporting/ disclosure, aligned with the reporting entity's sustainability reporting, Environmental, Social, and Governance (ESG) or integrated report.
- Natural capital risk/opportunity assessments provide information relevant for internal decision-making and external reporting/ disclosure, aligned with the reporting entity's corporate risk reporting and with disclosure frameworks such as the Task Force on Climate-Related Financial Disclosures (TCFD) and the Taskforce on Nature-Related Financial Disclosures (TNFD).

CONCEPTS

Natural capital impacts

A natural capital or nature-related impact is a negative or positive effect of an entity's activity on natural capital (see Natural Capital Coalition, 2017 and TNFD, 2023). Natural capital impact assessments focus on the impacts on natural capital that are caused by or otherwise attributable to the reporting entity, either directly by its activities and operations or indirectly through its value chain or financing activities.

Natural capital dependencies

A natural capital or nature-related dependency is an entity's reliance on or use of natural capital (see Natural Capital Coalition, 2017 and TNFD, 2023). Natural capital dependency assessments focus on the natural capital that the reporting entity depends or relies on, either directly for its activities and operations or indirectly through its value chain or financing activities.

Natural capital risks/opportunities

A natural capital or nature-related risk is a risk arising from a reporting entity's impacts and/or dependencies on natural capital (see TNFD, 2023). Natural capital or nature-related opportunities are opportunities that arise due to the existence of natural capital risks, or "activities that create positive outcomes for organisations and nature by creating positive impact on nature or mitigating negative impacts on nature" (TNFD, 2023). Natural capital risk/opportunity assessments focus on the risks (to the reporting entity and/or society) arising from the reporting entity's impacts and/or dependencies on natural capital, and associated opportunities.

Scope of the assessment

Natural capital impact, dependency and risk/opportunity assessments can either be limited in scope to the operations of the reporting entity or expanded to include those attributable to the reporting entity through its value chain or financing activities. The TNFD recommends reporting at the following levels: Direct operations (site, project or corporate level); Upstream; Downstream; and Financed (portfolio level) (TNFD, 2023). Alternatively, see guidance on 'scope 1' and 'scope 2' in BS8632:2021 section 5.1 p10 (BSI, 2021). In this handbook, our examples are limited in scope to the direct operations of the reporting entity.

How?

Impact, dependency and risk/opportunity assessments consist of three internal registers:

- **Natural capital impact register**
- **Natural capital dependency register**
- **Natural capital risk/opportunity register**

Which are used to produce three external reporting statements:

- **Natural capital impact statement**
- **Natural capital dependency statement**
- **Natural capital risk/opportunity statement**

We show how to organise natural capital impact, dependency and risk/opportunity information in the subsequent example registers and statements.

Natural capital risks link to natural capital accounting

Natural capital risks (and opportunities) identified in the natural capital risk assessment should be reflected in the projections of future physical and monetary flows and associated obligations in the natural capital accounts. This can be done through adjustments to physical flows, monetary values of flows and obligations, and/or the discount rate used to calculate present values.

Physical risks and transition risks

Physical changes such as climate change or habitat loss that affect natural capital dependencies can be thought of as 'physical risks', while changes in social responses to natural capital impacts are often driven by society's transition towards a lower-impact state, hence 'transition risks'. However, in principle, transitions can also affect natural capital dependencies (e.g. by increasing demand for some forms of natural capital and reducing demand for others), while physical risks can also affect the context and social consequences of impacts (e.g. climate change may increase water scarcity in a region, hence increasing the impacts of water consumption, which may lead to stricter regulation or higher pricing).

Other examples

The example natural capital impact and dependency assessments proposed here are broadly consistent with the recommendations of the Natural Capital Protocol (Natural Capital Coalition, 2016) and with BS8632:2021 (BSI, 2021).

The Transparent Project may also provide additional guidance in the future (Transparent Project, 2021).

The example natural capital risk assessment proposed here is broadly consistent with the recommendations of BS 8632:2021 (section 6.7.1.3 p21) for natural capital accounting (BSI, 2021), the Natural Capital Finance Alliance (NCFA) approach to portfolio-level natural capital risk assessment (NCFA and PwC, 2018, NCFA and UN Environment World Conservation Monitoring Centre, 2018) and individual asset-level natural capital risk assessment (Ascui and Cojoianu, 2019) which is in turn consistent with the guidance of the Natural Capital Protocol (Natural Capital Coalition, 2016). In addition, it is broadly consistent with the recommendations of the TNFD which provides guidance for reporting entities to disclose: "*how the reporting entity identifies, assesses and manages nature-related risks*" (TNFD, 2022 p10).

Additional guidance on risk management for reporting entities is available in the ISO standard on risk management (ISO, 2018). In addition, the Climate Disclosure Standards Board has published a framework to guide corporate reporting of natural-capital-related climate information (CDSB 2018) and the TCFD on climate-related risks (TCFD, 2017).

2.1 Natural capital impact register and impact statement

What?

- A natural capital impact register tracks a reporting entity's material impacts on natural capital (whether or not the natural capital affected is owned or controlled by the reporting entity). It can track either qualitative or quantitative metrics, and negative and/or positive impacts (see sidebar). It can include only physical measures of impacts, or these can also be given a monetary value using the principles set out in previous sections for natural capital accounting.
- A natural capital impact statement provides a summary of information from the natural capital impact register for the current period, compared with the previous reporting period. It is sometimes referred to as an 'environmental profit & loss statement'.

Why?

- A natural capital impact register helps reporting entities to track their natural capital impacts over time, allowing trends in performance to be monitored internally and facilitating better management of those impacts. It also enables the production of a natural capital impact statement, which provides a faithful representation of the reporting entity's relevant impacts on natural capital to external stakeholders, allowing trends in performance to be monitored. A natural capital impact statement should be aligned with the reporting entity's sustainability report, Environmental, Social, and Governance (ESG) or integrated report.
- The natural capital impact register can also be used to develop a natural capital risk register.

How?

Step 1: Identify those impacts that are potentially material for the reporting entity and prioritise the natural capital impacts to be included in the natural capital impact register. Options for this step include:

- Following the "Locate" and "Evaluate" steps in the TNFD's LEAP (Locate – Evaluate – Assess – Prepare) approach (TNFD, 2023);
- Undertaking a materiality assessment as per step 4 in the Natural Capital Protocol (Natural Capital Coalition, 2016) or as suggested in step 3 of the section on natural capital risk assessment;
- Using a high-level screening tool such as ENCORE (https://encore.naturalcapital.finance); or
- Using results from an existing generic or higher-level materiality assessment that is relevant for the reporting entity's sector and geography, e.g. for Australian forestry reporting entities, (Smith et al., 2021b, Smith et al., 2021a) and for Australian wheat, beef, dairy and sheep industry reporting entities (Ascui, 2023a, Ascui, 2023c, Ascui, 2023d, Ascui, 2023b).

CONCEPTS

Negative and positive impacts

Natural capital impacts are defined as negative or positive effects of an organisation's operations on natural capital (NCP 2016, pp.16-17).

In this handbook we follow this definition and use the terms 'positive' and 'negative' for impacts that generally improve or degrade natural capital, respectively. However, this is a complex topic and impacts could be positive for some aspects of natural capital and negative for others, and/or viewed differently from different value perspectives or by different stakeholders. The reporting entity should clarify the basis on which any distinction between 'positive' and 'negative' impacts is made, particularly if using these concepts to report 'net' impacts.

Scope or level of impact measurement

Any impact measurement exercise will require consideration of the scope of impacts that should be included. A key guiding principle should be to include all material impacts caused by the reporting entity (and not to include impacts that are not caused by the reporting entity). Causation can be direct (e.g. impacts caused by operational activities) or indirect (which may include impacts caused by other entities connected to the reporting entity, e.g. through value chains; as well as impacts caused through other connections such as through the provision of finance or via market forces). A convention has developed in greenhouse gas emissions reporting to differentiate between scope 1 (direct operational emissions), scope 2 (indirect emissions from purchased electricity, heating, cooling or steam), and scope 3 (all other indirect emissions). As scope 2 does not have a direct equivalent for other nature-related impacts, the TNFD recommends reporting at the following levels: Direct operations (site, project or corporate level); Upstream; Downstream; and Financed (portfolio level).

Step 2: Consider the appropriate qualitative or quantitative impact metrics and targets to measure each material natural capital impact. At a minimum, impacts should be measured using physical measures. Optionally, these physical measures can also be given a monetary value (see the natural capital accounting section of this handbook, or ISO 14008: 2019. Monetary valuation of environmental impacts and related environmental aspects (ISO, 2019)).

Step 3: Measure historical changes in the selected impact metrics and (optionally) estimate future quantities for the selected metrics. Estimates of future quantities should incorporate planned management decisions and any foreseen changes resulting from natural capital threats (see section on natural capital risk assessment), and any assumptions should be documented.

Step 4: Document the reporting entity's mitigation and adaptation activities for each impact. This may include details such as the timing and costs of undertaking these activities and any monitoring of their effectiveness.

Step 5: Complete the natural capital impact register using the measures in step 3 and 4.

Step 6: Prepare a natural capital impact statement using information from the natural capital impact register for the current reporting period, compared with information reporting for the previous period.

Impact metrics and targets

An **impact metric** is something that provides a simple and reliable means to measure impacts.

There are different ways to measure impacts. These include:

- Measuring the activities or outputs caused by the reporting entity that produce impacts (**impact drivers**);
- Measuring the state of nature affected by the reporting entity (e.g. ecosystem condition);
- Measuring the flows of ecosystem services or abiotic flows affected by the reporting entity;
- Measuring responses to any of the above, such as fines imposed by an environmental regulator, or actions taken to prevent or mitigate impacts.

An impact metric on its own does not provide sufficient information to understand how significant an impact is. This requires an understanding of the organisational and environmental context. We therefore recommend that impact metrics are recorded and reported together with targets that represent the desired maximum level for negative impacts, or the desired minimum level for positive impacts. The basis for these targets (e.g. organisational commitments, regulatory requirements or environmental sensitivity thresholds) should be explained in notes.

Impacts are likely to vary by industry, geography, and the priorities of the reporting entity, and thus impact metrics and targets will also be highly heterogeneous. We provide a limited set of examples in this handbook. The TNFD recommendations include various impact metrics, and the Natural Capital Measurement Catalogue (http://www.naturalcapitalmeasurement.org) contains further example impact metrics and measurement methods.

Example:

- The example below shows how to combine qualitative and quantitative information for both negative and positive impacts from a variety of operations into a natural capital impact register and associated natural capital impact statement.
- The example natural capital impact register records a definition of the impact, its location, selected metrics and targets, measures of the impact over time (from 2010 to 2021) plus future projections (shown for 2030 and 2050), and a record of mitigation actions undertaken by the reporting entity to mitigate their negative impacts and/or enhance their positive impacts on natural capital.
- The example natural capital impact statement shows the same information, but with measured values restricted to the current and previous reporting period (including the % change). It also includes notes providing further narrative information.
- The examples only include physical measures, but monetary values could be included as additional columns by applying a suitable monetary unit value to each physical measure.

Consistency of terminology: natural capital impact statement

Various organisations have produced statements or guidance on how to report on natural capital impacts from an organisational perspective, but the terminology used to describe these statements varies, and this can create confusion. Here, the term 'natural capital impact statement' is used to refer to a statement of a reporting entity's material impacts on natural capital and has the reporting entity's wider relationship with natural capital as the focus (as compared with natural capital accounting, which generally focuses on the natural capital assets that the reporting entity owns or controls). However, it is broadly comparable with what some organisations have called an 'environmental profit and loss' statement (Kering, 2020, PUMA, 2011).

Other examples

The TNFD Framework (beta v0.4) provides a set of generically applicable core impact metrics, plus optional additional metrics and sector-specific metrics, including for food and agriculture, and the tropical forestry biome.

The Biological Diversity Protocol provides detailed guidance on measuring and reporting on biodiversity impacts (Endangered Wildlife Trust, 2020).

The Bioregional Assessment Program also proposed a natural capital impact framework (Henderson et al., 2018) and implemented this using a Hunter Valley coal industry example (Herron et al., 2018).

A variety of frameworks provide guidance for reporting entities to report on their natural capital impacts, such as sustainability reporting and environmental, social and governance (ESG) reporting, and SDG reporting (Global Reporting Initiative (GRI), 2013). An international standard on monetary valuation of environmental impacts has been published, ISO 14008: 2019 *Monetary valuation of environmental impacts and related environmental aspects* (ISO, 2019).

The International Sustainability Standards Board (ISSB) has published an exposure draft standard, Exposure Draft IFRS S1 *General Requirements for Disclosure of Sustainability-related Financial Information* (ISSB, 2022).

Companies such as Kering and PUMA have tracked and reported on their natural capital impacts (Kering, 2020, PUMA, 2011).

Impacts on natural capital for forestry are also explored in O'Grady et al. (2020).

EXAMPLE NATURAL CAPITAL IMPACT REGISTER

Thematic area	Topic	Impact	Location	Metrics	Type of metric	Target
Negative impacts						
Water	**Water use**	Water abstracted from water-stressed catchments is not available for ecosystem use	Catchment X	Total water withdrawal and consumption from areas of water stress (ML)	Impact driver	<10,000 ML
	Water quality	Activities affect the quality of surface or sub-surface water	Region X	Number of days of exceedances of water quality threshold levels per year (days/year)	State	0
Biodiversity and ecosystems	**Weeds**	Activities introduce and spread weeds	Region X	Area of pine wildling infestations in adjacent land associated with the plantation estate (ha)	State	0
Air	**Greenhouse gas emissions**	Operations emit greenhouse gases (directly and indirectly)	Regions X, Y and Z	Gross scope 1, 2 and 3 greenhouse gas emissions (tCO_2e)	Impact driver	25,000
Positive impacts						
Air	**Greenhouse gas emissions**	Improved forest management practices increase carbon sequestration and storage	Regions X, Y and Z	Greenhouse gas removals (tCO_2e)	Impact driver	50,000

	Historical measures			Current year	Mitigation	Future projections	
	2010	2015	2020	2021		2030	2050
	50,000	40,000	25,000	**18,000**	Continue implementing water efficiency measures and shift water use away from catchment X.	<10,000	0
	28	35	21	**12**	Maintain and expand riparian buffers. Implement a waterway monitoring scheme before and after forestry, road-building and mining operations.	0-10	0
	N/A	N/A	15	**10**	Monitor adjacent land to pine plantations for wildlings and implement weed control.	0	0
	61,394	58,830	45,595	**43,039**	Continue implementing energy efficiency improvements.	25,000	10,000
	40,388	34,970	60,008	**63,404**	Continue implementing improved forest management practices.	50,000	50,000

EXAMPLE NATURAL CAPITAL IMPACT STATEMENT

Thematic area	Topic	Impact	Location	Metrics	Type of metric
Negative impacts					
Water	**Water use**	Water abstracted from water-stressed catchments is not available for ecosystem use[a]	Catchment X	Total water withdrawal and consumption from areas of water stress (ML)	Impact driver
	Water quality	Activities affect the quality of surface or sub-surface water[b]	Region X	Number of days of exceedances of water quality threshold levels per year (days/year)	State
Biodiversity and ecosystems	**Weeds**	Activities introduce and spread weeds[c]	Region X	Area of pine wildling infestations in adjacent land associated with the plantation estate (ha)	State
Air	**Greenhouse gas emissions**	Operations emit greenhouse gases (directly and indirectly)[d]	Regions X, Y and Z	Gross scope 1, 2 and 3 greenhouse gas emissions (tCO_2e)	Impact driver
Positive impacts					
Air	**Greenhouse gas emissions**	Improved forest management practices increase carbon sequestration and storage[e]	Regions X, Y and Z	Greenhouse gas removals (tCO_2e)	Impact driver

[a] One of the upland streams that the reporting entity takes water from is classified as part of a water-stressed catchment. The reporting entity has reduced the water it takes from this stream through implementing a range of efficiency measures, with a view to meeting a target of less than 10,000 ML by 2030, reducing to zero by 2050. This disclosure metric is consistent with TNFD core disclosure metric C 4.0.

[b] Water quality impacts from the reporting entity's operations are typically caused by plantation forest harvesting and road-building. The reporting entity is implementing operational controls in all of these areas with a view to achieving zero exceedances as soon as possible. $500k has been spent on maintaining and expanding riparian buffers over the previous 10 years.

[c] The reporting entity's pine plantation estate can contribute to the spread of pine wildlings in adjacent areas. Monitoring of pine wildling infestations in adjacent land only started in 2020, so no data is recorded for 2010 or 2015. Over the next two years, the reporting entity will invest $50k in implementing regular weed control along with monitoring, with a view to achieving zero pine wildling infestation area by 2030.

[d] The reporting entity's scope 1, 2 and 3 greenhouse gas emissions have been regularly monitored, following the Greenhouse Gas Protocol. Emissions have been reduced through implementing a range of efficiency measures, with a view to achieving a target of no more than 25,000 tCO_2e by 2030 and 10,000 tCO_2e by 2050. This disclosure metric is consistent with TNFD core disclosure metric C 1.0.

[e] Through the implementation of improved forest management practices (e.g. longer rotations and more efficient thinning) the reporting entity has increased carbon sequestration and storage in the plantation forest estate beyond a business as usual baseline, surpassing its target of 50,000 tCO_2e greenhouse gas removals in both 2020 and 2021. This has enabled the reporting entity to claim negative net greenhouse gas emissions in 2020 and 2021.

	Target	Measures			Mitigation
		2020	2021	% Change	
	<10,000	25,000	**18,000**	-28%	Continue implementing water efficiency measures and shift water use away from catchment X.
	0	21	**12**	-43%	Maintain and expand riparian buffers. Implement a waterway monitoring scheme before and after forestry, road-building and mining operations.
	0	15	**10**	-33%	Monitor adjacent land to pine plantations for wildlings and implement weed control.
	25,000	45,595	**43,039**	-5.6%	Continue implementing energy efficiency improvements.
	50,000	60,008	**63,404**	5.7%	Continue implementing improved forest management practices.

2.2 Natural capital dependency register and dependency statement

What?

- A natural capital dependency register tracks a reporting entity's material dependencies on natural capital (whether or not the natural capital depended on is owned or controlled by the reporting entity). It can track either qualitative or quantitative metrics, and positive and/or negative dependencies (see sidebar). It can include only physical measures of dependencies, or these can also be given a monetary value using the principles set out in previous sections for natural capital accounting.
- A natural capital dependency statement provides a summary of information from the natural capital dependency register for the current period, compared with the previous reporting period.

Why?

- A natural capital dependency register provides information for reporting entities to track their natural capital dependencies over time, allowing trends in performance to be monitored internally and facilitating better management of those dependencies. It also enables the production of a natural capital dependency statement, which provides a faithful representation of the reporting entity's relevant dependencies on natural capital to external stakeholders, allowing trends in performance to be monitored. A natural capital dependency statement should be aligned with the reporting entity's sustainability report, Environmental, Social, and Governance (ESG) or integrated report.
- The natural capital dependency register can also be used to develop part of a natural capital risk assessment register.

How?

Step 1: Identify those dependencies that are potentially material for the reporting entity and prioritise the natural capital dependencies to be included in the natural capital dependency register. Options for this step include:

- Following the "Locate" and "Evaluate" steps in the TNFD's LEAP (Locate – Evaluate – Assess – Prepare) approach (TNFD, 2023);
- Undertaking a materiality assessment as per step 4 in the Natural Capital Protocol (Natural Capital Coalition, 2016) or as suggested in step 3 of the section on natural capital risk assessment;
- Using a high-level screening tool such as ENCORE (https://encore.naturalcapital.finance); or
- Using results from an existing generic or higher-level materiality assessment that is relevant for the reporting entity's sector and geography, e.g. for Australian forestry reporting entities, (Smith et al., 2021b, Smith et al., 2021a) and for Australian wheat, beef, dairy and sheep industry reporting entities (Ascui, 2023a, Ascui, 2023c, Ascui, 2023d, Ascui, 2023b).

CONCEPTS

Dependencies

Natural capital dependencies are defined as a "business reliance on or use of natural capital" (Natural Capital Coalition 2016 pp.16-17). This can be interpreted as a more general definition applicable to any reporting entity, whether it is a business or other entity.

Typical dependencies include ecosystem services or abiotic flows from the environment that provide essential inputs to operations (e.g. biomass provisioning services or water inputs). Other dependencies may enable production (e.g. pollination services) or protect the entity or its value chain from disruption (e.g. flood mitigation services).

In addition to ecosystem services and abiotic flows, an entity may also depend on more general environmental conditions, such as average temperatures falling within a certain range. Dependencies on environmental conditions can be particularly important for entities in agricultural and forestry industries (Smith et al., 2021b, Smith et al., 2021a, Ascui, 2023a, Ascui, 2023c, Ascui, 2023d, Ascui, 2023b).

Positive and negative dependencies

Dependencies are usually thought of as 'positive' in the sense that an entity depends or relies on the presence of natural resources, ecosystem services or sets of environmental conditions that are beneficial for the entity. However, an entity may have equally important dependencies on the absence (or relative infrequency) of natural resources, ecosystem disservices or environmental conditions that are harmful for the entity – e.g. an absence of arsenic in groundwater, an absence of certain pests or diseases, or a low frequency of frosts at a critical point in the season. These can be thought of as 'negative' dependencies and may be equally important to monitor for both internal management and external reporting purposes.

Step 2: Consider the appropriate qualitative or quantitative dependency metrics and targets to measure each material natural capital dependency. At a minimum, dependencies should be measured using physical measures. Optionally, these physical measures can also be given a monetary value (see the natural capital accounting section of this handbook, or ISO 14008: 2019 *Monetary valuation of environmental impacts and related environmental aspects* (ISO, 2019)).

Step 3: Measure historical changes in the selected dependency metrics and (optionally) estimate future values for the selected metrics. Estimates of future quantities should incorporate planned management decisions and any foreseen changes resulting from natural capital threats (see section on natural capital risk assessment), and any assumptions should be documented.

Step 4: Document the reporting entity's mitigation and adaptation activities for each dependency. This may include details such as the timing and costs of undertaking these activities and any monitoring of their effectiveness.

Step 5: Complete the natural capital dependency register using the measures in step 3 and 4.

Step 6: Prepare a natural capital dependency statement using information from the natural capital dependency register for the current reporting period, compared with information reporting for the previous period.

Example:

- The example below shows how to combine qualitative and quantitative information for both positive and negative dependencies from a variety of operations into a natural capital dependency register and associated natural capital dependency statement.
- The example dependency register records a definition of the dependency, its location, selected metrics and targets, measures of the dependency over time (from 2010 to 2021) plus future projections (shown for 2030 and 2050), and a record of mitigation actions undertaken by the reporting entity to ensure availability of their positive dependencies and/or mitigate their negative dependencies on natural capital.
- The example natural capital dependency statement shows the same information, but with measured values restricted to the current and previous reporting period. It also includes notes providing further narrative information.
- The examples only include physical measures, but monetary values could be included as additional columns by applying a suitable monetary unit value to each physical measure.

Dependency metrics and targets

A **dependency metric** is something that provides a simple and reliable means to measure dependencies.

There are different ways to measure dependencies. These include:

- Measuring the amount of the relevant abiotic flows, ecosystem services or environmental conditions available to or received by the reporting entity (**dependency availability**);
- Measuring the state of nature that provides the above dependencies (e.g. ecosystem condition);
- Measuring broader changes in impact drivers (e.g. climate change or pollution) that affect the state of nature that provides the above dependencies;
- Measuring responses to any of the above, such as actions taken to ensure ongoing availability of critical dependencies.

A dependency metric on its own does not provide sufficient information to understand how significant a dependency is. This requires an understanding of the organisational and environmental context. We therefore recommend that dependency metrics are recorded and reported together with targets that represent the desired minimum level for positive dependencies, or the desired maximum level for negative dependencies. The basis for these targets (e.g. organisational requirements or environmental sensitivity thresholds) should be explained in notes.

Dependencies are likely to vary by industry, geography, and the priorities of the reporting entity, and thus dependency metrics and targets will also be highly heterogeneous. We provide a limited set of examples in this handbook. The TNFD recommendations include various dependency metrics, and the Natural Capital Measurement Catalogue (http://www.naturalcapitalmeasurement.org) contains further example dependency metrics and measurement methods.

Other examples

A natural capital dependency register is a relatively new concept and therefore there are limited existing examples.

A conceptual exploration of dependencies on natural capital for forestry can be found in O'Grady et al. (2020).

EXAMPLE NATURAL CAPITAL DEPENDENCY REGISTER

	Topic	Dependency	Location	Metrics	Type of metric
Positive dependencies					
Water	**Water availability**	Adequate rainfall to meet target biomass	Region X (plantation forest)	mm of rainfall received (mm/year)	Availability
Land and soil	**Soil organic carbon**	Sufficient soil organic carbon (SOC) to maintain target pasture productivity	Region Y (native pastures)	% SOC (area average from soil samples)	State
Biodiversity and ecosystems	**Pollination services**	Adequate pollination services to maintain plants and seeds production	Region Z (native forest)	Number of beehives in native forest estate	Availability
Negative dependencies					
Weather and climate	**Bushfire**	Destructive bushfire	Regions X and Y (plantation and native forest)	Percent of forest estate affected by destructive bushfire (%) (rolling 5-year average)	State

EXAMPLE NATURAL CAPITAL DEPENDENCY STATEMENT

Thematic area	Topic	Dependency	Location	Metrics	Type of metric
Positive dependencies					
Water	**Water availability**[a]	Adequate rainfall to meet target biomass	Region X (plantation forest)	mm of rainfall received (mm/year)	Availability
Land and soil	**Soil organic carbon**[b]	Sufficient soil organic carbon (SOC) to maintain target pasture productivity	Region Y (native pastures)	% SOC (area average from soil samples)	State
Biodiversity and ecosystems	**Pollination services**[c]	Adequate pollination services to maintain plants and seeds production	Region Z (native forest)	Number of beehives in native forest estate	Availability
Negative dependencies					
Weather and climate	**Bushfire**[d]	Destructive bushfire	Regions X and Y (plantation and native forest)	Percent of forest estate affected by destructive bushfire (%)	State

[a] The plantation forest estate requires a minimum average rainfall of at least 550mm/year. A long-term drying trend has been observed and is expected to continue, due to the effects of climate change in the region (rainfall is projected to reduce to between 420mm and 485mm by 2030 and between 415mm and 490mm by 2050). The reporting entity is responding by developing more drought-resistant phenotypes, changing species planted and decreasing tree planting density as the estate is harvested and re-planted. The reporting entity has spent $200k on researching and trialling drought-resistant phenotypes and species over the previous 5 years. As the mix of species or phenotypes changes, the target level will be revised downwards to reflect the new water requirements.

[b] Soil organic carbon (SOC) contributes to pasture productivity via nutrient retention and availability, improved soil structure, and improved moisture retention. A threshold of 2% has been identified as the level below which pasture productivity is likely to fall below targets. Sampling for SOC was undertaken in 2015 and again in 2021, and an average reduction of 9.6% (from 2.1% to 1.9%) was observed. More sampling will be required to confirm this trend, but the reporting entity has decided to pre-emptively reduce its average stocking rate in order to increase biomass inputs to the soil, with the goal of returning to 2% SOC by 2030.

	Target	Historical measures			Current year	Mitigation	2020 Previous statement	
		2010	2015	2020	2021		2030	2050
	>550	490	459	468	**461**	Develop drought resistant phenotypes. Change species planted. Decrease tree planting density.	420 - 485	415 - 490
	>2.0	N/A	2.1	N/A	**1.9**	Reduce stocking rate to increase biomass input to SOC.	2.0	2.0
	120	130	130	102	**108**	Continue rebuilding beehive capacity.	120	120
	2	0	1	5	**4**	Create firebreaks and buffers. Increase prescribed burning activities to reduce fuel load.	0-5	0-5

	Target	Measures			Mitigation
		2020	2021	% Change	
	>550	468	**461**	-1.5%	Develop drought resistant phenotypes. Change species planted. Decrease tree planting density.
	>2.0	N/A	**1.9**	N/A	Reduce stocking rate to increase biomass input to SOC.
	120	102	**108**	5.6%	Continue rebuilding beehive capacity.
	2	5	**4**	-20%	Create firebreaks and buffers. Increase prescribed burning activities to reduce fuel load.

[c] Pollination by honeybees, in addition to native pollinator species, plays an important role in the production of seeds and plants harvested from the reporting entity's native forest estate. The availability of pollination services is indirectly measured via the number of beehives kept within the native forest estate, with a target of 120 beehives being identified as suitable to provide the necessary services. 28 beehives were lost during 2020 bushfires, bringing the number down to 102 in that year. A further 15 beehives were lost during 2021 bushfires, although 21 new beehives were added, bringing the total to 108. The reporting entity will continue to work with local bee-keepers to help rebuild beehive capacity over the next two years, with the aim to return to 120 by 2024.

[d] Both the plantation forest and native forest estates are vulnerable to bushfires. A 1% threshold for area affected by destructive bushfire represents an acceptable long-term level of risk for the reporting entity. The forest estate was significantly affected by bushfires in both 2020 and 2021, although the area affected was 20% less in 2021 (from 5% to 4% total area). The incidence of bushfire is expected to increase over time, together with the drying trend due to the effects of climate change. The reporting entity is therefore creating more firebreaks and buffers across the entire forest estate, and implementing a more frequent programme of prescribed burns to reduce fuel loads in the native forest estate. $300k has been spent on 10km of new fire breaks and 10,000 ha of prescribed burning activities over the previous 10 years.

2.3 Natural capital risk/opportunity register and risk/opportunity statement

What?

- A natural capital risk register tracks how the reporting entity identifies, assesses, and manages natural capital risks. It includes a natural capital risk materiality assessment and information on the reporting entity's risk mitigation and adaptation activities for each natural capital impact and dependency risk.
- A similar approach can be used to create a natural capital opportunity register (see sidebar).
- A natural capital risk/opportunity statement provides a summary of information from the natural capital risk/opportunity register for the current period, compared with the previous reporting period.

Why?

- A natural capital risk/opportunity register allows a reporting entity to monitor risks and/or opportunities for internal management purposes. It shows actions aligned with mitigating risks and/or exploiting opportunities.
- The risk/opportunity register should enable reporting entities to identify and prioritise which natural capital impacts and dependencies could lead to potentially material risks and/or opportunities for the reporting entity.
- The risk/opportunity statement allows a reporting entity to disclose information externally on their natural capital risks and/or opportunities, and show how their actions are mitigating these risks and/or maximising opportunities. It should be aligned with the reporting entity's corporate risk report, TCFD and TNFD report.

How?

Step 1: Define the reporting entity's objectives in relation to managing natural capital risks and/or opportunities. This may help to define the scope of the natural capital risk/opportunity register, including the organisational boundary (e.g. whether to include all business units or subsidiaries, or operations in a given geography), the value-chain boundary (e.g. whether to limit to direct operations, or include upstream and/or downstream interactions), the temporal boundary (e.g. next 1-2 years, 5 years or 30 years), the value perspective (e.g. enterprise value, societal value, or both), and whether to focus on natural capital impact risks, dependency risks, or both. See (Ascui and Cojoianu, 2019) steps 2.1 to 2.3.4.

CONCEPTS

Natural capital (or nature-related) risks

Natural capital risks are risks arising from a reporting entity's impacts and/or dependencies on natural capital. The TNFD calls these **'nature-related risks'**, defined as: "potential threats posed to an organisation linked to their and wider society's dependencies on nature and nature impacts. These can derive from physical, transition and systemic risks." (TNFD, 2023).

Natural capital (or nature-related) opportunities

Natural capital opportunities are opportunities that arise due to the existence of natural capital risks. The TNFD calls these **'nature-related opportunities'**, defined as: "activities that create positive outcomes for organisations and nature by creating positive impact on nature or mitigating negative impacts on nature" (TNFD, 2023).

Nature-related opportunities can occur:

- When organisations avoid, reduce, mitigate or manage nature-related risks, for example, connected to the loss of nature and ecosystem services that the organisation and society depend on;
- Through the strategic transformation of business models, products, services, markets and investments that actively work to reverse the loss of nature, including by restoration, regeneration of nature and implementation of nature-based solutions (TNFD, 2023).

Materiality

The concept of materiality has been adopted from the field of accounting (Whitehead, 2017, Edgley et al., 2015). Broadly, something is 'material' if it has reasonable potential to significantly alter the decisions being taken by a user of the information being reported.

There are different interpretations of what this means in the context of natural capital risk- or opportunity-related information. At a minimum, in order for natural capital risk/opportunity disclosures to be consistent with the expectations of users of traditional corporate financial reports, entities should report on any natural capital risks or opportunities that have reasonable potential to affect enterprise

Step 2: List the reporting entity's natural capital impacts and dependencies that could potentially give rise to material risks or opportunities. The reporting entity's significant impacts and dependencies should already appear in the entity's impact and dependency registers (see sections on impacts and dependencies above).

Natural capital opportunities can arise from the reduction, mitigation or management of natural capital risks, or from strategic transformation to adjust to changes in nature or to society's responses to changes in nature. The first of these categories of opportunities therefore flows from the identification of natural capital risks. The second category is more aligned with existing approaches to corporate strategy and is not dealt with further in this handbook (but see TNFD, 2023).

Step 3: Conduct a natural capital risk materiality assessment. Identify criteria for materiality, consistent with the objectives established in Step 1, and evaluate the potentially material natural capital risks from Step 2 against these criteria. Guidance is provided under the "Assess" step A4 in the TNFD's LEAP (Locate – Evaluate – Assess – Prepare) approach (TNFD, 2023). An optional simplified approach is proposed below, based on the principle that, if materiality is viewed from an enterprise value perspective (see sidebar), natural capital risks can arise either from threats to the future availability of significant dependencies on natural capital, or consequences from significant impacts on natural capital. Therefore, there are two key components of natural capital risk:

- For impact risks, the **degree of impact** on nature caused by the reporting entity (which can also be thought of as including the scale and severity of impact on nature), and the **severity of consequences** for the reporting entity (which can also be thought of as reflecting the value of the impact on nature to society, insofar as society responds to the impact by imposing consequences on the reporting entity, such as fines, regulation, loss of market access, etc.).
- For dependency risks, the **degree of dependency** of the reporting entity on nature (which can also be thought of as the entity's vulnerability to unavailability of the dependency), and the **severity of threats** to the future availability of the dependency (which can also be thought of as a combination of the magnitude and likelihood of threats to the natural capital that provides the dependency).

Step 3a: For each potentially material risk from Step 2, evaluate the 'degree of impact' and 'severity of consequences' (for impact risks) and 'degree of dependency' and 'severity of threat' (for dependency risks). This evaluation may be qualitative, quantitative, or a mix of both. For example, each component may be ranked 'low', 'moderate' or 'high'.

value. Optionally, entities may also report on natural capital risks or opportunities that have reasonable potential to affect nature or society without affecting enterprise value (this is sometimes termed 'double materiality'). The approach taken to materiality should be disclosed (TNFD, 2023).

Risk/opportunity materiality assessment

The TNFD provides guidance for risk/opportunity materiality assessment under step A4 in its LEAP (Locate – Evaluate – Assess – Prepare) approach (TNFD, 2023). Essentially, this involves assessing the following components:

- **Magnitude** of risks or opportunities: a qualitative or quantitative assessment of financial impact;
- **Likelihood** of the risk or opportunity;
- **Vulnerability** of the reporting entity, which "refers to the susceptibility of an organisation to a risk/opportunity event in terms of its preparedness, agility and adaptability. The organisation's ability or inability to adapt/mitigate/control the risk, or ability to harness the opportunity, is dependent on risk and opportunity awareness, management along the value chain, operational and managerial resilience, value chain and/or product diversification, or market or sector influence" (TNFD, 2023);
- **Speed of onset**, which "refers to the time that elapses between the occurrence of an event and the point at which the organisation first feels its effects [e.g. short-term, medium-term or long-term] (TNFD, 2023);
- **Scale (temporal and spatial)** and **severity of impact** on nature; and
- The **value of the impact on nature to society**.

At the time of writing, these last two criteria were not well developed.

Step 3b: Combine the degree of impact with severity of consequences to calculate overall materiality for each impact risk, and the degree of dependency with severity of threat to calculate overall materiality for each dependency risk. An example is provided below.

		Severity of consequences/threats		
		Low	Moderate	High
Degree of impact/ dependency	High	Moderate	High	V. High
	Moderate	Low	Moderate	High
	Low	V. Low	Low	Moderate

Step 4: Prioritise the identified material natural capital risks from Step 3, e.g. by listing from highest to lowest materiality.

Step 5: Document the reporting entity's mitigation and adaptation activities for each prioritised risk from Step 4. For example, list the actions being taken and to be taken, by when and by whom, current status, and the expected adequacy of the actions in reducing risk. It may be helpful to identify whether actions are expected to reduce the degree of impact or dependency, or the severity of threats or consequences.

Step 6: Calculate an overall residual risk score for each natural capital impact and dependency risk by adjusting for the adequacy of the reporting entity's mitigation and adaptation activities.

Step 7: (optional): Document natural capital opportunities, e.g. through mitigating risks or through strategic transformations.

Step 8: Document the outcomes of each step in the natural capital risk register. Regularly review and respond to changes over time.

Example:

- The examples below show one way to combine qualitative and quantitative materiality assessment information in a natural capital risk/opportunity register and associated natural capital risk/opportunity statement.
- The examples record a definition of the risk, its type, location and timeframe, and a qualitative assessment of the degree of impact, severity of consequences and overall risk materiality score. Each example also shows a brief summary of the reporting entity's risk mitigation and adaptation activities and their adequacy in reducing risk, leading to a "residual risk materiality score", and a summary of opportunities arising from each identified risk.

Degree of impact

For negative impacts, the degree of impact can be assessed by considering to what extent the relevant stock of natural capital or flow of ecosystem services could continue to function after a plausible impact. A high degree of impact would indicate the natural capital or ecosystem service is likely to be significantly damaged and unable to repair itself without costly intervention. For positive impacts, a high degree of impact would indicate a significant improvement to natural capital. See (Smith et al., 2021b, Smith et al., 2021a).

Severity of consequences

Severity of consequences can be assessed by considering how significantly a reporting entity could be affected (now or in the future) by any plausible societal or ecosystem response to the reporting entity's natural capital impact. A high severity of consequences would indicate the response to natural capital impacts could have significant financial consequences for the reporting entity.

Degree of dependency

The degree of dependency can be assessed by considering to what extent the reporting entity could continue to function without the relevant natural capital or ecosystem services. A high degree of dependency would indicate that production would be significantly impaired, and substitutes either do not exist or are only available at significantly higher prices. See (Smith et al., 2021b, Smith et al., 2021a).

Severity of threats

Severity of threats can be assessed by considering how significantly a reporting entity could be affected (now or in the future) by plausible changes in the availability of abiotic flows, ecosystem services or environmental conditions that the reporting entity depends on. A high severity of threats would indicate that current or future threats to natural capital could significantly reduce the availability of the relevant dependency for the reporting entity.

Other examples

External disclosure frameworks that focus on risk include the recommendations of the TCFD and TNFD.

An example of a natural capital risk statement is given in (Ascui and Cojoianu, 2019), Table 4.

EXAMPLE NATURAL CAPITAL RISK/OPPORTUNITY REGISTER (IMPACT RISKS AND OPPORTUNITIES)

	Topic	Impact risk	Type of risk	Location	Timeframe	Degree of impact	Severity of consequences
Water	**Water use**	The risk of consequences for the reporting entity arising from water abstraction from water-stressed catchments	Transition risk – reputational	Catchment X	Short term	High	Low
	Water quality[a]	The risk of consequences for the reporting entity arising from forestry activities negatively affecting the quality of surface or sub-surface water	Transition risk – policy and legal	Region X	Short term	Moderate	Moderate
Biodiversity and ecosystems	**Weeds**[b]	The risk of consequences for the reporting entity arising from forestry activities spreading weeds	Transition risk – market and reputational	Region X	Short term	Moderate	Moderate
Air	**Greenhouse gas emissions**	The risk of consequences for the reporting entity arising from greenhouse gas emissions directly or indirectly caused by the reporting entity	Transition risk – reputational	Regions X, Y and Z	Medium term	High	Low

Overall risk materiality	Mitigation and adaptation activities	Residual degree of impact	Residual severity of consequences	Residual risk materiality	Opportunities
Moderate	Continue implementing water efficiency measures and shift water use away from catchment X.	Moderate	Low	Low	Improved reputation and community relations
Moderate ($50/ha/year)	Maintain and expand riparian buffers. Implement a waterway monitoring scheme before and after forestry, road-building and mining operations	Low	Moderate	Low	Reduced regulatory compliance costs
Moderate ($80/ha/year)	Monitor adjacent land to pine plantations for wildlings and implement weed control.	Low	Moderate	Low	Improved reputation and community relations, access to markets via sustainability certification
Moderate	Continue implementing energy efficiency improvements.	Moderate	Low	Low	Increased revenue from carbon credits created by implementing improved forest management practices that increase carbon sequestration and storage

EXAMPLE NATURAL CAPITAL RISK/OPPORTUNITY STATEMENT (IMPACT RISKS AND OPPORTUNITIES)

	Topic	Impact risk	Type of risk	Location	Timeframe
Water	**Water use**[a]	The risk of consequences for the reporting entity arising from water abstraction from water-stressed catchments	Transition risk – reputational	Catchment X	Short term
	Water quality[b]	The risk of consequences for the reporting entity arising from forestry activities negatively affecting the quality of surface or sub-surface water	Transition risk – policy and legal	Region X	Short term
Biodiversity and ecosystems	**Weeds**[c]	The risk of consequences for the reporting entity arising from forestry activities spreading weeds	Transition risk – market and reputational	Region X	Short term
Air	**Greenhouse gas emissions**[d]	The risk of consequences for the reporting entity arising from greenhouse gas emissions directly or indirectly caused by the reporting entity	Transition risk – reputational	Regions X, Y and Z	Medium term

[a] Water use impact risk is assessed as moderate materiality due to a qualitative assessment of high degree of impact (due to abstracting significant quantities of water from a water-stressed catchment – see impact statement) and low severity of consequences (there are no legal or regulatory constraints on the entity's right to abstract water from catchment X, but it is not consistent with the entity's reputation as a sustainable producer, and has led to community concerns which could constrain future development opportunities). The reporting entity is implementing a range of water efficiency and demand shifting measures that are expected to reduce the degree of impact to moderate in the short term, hence reducing the residual materiality of this risk to a low level and leading to opportunities for improved reputation and community relations in future.

[b] Water quality impact risk is assessed as moderate materiality due to a qualitative assessment of moderate degree of impact (see impact statement) and moderate severity of consequences (due to regulatory fines for water quality exceedances). A quantitative indicator of financial costs of on average $50 per hectare per year is also shown, representing average reporting entity costs from fines. The reporting entity intends to implement further mitigation actions to reduce the degree of impact to low, hence reducing the residual materiality of this risk to a low level and leading to opportunities for reduced regulatory compliance costs in future.

[c] Weeds impact risk is assessed as moderate materiality due to a qualitative assessment of moderate degree of impact (see impact statement) and moderate severity of consequences (due to community concerns which could constrain future development opportunities, and the potential to lose the entity's sustainability certification which enables access to certain markets). A quantitative indicator of financial costs of on average $80 per hectare per year is also shown, representing average reporting entity costs from weed monitoring and control measures. The reporting entity intends to implement further mitigation actions to reduce the degree of impact to low, hence reducing the residual materiality of this risk to a low level and leading to opportunities for improved community relations and ongoing access to markets in future.

[d] Greenhouse gas emissions impact risk is assessed as moderate materiality due to a qualitative assessment of high degree of impact (see impact statement) and low severity of consequences (due to there being no current regulation of greenhouse gas emissions in the agriculture and forestry sectors, and low reputational consequences due to the entity having been able to claim that it has achieved net zero emissions in 2020 and 2021). The reporting entity intends to implement further mitigation actions to reduce the degree of impact to moderate, hence reducing the residual materiality of this risk to a low level and leading to opportunities for additional revenue from creation of carbon credits in future.

Overall risk materiality	Mitigation and adaptation activities	Residual risk materiality	Opportunities
Moderate	Continue implementing water efficiency measures and shift water use away from catchment X.	Low	Improved reputation and community relations
Moderate ($50/ha/year)	Maintain and expand riparian buffers. Implement a waterway monitoring scheme before and after forestry, road-building and mining operations	Low	Reduced regulatory compliance costs
Moderate ($80/ha/year)	Monitor adjacent land to pine plantations for wildlings and implement weed control.	Low	Improved reputation and community relations, access to markets via sustainability certification
Moderate	Continue implementing energy efficiency improvements.	Low	Increased revenue from carbon credits created by implementing improved forest management practices that increase carbon sequestration and storage

EXAMPLE NATURAL CAPITAL RISK/OPPORTUNITY REGISTER (DEPENDENCY RISKS AND OPPORTUNITIES)

	Topic	Dependency risk	Type of risk	Location	Timeframe	Degree of dependency	Severity of threat
Water	**Water availability**	The risk of lower productivity and/or increased costs due to inadequate water to meet target biomass	Physical risk – chronic	Region X	Medium to long term	High	High
Land and soil	**Soil organic carbon**	The risk of lower productivity and/or increased costs due to insufficient soil organic carbon (SOC) to maintain target pasture productivity	Physical risk – chronic	Region Y (native pastures)	Medium to long term	Moderate	Moderate
Biodiversity and ecosystems	**Pollination services**	The risk of lower productivity and/ or increased costs due to insufficient pollination services to maintain plants and seeds production	Physical risk - acute	Region Z (native forest)	Short term	High	Moderate
Weather and climate	**Bushfires**	The risk of lower productivity and/ or increased costs due to exposure to destructive bushfire	Physical risk – acute	Regions X and Y (plantation and native forest)	Short to long term	High	High

Overall risk materiality	Mitigation and adaptation activities	Residual degree of dependency	Residual severity of threat	Residual risk materiality	Opportunities
Very High ($600/ha/year)	Develop drought resistant phenotypes. Change species planted.	Low	High	Moderate	Shift market positioning to slower-growing, higher-quality timber species.
Moderate	Reduce stocking rate to increase biomass input to SOC.	Moderate	Low	Low	Potential to create carbon credits from increased soil carbon sequestration.
High	Continue rebuilding beehive capacity.	High	Low	Moderate	Improved reputation and community relations.
Very High ($170/ha/year)	Create firebreaks and buffers. Increase prescribed burning activities to reduce fuel load.	High	Moderate	High	Potential to increase soil carbon sequestration through low-temperature prescribed burns.

EXAMPLE NATURAL CAPITAL RISK/OPPORTUNITY STATEMENT (DEPENDENCY RISKS AND OPPORTUNITIES)

	Topic	Dependency risk	Type of risk	Location	Timeframe
Water	**Water availability**[a]	The risk of lower productivity and/or increased costs due to inadequate water to meet target biomass	Physical risk – chronic	Region X	Medium to long term
Land and soil	**Soil organic carbon**[b]	The risk of lower productivity and/or increased costs due to insufficient soil organic carbon (SOC) to maintain target pasture productivity	Physical risk – chronic	Region Y (native pastures)	Medium to long term
Biodiversity and ecosystems	**Pollination services**[c]	The risk of lower productivity and/or increased costs due to insufficient pollination services to maintain plants and seeds production	Physical risk - acute	Region Z (native forest)	Short term
Weather and climate	**Bushfires**[d]	The risk of lower productivity and/or increased costs due to exposure to destructive bushfire	Physical risk – acute	Regions X and Y (plantation and native forest)	Short to long term

[a] Water availability dependency risk is assessed as very high materiality due to a qualitative assessment of high degree of dependency (due to inability to meet biomass growth targets with insufficient rainfall) and high severity of threats (a projected drying trend due to climate change). The reporting entity is developing drought resistant phenotypes, changing species planted and decreasing tree planting density as the estate is harvested and re-planted, which is expected to reduce the degree of dependency to low in the medium to long term, hence reducing the residual materiality of this risk to a moderate level and leading to opportunities for a change in market positioning to slower-growing, higher-quality timber production in future.

[b] Soil organic carbon (SOC) risk is assessed as moderate materiality due to a qualitative assessment of moderate degree of dependency (as just one of several soil quality parameters that influence productivity) and moderate severity of threats (see dependency statement for recent trends). The reporting entity intends to reduce the severity of threat to low by reducing stocking rates, hence reducing the residual materiality of this risk to a low level and leading to opportunities for additional revenue from creation of carbon credits in future.

[c] Pollination services dependency risk is assessed as high materiality due to a qualitative assessment of high degree of dependency (due to inability to produce seeds and plants without pollination services) and moderate severity of threats (see dependency statement for recent trends). The reporting entity intends to implement further mitigation actions in collaboration with the local beekeeping community to reduce the severity of threat to low, hence reducing the residual materiality of this risk to a moderate level and leading to opportunities for improved reputation and community relations in future.

[d] Bushfires dependency risk is assessed as very high materiality due to a qualitative assessment of high degree of dependency (as forests can be severely damaged or destroyed by bushfires) and high severity of threat (a projected increase in fire weather due to climate change). The reporting entity intends to implement further mitigation actions to reduce the severity of threat to moderate, hence reducing the residual materiality of this risk to a high level and leading to opportunities to increase soil carbon sequestration (through the generation of long-lived pyrogenic carbon from low-intensity prescribed burns) in future.

Overall risk materiality	Mitigation and adaptation activities	Residual risk materiality	Opportunities
Very High ($600/ha/year)	Develop drought resistant phenotypes. Change species planted. Decrease tree planting density.	Moderate	Shift market positioning to slower-growing, higher-quality timber species.
Moderate	Reduce stocking rate to increase biomass input to SOC.	Low	Potential to create carbon credits from increased soil carbon sequestration.
High	Continue rebuilding beehive capacity.	Moderate	Improved reputation and community relations.
Very High ($170/ha/year)	Create firebreaks and buffers. Increase prescribed burning activities to reduce fuel load.	High	Potential to increase soil carbon sequestration through low-temperature prescribed burns.

Appendix

Key concepts: Natural capital risks

NATURAL CAPITAL RISKS		
Nature-related risks	**Example nature-related dependency risks**	**Example nature-related impact risks**
Operational	Decreased resource availability. Increased susceptibility of operations and/or value chain to physical risks e.g. extreme weather events. Decreased provision of nature-related services that the reporting entity relies on – e.g. changing precipitation patterns leading to inadequate water supply. Increased nature-related disservices - e.g. pests and diseases. Reduced revenue and higher costs from negative impacts on workforce – e.g. health and safety restrictions on working in extreme weather. Increased insurance premiums.	Decreased revenue and higher costs due to changes in the availability or ability of nature to mitigate impacts such as emissions and pollution.
Regulatory and legal	Reduced revenue and higher costs from future regulatory changes that restrict resource use or nature-related services that a reporting entity relies on.	Reduced revenue and higher costs from future regulatory changes that restrict nature-related impacts or create additional obligations to maintain or enhance natural capital. Increased costs from exposure to future fossil fuel price increases. Increased costs from exposure to any current or future carbon price.
Reputational	Decreased demand for products and services due to increased stakeholder concern about nature-related dependencies. Reduced revenue and higher costs from stigmatisation of the industry or sector and negative impacts on workforce – e.g. attracting and retaining employees.	Decreased trust and acceptance of operations as consumers become more aware of nature-related impacts – loss of social licence to operate.
Market and product	Decreased revenue due to changing consumer preferences related to natural capital dependencies. Decreased market valuation reflecting the susceptibility or lack of resilience to physical risks.	Reduced demand for products and services due to changing consumer preferences related to natural capital impacts – such as lower emissions / lower pollution. Decreased market access - e.g. customers only willing to buy green certified products.
Financing	Decreased finance availability due to nature-related dependency risks such as extreme weather events.	Decreased finance availability and the inability to access new kinds of finance (green bonds, sustainability-linked loans) due to impacts on nature.

Key concepts: Natural capital opportunities

NATURAL CAPITAL RISKS		
Nature-related opportunities	**Example nature-related dependency opportunities**	**Example nature-related impact opportunities**
Operational	Increased resource use efficiency. Increased resilience of operations and/ or value chain to physical risks. Better management of natural capital to maintain or enhance the services it provides.	Reduced exposure to future fossil fuel price increases. Reduced exposure to any current or future carbon price.
Regulatory and legal	Better positioning of the reporting entity for any future regulatory changes related to resource supply or services from nature.	Better positioning of the reporting entity for any future regulatory changes related to natural capital impacts, such as greenhouse gas emissions, pollution or obligations to maintain or enhance natural capital owned. Increased influence on relevant policy decisions.
Reputational	Increased reputation with stakeholders from the ability of the reporting entity to communicate any dependencies on nature and how it is managing any risk related to those dependencies.	Increased trust and acceptance of operations – maintained social licence to operate. Increased reputation or market access from demonstration of sustainable operations and nature enhancements.
Market and product	Better positioning of the reporting entity to reflect changing services provided by nature or future threats.	Better positioning of the reporting entity to reflect changing consumer preferences related to natural capital impacts. Increased revenue from demand for lower emission / lower polluting products and services. Increased market access - e.g. green certified products.
Financing	Increased market valuation reflecting improved resilience to physical risks. Increased finance availability or access to new kinds of finance (e.g. green bonds, sustainability-linked loans) resulting from the ability of the reporting entity to communicate its improved resilience to nature-related risks.	Increased finance availability or access to new kinds of finance (green bonds, sustainability-linked loans) from the ability of the reporting entity to communicate its mitigation of impacts on nature – or to show nature enhancements. Access to new environmental markets – e.g. payment for ecosystem services schemes, carbon or biodiversity credits – for owners of natural capital assets.

Glossary

Abiotic flows are "contributions to benefits from the environment that are not underpinned by or reliant on ecological characteristics and processes" (SEEA-EA 2021, para. 6.35).

An **asset** is "a store of value representing a benefit or series of benefits accruing to an economic owner by holding or using the entity over a period of time. It is a means of carrying forward value from one accounting period to another" (SEEA-CF 2014, para. 5.32).

Benefits are "the goods and services that are ultimately used and enjoyed by people and society" (SEEA-EA 2021, para. 2.15).

Catastrophic losses refer to decreases due to large scale, discrete and recognisable events that cause a significant decline in the condition of an ecosystem asset, i.e., significant losses in structure, function or composition, and hence affect the future flows of ecosystem services in physical terms (SEEA-EA 2021, para. 10.37).

Cultural services are "the experiential and intangible services related to the perceived or actual qualities of ecosystems whose existence and functioning contributes to a range of cultural benefits" (SEEA-EA 2021, para. 6.51).

Dependency metric: something that provides a simple and reliable means to measure dependencies.

Drivers are natural or anthropogenic factors that cause changes in natural capital and its ability to supply ecosystem services.

Ecosystem assets are "contiguous spaces of a specific ecosystem type characterised by a distinct set of biotic and abiotic components and their interactions" (SEEA-EA 2021, para. 2.11). Accounting for ecosystem assets is covered in the SEEA-EA.

Ecosystem condition is "the quality of an ecosystem measured in terms of its abiotic and biotic characteristics. Condition is assessed with respect to an ecosystem's composition, structure and function which, in turn, underpin the ecological integrity of the ecosystem, and support its capacity to supply ecosystem services on an ongoing basis. Measures of ecosystem condition may reflect multiple values and may be undertaken across a range of temporal and spatial scales" (SEEA-EA 2021, para. 5.2).

Ecosystem condition variables are "quantitative metrics describing individual characteristics of an ecosystem asset. A single characteristic can have several associated variables, which may be complementary or overlapping" (SEEA-EA 2021, para. 5.41).

Ecosystem condition indicators are "rescaled versions of ecosystem condition variables. They are derived when condition variables are set against reference levels determined with respect to ecological integrity" (SEEA-EA 2021, para. 5.60).

Ecosystem condition indices and sub-indices are "composite indicators that are aggregated from the combination of individual ecosystem condition indicators recorded in the ecosystem condition indicator account" (SEEA-EA 2021, para. 5.81).

Ecosystem conversions refer to situations in which, for a given location, there is a change in ecosystem type involving a distinct and persistent change in the ecological structure, composition and function which, in turn, is reflected in the supply of a different set of ecosystem services and different expected future returns (SEEA-EA 2021, para. 10.30).

Ecosystem disservices "arise in contexts in which the outcomes of interactions between economic units and ecosystem assets are negative from the perspective of the economic units" (SEEA-EA 2021, para. 6.75).

Ecosystem enhancement (degradation) is the increase (decrease) in the value of an ecosystem asset over an accounting period that is associated with an improvement (a decline) in the condition of the ecosystem asset during that accounting period (SEEA-EA 2021, paras.10.15 and 10.21).

Ecosystem extent is "the size of an ecosystem asset in terms of spatial area" (SEEA-EA 2021, para. 2.13)

Ecosystem services are "the contributions of ecosystems to the benefits that are used in economic and other human activity" (SEEA-EA 2021, para. 2.14).

Environmental assets are individual non-ecosystem assets such as mineral deposits, land, water, timber and energy resources. Accounting for environmental assets is covered in the SEEA-CF.

Exchange values "are the values at which goods, services, labour or assets are in fact exchanged or else could be exchanged for cash" (SEEA-EA 2021, para. 8.13).

Final ecosystem services are "those ecosystem services in which the user of the service is an economic unit – i.e., business, government, or household" (SEEA-EA 2021, para. 6.24).

Impact metric: something that provides a simple and reliable means to measure impacts.

Intermediate ecosystem services are "those ecosystem services in which the user of the ecosystem services is an ecosystem asset and where there is a connection to the supply of final ecosystem services" (SEEA-EA 2021, para. 6.26).

Market value is the amount for which something can be bought or sold in a given market (NCP 2016, p. 124).

An impact or dependency on natural capital is **material** if consideration of its value has the potential to significantly alter the decisions being taken by a user of the information (Natural Capital Coalition 2016, p. 43).

Natural capital is the stock of renewable and non-renewable natural resources (e.g., plants, animals, air, water, soils, minerals) that combine to yield a flow of benefits to people (Natural Capital Coalition, 2016 p. 2)

Natural capital accounting is "the process of compiling consistent, comparable and regularly produced data using an accounting approach on natural capital and the flow of services generated in physical and monetary terms" (Lammerant, 2019, p. 7).

A **natural capital dependency** is a "business reliance on or use of natural capital" (Natural Capital Coalition 2016 pp.16-17).

A **natural capital impact** is a "negative or positive effect of business activity on natural capital" (Natural Capital Coalition 2016 pp.16-17).

Natural capital impact and dependency assessment is "the process of identifying, measuring and valuing relevant ("material") natural capital impacts and/ or dependencies, using appropriate methods" (Lammerant, 2019, p. 7).

Natural capital reporting or disclosure involves the communication of natural-capital-related information to external stakeholders, such as shareholders, regulators, and civil society.

Natural capital risk assessment is the process of identifying, measuring and evaluating relevant ("material") risks arising from an entity's impacts and/or dependencies on natural capital (Ascui and Cojoianu, 2019).

Non-market value is the value of goods and services that are not traded for money but are valued based on what people would be willing to pay for them, if markets existed.

Obligation costs are the cost of restoring, maintaining or enhancing the quantity and quality of natural capital assets as per the organization's responsibility (legal or voluntary). (BS-8632:2021).

Production costs in the BSI (BSI, 2021) are the costs that are necessary to incur to realize the flow of benefits at a point in time. (BS 8632:2021, section 6.7.1.5). Here, we extend this definition of production costs to also include the subset of 'maintenance costs' of natural capital where the reporting entity has no legal or voluntary obligation to incur those costs.

Provisioning services are "those ecosystem services representing the contributions to benefits that are extracted or harvested from ecosystems" (SEEA-EA 2021, para. 6.51).

Reappraisals should be recorded when updated information emerges that permits a reassessment of the expected condition of the ecosystem assets or the future demand for ecosystem services, such that the expected pattern of future returns at the end of the accounting period is different from the pattern that had been expected at the start of the accounting period (SEEA-EA 2021, para. 10.38).

Regulating services are "those ecosystem services resulting from the ability of ecosystems to regulate biological processes and to influence climate, hydrological and biochemical cycles, and thereby maintain environmental conditions beneficial to individuals and society" (SEEA-EA 2021, para. 6.51).

Revaluations are "changes in the value of ecosystem assets over an accounting period that are due solely to movements in the unit prices of ecosystem services which underpin the derivation of the net present value of ecosystem assets" (SEEA-EA 2021, para. 10.41).

Thresholds are a point or level at which new properties emerge in an ecological, economic or other system, whereby a small change in a pressure or driver can lead to a relatively large change in the state of natural capital, with consequences for the benefits it provides (Natural Capital Committee, 2019).

Value to society / External value / Public Value is the costs and benefits to wider society (NCP 2016, p. 124).

Value to the reporting entity / Internal Value / Private value is the costs and benefits to the reporting entity (NCP 2016, p. 124).

Welfare values reflect the contribution of an asset or service to human welfare, regardless of their contribution to the economy (Binner et al., 2017).

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