Virgin Islands Ecosystem Accounting

2020 Ecosystem Account

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Document evolution

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2020 Ecosystem Account

At 151 square kilometres (Government of the Virgin Islands, 2019a) with a population of 27,800 (Government of the Virgin Islands, 2019b), the island nation of the British Virgin Islands (BVI), or the Virgin Islands (VI), is largely dependent on its wealth of environmental assets, in fact the environment contributes at least **$93 million annual value** to the Virgin Islands in 2020. These environmental assets provide an abundance of benefit to the people of the Virgin Islands, including: the attraction of some of the world's most beautiful beaches for tourists ($13m/ year); coral reefs for coastal protection ($75m/ year); terrestrial and marine ecosystems sequestering carbon ($4m/ year); and other more difficult to measure values such as the biodiversity that makes life richer to both local inhabitants and visitors. The economic prosperity and wellbeing of the people of the Virgin Islands are fundamentally linked to effective management of the environment, and an understanding of the value that it provides.

Ecosystem Accounts provide economic evidence that supports the delivery of sustainable value from environmental assets[1]. Effective management of the environment must consider the extent and underlying condition of ecosystems over time, as well as the range of benefits they provide and the economic value of those benefits to different stakeholder groups. Specifically, the data in Ecosystem Accounts can help address several fundamental questions for policy and planning:

- What environmental assets are present and what state are they in? How does this change over time?
- What benefits does the environment provide? How are these received by beneficiaries?
- What is the economic value of these benefits? How is this value distributed across the population?

The environmental and socioeconomic data produced within Ecosystem Accounts provide a basis for answering these questions. Their importance is reflected in the development of the System of Environmental Economic Accounting – Ecosystem Accounts (SEEA-EA, by the United Nations (UN). Officially adopted by the UN as a Statistics standard in March 2021, the SEEA-EA supports the implementation of ecosystem accounting as a part of National Accounts by National Statistics Offices around the world (see **Box 1**).

Development of Ecosystem Accounts provide indicators that compliment national economic and social indicators (such as GDP and demographic trends), and this evidence can support policy development and decision making, such as:

- Effective decisions which impact on the environment and the benefits it provides;
- Action on climate change, including mitigation, adaptation and resilience to impact;
- Delivery of international initiatives, such as the UN Sustainable Development Goals (SDGs)[2]; and
- A green post-COVID economic recovery, and in particular a sustainable tourism sector.

[1] See: **Box 1**

[2] See: https://sdgs.un.org/goals

For Ecosystem Accounts to be a valuable addition to government and organisational policy and planning strategy, they should be embedded into the decision-making process, and updated on an annual basis both to provide current data and to monitor trends over time. A partnership of eftec, the UK Joint Nature Conservation Committee (JNCC), the Virgin Island's Ministry of Natural Resources, Labour and Immigration and Central Statistics Office with funding from the UK Government via the Darwin Initiative, have continued developing the ecosystem accounting process in the Virgin Islands. The aim is to embed the consistent production of national environmental statistics through ecosystem accounting within the Government of Virgin Islands.

Physical flow and monetary flow

A range of benefits have been assessed within the Ecosystem Account, with estimated annual physical flow and monetary values given a confidence rating, as described in **Table 1**. The confidence rating is based on the robustness of the evidence and assumptions used. The Ecosystem Service Flow and Asset Accounts are presented in **Table 2**. The supplementary information is presented in **Table 3.** Note that the evidence presented in the summary table should be interpreted as a partial valuation of the total contribution of the environment to the Virgin Islands. The Virgin Island's environment provides additional benefits, such as fisheries, agriculture and local recreation values, which cannot be accurately quantified or valued at this time due to data limitations. Future iterations of the accounts should seek to address these gaps to provide a fuller valuation (see Annex 1 of the Technical Report).

Table 1: Description of confidence

Confidence	Symbol	Description
Low	●	Evidence is partial and significant assumptions are made so that the data provides only order of magnitude estimates of value to inform decisions and spending choices.
Medium	●	Science-based assumptions and published data are used but there is some uncertainty in combining them, resulting in reasonable confidence in using the data to guide decisions and spending choices.
High	●	Evidence is peer reviewed or based on published guidance so there is good confidence in using the data to support specific decisions and spending choices.
No colour	●	Not assessed

Table 2: Ecosystem Service Flow and Asset Accounts (2020)

Produced at: February 2022	Ecosystem Service Flow Accounts						Ecosystem Asset Account (PV* US$m)
	Physical terms (unit/yr)			Monetary terms (US$m/yr)			
	Reporting	Confidence	Physical indicator	Reporting	Confidence	Valuation metric	
Carbon sequestration	40,403	●	Total carbon sequestered (tCO2e/yr)	4	●	Cost of achieving emission reductions	100
Coastal protection	2,234	●	Total number of buildings protected by coral reefs (buildings/yr)	75	●	Estimated damage costs to buildings if coral reefs were destroyed	1,285
Tourism	978,086	●	Total number of visits (visits/yr)	13	●	Tourist expenditure (value added to tourism industry attributed to ecosystems)	669
			Total value	**93**	●	**Mix of values**	**2,054**

* The present value (PV) is the sum over 25-years. It is the total monetary value of a stream of benefits profiled over time, accounting for greater worth being placed on nearer term values than those further in the future.

Table 3: Supplementary information

Produced at: February 2022	Physical terms (unit/yr)			Monetary terms (US$m/yr)			Present Value 25 yr (US$m)
	Reporting	Confidence	Physical indicator	Reporting	Confidence	Valuation metric	
Other exchange values							
Tourism	978,086	●	Total number of visits (visits/yr)	43	●	Remaining visitor expenditure attributed to ecosystems	2,080
Non-monetised benefits							
Coastal protection	148	●	Total length of roads at high risk of storm surge (km/yr)				
Flood hazard regulation	362	●	Total length of roads at high risk of inland flooding (km/yr)				
Beach erosion protection	71	●	Total number of buildings at risk from beach erosion (Buildings/yr)				
	10	●	Total length of roads at risk from beach erosion (km/yr)				

Ecosystem Extent and Condition account

Spatial analysis was conducted to assess the ecosystems present within the Virgin Islands. The quantity (i.e. extent) and quality (i.e. condition) of the present ecosystems are recorded in the Ecosystem Extent Account (**Table 4**) and Ecosystem Condition Account (**Table 5**), respectively. The accounts can be used to monitor changes in the environmental assets over time. The terrestrial and marine ecosystem of the Virgin Islands are mapped in **Figure 1.**

Table 4: Ecosystem Extent Account

IUCN Code	Ecosystem	Area (ha)
	Terrestrial	
Total		**19,187**
T1	Tropical-subtropical forests biome	3,755
T1.2	Tropical-subtropical dry forests and scrubs	5,787
T1.3	Tropical-subtropical montane rainforests	1,761
T7	Intensive land-use	43
T7.4	Urban and industrial ecosystems	2,133
MFT1.2	Intertidal forests and shrublands	384
MT1.3	Sandy shorelines	203
F2.7	Ephemeral salt lakes	989
n/a	Bare ground	250
n/a	Rock	490
n/a	Sediment	3,392
	Marine	
Total		**166,464**
M1.1	Seagrass meadows	7,010
M1.3	Photic coral reefs	9,215
M1.6	Subtidal rocky reefs	77,525
M1.7	Subtidal sand beds	72,662
M1.8	Subtidal mud plains	52

Source: JNCC (2018); TNC (2020)

Table 5: Ecosystem Condition Account

Category	Sub-category	Value
	Ecological communities and species	
Fisheries Priority areas (ha)		102
Protected fisheries area (ha)		5,020
Tropical Important Plant (TIP) areas (ha)		7,365
Number of leatherback nesting sites (#)		11
Christmas bird count (#)	Abundance – Tortola	696
	Abundance - Anegada	957
	Number of species – Tortola	39
	Number of species - Anegada	34
	Land	
National Park area	Total area (ha)	447
Number of Stony Coral Tissue Loss Disease (SCTLD) treatment areas		23

Source: National Parks Trust (2020a; 2020b; 2020c; 2020f), National Parks Trust (2021a; 2021b); MNRLI (2021)

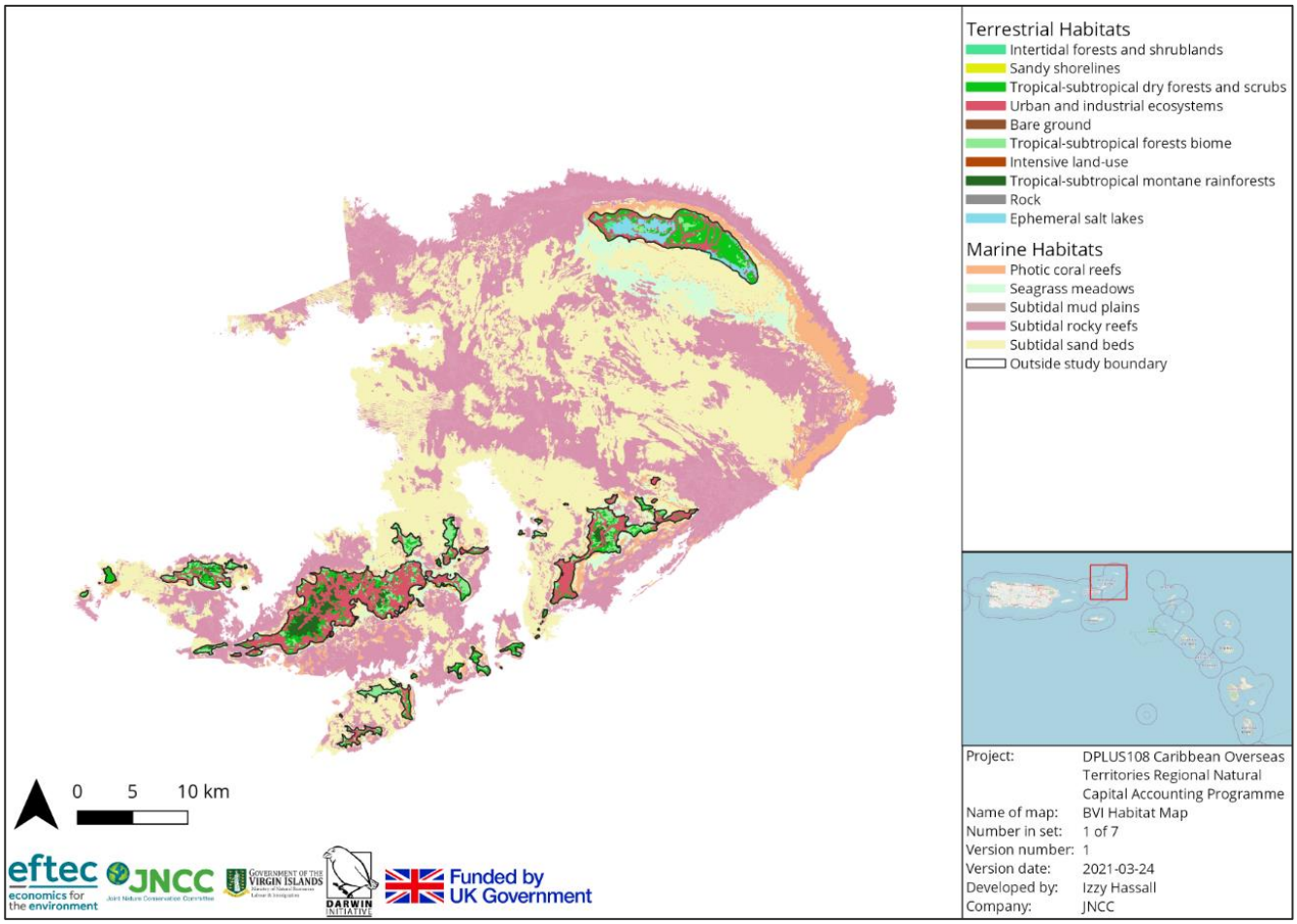

Figure 1: The Virgin Islands terrestrial and marine ecosystems
Source: JNCC (2018); TNC (2020)

Links to the Virgin Islands policy initiatives

The ultimate purpose of Ecosystem Accounts is to facilitate improved management of the economy and environment. The structure of Ecosystem Accounts provides a consistent means to present this evidence, but it can also be adapted to specific uses, producing indicators and other information fit for purpose. Appendix B to the Technical Report sets out the link between the Ecosystem Accounts and the output and outcome indicators in the Ministry of Natural Resources & Labours' Key Programme Strategies (KPS). Some of the KPS indicators can be directly linked to the Ecosystem Accounts (e.g. KPS 7 (area of functioning salt ponds) and the Ecosystem Extent and Condition Accounts). The KPS and the respective links to the Ecosystem Account is ongoing work and are expected to be updated as the Ecosystem Accounts are updated.

Box 1: Ecosystem Accounts

The ecosystem accounting approach helps frame the interconnection between humans and the environment in economic terms. The environment can be viewed as an asset, or natural capital, that provides a revenue of ecosystem goods and services, which benefit people. This includes provisioning services, such as agricultural produce or fisheries, regulating services, such as protection from natural hazards and carbon sequestration, and cultural services, such as tourism and local recreation. These benefits can be measured and valued in a consistent and structured manner, and compiled into an accounting framework, called Ecosystem Accounts. Ecosystem Accounts produce environmental statistics which provide an evidence base on the benefits provided by the environment.

An Ecosystem Account is structured as a set of component accounts, each of which require data to be consistently collected and collated in a systematic way. The main components of an Ecosystem Account are:

- **Ecosystem Extent and Condition Account** – an inventory that holds details on the state of all the ecosystem assets that are present, including their extent and condition (quality and other relevant factors). For example, the spatial area of a reef system, and its health in terms of suitable indicators.
- **Ecosystem Services Flow Account (physical terms)** – contains the flow of goods and services which are dependent on the ecosystem assets that are identified in the extent and condition accounts. This includes benefits related to provisioning, regulating and cultural goods and services provided by ecosystems.
- **Ecosystem Service Flow Account (monetary terms)** – calculates the annual value of the estimated flow of benefits that are captured in the Ecosystem Services Flow Account (physical terms).
- **Ecosystem Asset Account** - records the net present value approach to obtain values in monetary terms for ecosystem assets based on the monetary valuation of ecosystem services.

This set of accounts therefore monitor the presence and state of different habitats, the benefits these provide, and the value that humans receive from them. When updated year on year they provide a useful means to monitor and evaluate growth or decline in any of these contributing elements, while also helping to understand the relationship between the environment, the services it provides, and how humans use and value them.

The data collection and analysis for the Virgin Islands 2020 Ecosystem Account occurred in parallel to the development and publication of the SEEA-EA standard. As such while the Virgin Islands 2020 Ecosystem Account is generally aligned with the direction and intention of the SEEA-EA standard, full compatibility should be worked towards as the implementation of the SEEA standard continues to evolve globally over time.

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1.Introduction

eftec, with project partner Joint Nature Conservation Committee (JNCC) and funding from the UK Government, have initiated *natural capital accounting* with the environment and statistics departments of the local governments of five UK Overseas Territories (OTs)[3]. The purpose is to build initial *Ecosystem Accounts* and to provide a foundation for data collection and processing to produce national environmental statistics in support of better decision making.

As far as possible, the ecosystem accounting work is aligned to producing UN SEEA-EA compatible accounts. The UN adopted the SEEA-EA as an internationally recognised statistical standard in March 2021. This is an important step supporting the development and integration of Ecosystem Accounts into national accounts, and thereby forming a basis of environmental economic evidence for policy makers. The SEEA-EA standard is new, much work is yet to be done on practical implementation. It will take time before a comprehensive and broadly applicable guidance is developed and consistently put into practice. Therefore, the accounts can be expected to evolve over time, becoming more robust and complete through subsequent iterations. The current project establishes the groundwork from which this can occur.

Ecosystem Accounts are a structured way to measure and monitor the benefits provided by the natural environment. They can be produced alongside other national accounts as a basis for understanding human dependence and impact on the environment, and to inform policy and planning decisions. They should be updated annually to build up the available evidence base, to demonstrate change over time, and to improve on the methods applied.

This report gives an overview of the concepts, process and structure of Ecosystem Accounts, and current progress on their implementation. It provides additional context for the Ecosystem Account summarised above. The remaining sections are structured as follows:

- **Section 1:** Introduction
- **Section 2:** Background on natural capital and Ecosystem Accounts
- **Section 3:** Implementation of ecosystem accounting
- **Section 4:** Conclusion

[3] The OTs included in this project are: Anguilla, British Virgin Islands, Cayman Island, Montserrat and Turks and Caicos Islands.

2. Natural capital and Ecosystem Accounts

This section presents the background and concepts of natural capital and ecosystem services, also describing the process which produces Ecosystem Accounts and the structure of the accounts. As the SEEA-EA is recently published, the relationship with natural capital accounting is still evolving. As applied in this report, the SEEA-EA standard for ecosystem accounting can be thought of as a subset of the broader process of natural capital accounting. They generally apply the same concepts and methods. SEEA-EA does so in a more specific way to align with the System of National Accounts (which is the internationally agreed standard set of recommendations on how to compile measures of economic activity, such as GDP).

2.1 Concepts

Natural capital is defined by the UK Natural Capital Committee as: "the elements of nature that directly and indirectly produce value or benefits to people, including ecosystems, species, freshwater, land, minerals, the air and oceans, as well as natural processes and functions". Natural capital, or ecosystem assets, provide benefits to people, through ecosystem services. The focus of ecosystem accounting is to measure and value the benefits from ecosystem services and the underlying ecosystem assets, and to present this evidence in a structured format called Ecosystem Accounts.

In the Common International Classification of Ecosystem Services (CICES), ecosystem services are defined as 'the contributions that ecosystems make to human well-being'. They are seen as arising from the interaction of biotic and abiotic processes and refer specifically to the 'final' outputs or products from ecological systems, specifically the things directly consumed or used by people. Ecosystem services are therefore the flows of benefits which people gain from natural ecosystems, and natural capital is the stock of ecosystems from which these benefits flow (**Figure 2.1**). Ecosystem services can be subdivided into provisioning, regulating, cultural and supporting services (**Box 2.1**).

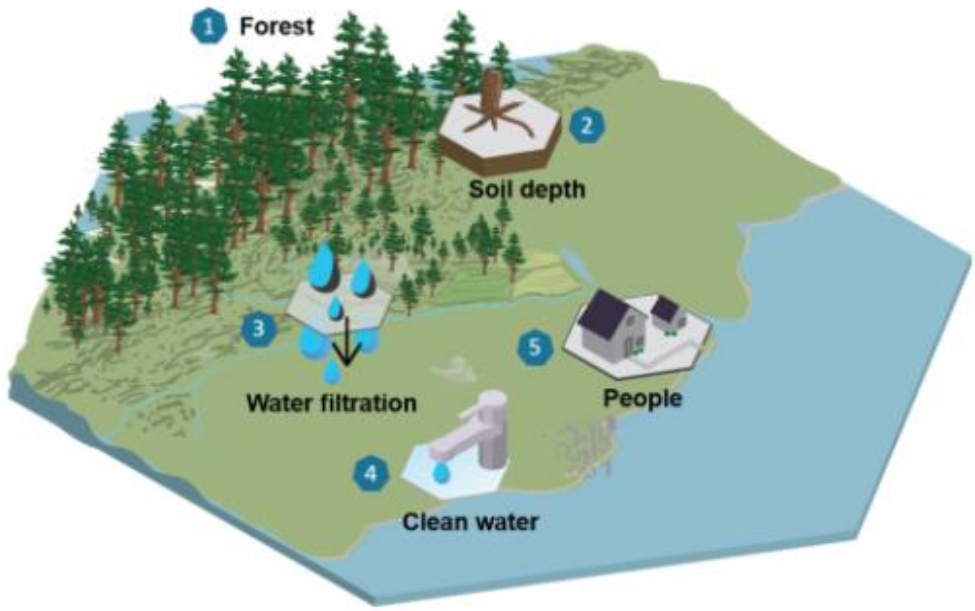

Figure 2.1: How ecosystem assets generate ecosystem services to beneficiaries in a spatial relationship
Source: UN (2021)

Viewing the environment through the lens of natural capital is an effective means to consider its value in the language of economics. Using the concept of capital and expressing the value of ecosystem services in monetary terms helps to integrate the natural environment into decision-making, in which it can otherwise be invisible.

Box 2.1: Types of ecosystem services

The most widely used definition of ecosystem services is from the Millennium Ecosystem Assessment: "the benefits people obtain from ecosystems". It further categorised ecosystem services into four types:

- **Provisioning services**: material outputs from nature (e.g., seafood, water, fibre, genetic material).
- **Regulating services:** indirect benefits from nature generated through regulation of ecosystem processes (e.g., mitigation of climate change through carbon sequestration, water filtration by wetlands, erosion control and protection from storm surges by vegetation, crop pollination by insects).
- **Cultural services:** non-material benefits from nature (e.g. spiritual, aesthetic, recreational, and others)
- Provisioning, regulating and cultural services are referred to as final ecosystem services and are underpinned by **Supporting services**. These are the fundamental ecological processes that support the delivery of other ecosystem services (e.g. nutrient cycling, primary production, soil formation).
- Analysis of benefits from natural capital also includes **abiotic services**, the benefits arising from fundamental geological processes (e.g. the supply of minerals, metals, oil and gas, geothermal heat, wind, tides, and the annual seasons).

2.2 The ecosystem accounting process

Ecosystem accounting is a process of compiling and linking data on the quantity and quality of ecosystem assets and physical and monetary data on the benefits they provide. The data are presented in a consistent framework, which should as far as possible align with the SEEA-EA standards for producing Ecosystem Accounts. These accounts present evidence to measure and monitor benefits from ecosystems consistently over time to inform policy and planning decisions. In the same way that the structured recording of other national statistics in conventional national accounts informs and improves a country's economic and social decisions, Ecosystem Accounts can inform better management of a country's ecosystem assets.

Ecosystem Accounts are structured as a set of interrelated component accounts that record the value that is provided by a country's ecosystem assets. The aim of these accounts is to answer the following key questions:

- What ecosystem assets do we have? -> An Ecosystem Extent and Condition Account (together sometimes referred to as an *asset register)* is an inventory that holds details of the stocks of ecosystem assets that are present within the geographical boundary of the country. For example, a coral reef may contain a variety of species and the quality of this diversity may be measured by the number of species recorded on the site for a few selected taxa (e.g. fish, coral). The asset

register helps track trends in the quantity and quality of ecosystems.

- What benefits do these assets provide? -> An Ecosystem Services Flow Accounts (physical terms) contains the flow of goods and services which are dependent on the ecosystems that are identified in the extent and condition accounts. This account provides information on the benefits provided by ecosystems, with the flows measured in different physical units (e.g. number of recreational visits or visitors, weight of produce).
- What is the value of these benefits? -> An Ecosystem Services Flow Accounts (monetary terms) calculates the annual value of the estimated flow of goods and services that are captured in the Ecosystem Services Flow Account (physical terms). The Monetary Ecosystem Asset Account measures the aggregate value of flows of goods and services into the future.

2.2.1 Data collection

Some relevant data will already exist, such as economic data for natural resources, the tourism sector, and utilities and infrastructure data. Additional data can be collected through social research including surveying, economic and econometric analysis, and monitoring of environmental outputs and levels of usage. Geo-referenced socio-economic data along with infrastructure maps can be compared with habitat maps to help identify and measure location specific use.

In practice, secondary data in a readily useable format may be limited, especially with regards to regulating services. Resource and time constraints can further limit primary data collection. This may require an innovative approach with what is available, clearly caveated with assumptions and further inferences to fill remaining gaps and making use of modelling where possible. In such cases, it is important to prioritise the most material benefits in the given context and to focus on where the most value is being provided.

2.3 Structure of Ecosystem Accounts

This section provides more detail on the component accounts which together make up the Ecosystem Account. Figure 2.2 presents the links between the components of Ecosystem Accounts.

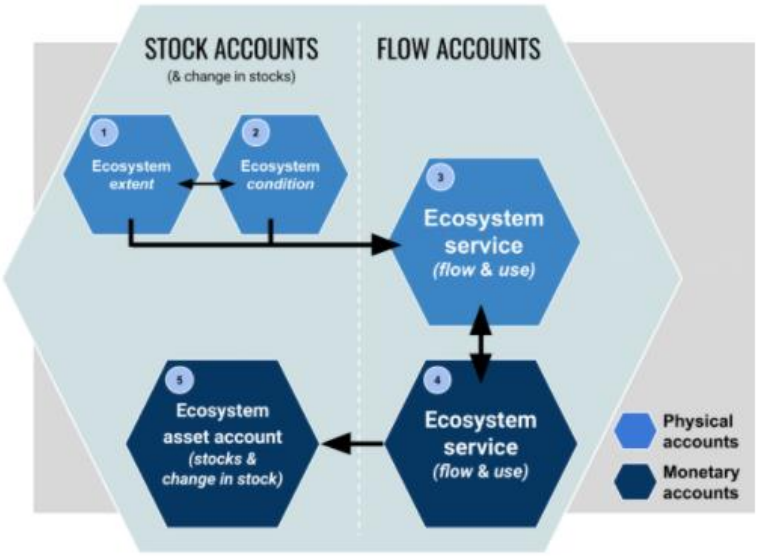

Figure 2.2: Ecosystem Accounts and how they relate to each other
Source: UN (2021)

2.3.1 Ecosystem Extent and Condition Accounts

The Ecosystem Extent and Condition Accounts (or asset register) record the quantity and quality of all of the ecosystem assets in a given area. The asset register therefore acts as an inventory that holds details of the stocks of ecosystem assets that are relevant to the accounts, along with information on their quality, functionality, and other relevant factors.

The foundation for an asset register is the distribution and condition of ecosystems which are present within the accounting area. Ecosystem extent can be determined and mapped by desk-based analysis, such as with data available from existing surveys and obtained through existing remote sensing techniques such as Earth Observation (EO) and processed using Geographic Information Systems (GIS). The combination of remote sensing and on-the-ground techniques provides a strong evidence base from which to build the spatial basis for an asset register.

2.3.1 Ecosystem Service Flow Accounts (physical terms)

The Ecosystem Service Flow Accounts (physical terms) records the flow of goods and services from ecosystems in the asset register. They provide a physical measure of the quantity of benefits provided on an annual basis, and include information on the variety of ways that the environment provides value to people. These benefits include the provisioning, regulating and cultural services provided by ecosystems, such as fisheries, sea surge protection and locations for tourism.

Not all physical flows from ecosystems will be significant or material for evaluating. The most relevant flows of benefits should be identified and prioritised for inclusion in an account. Once the prioritised benefits that are possible to quantify are identified, the annual flows should be measured. The approach to measuring the benefits provided within the OTs will vary between territories by type of ecosystem service and benefit.

2.3.1 Ecosystem Service Flow Accounts (monetary terms) and Ecosystem Asset Accounts

The Ecosystem Service Flow Accounts (monetary terms) measures the monetary value of the flows of benefits that are captured in the Ecosystem Service Flow Accounts (physical terms) . It aims to measure the exchange value of both market and non-market ecosystem services through different economic valuation techniques. This applies to both the annual value of ecosystem services and the ecosystem asset value, measured as the aggregate value of the expected annual stream of benefits over the defined assessment period (set out in the Ecosystem Asset Account).

As the monetary account measures value in a common metric, money, it allows for comparison between different benefits within the accounts, and between different accounts. Importantly, it also allows for comparison across many other factors which may act as inputs to decision making, such as: national economic accounts; the financial cost of an intervention; replacement costs for critical infrastructure; the price paid for public provision of alternative services; and income revenue streams from traditional capital assets. Monetary values help assess trade-offs across these factors, and to justify allocation of resources

to environmental management and protection.

2.3.2 Account summary

Physical flows and monetary flows should be recorded separately, and then reported together. This creates added value by showing the links between ecosystems, ecosystem services and the value of benefits to people. Where monetary valuations are uncertain, but suggest certain benefits are important, physical flow indicators might be the best measure. In the context of the OTs, it may be likely in some cases that producing Ecosystem Service Flow Accounts (physical terms) is more feasible than monetary valuations, but even so the aim should be to build monetary accounts to guide the collection of the most important data for the Ecosystem Service Flow Accounts (physical terms). Results should always be expressed with appropriate caveats to ensure that the monetary units applied reflect the value as accurately as possible. A traffic light system can be used to indicate uncertainties in data or methods applied in the Ecosystem Account (see **Table 2.1**).

Table 2.1: Presenting uncertainty in the physical and monetary flow of ecosystem services

Level of confidence	Symbol	Description of confidence
High	●	Evidence is peer reviewed or based on published guidance so there is good confidence in using the data to support specific decisions.
Medium	●	Science-based assumptions and published data are used but there is some uncertainty in combining them, reasonable confidence in using the data to guide decision.
Low	●	Evidence is partial and significant expert judgement-based assumptions are made so that the data provides only order of magnitude estimates of physical quantity or monetary value.

3. Implementation of ecosystem accounting

This section outlines the implementation of the Ecosystem Accounts, covering progress and next steps of the current ecosystem accounting activities, and areas to explore for applying the Ecosystem Accounts to policy and planning.

3.1 Current progress and next steps

The current project has initiated and developed Ecosystem Accounts in the five Caribbean UK OTs. Further embedding them involves engagement with government departments and other stakeholders to gain an understanding of key issues, discuss the concepts and uses of the accounts, and identify and collect available data.

Ideally, the process should be embedded in national statistics outputs through annual updates of the accounts, building more reliable data systems and methodologies with each iteration. Data collection and management systems will need to be developed further to ensure the quality of outputs is of an appropriate level to inform policy and planning. This may involve the use of standardised protocols and knowledge about data handling and processing; however, adoption of these broader protocols must also be applicable to the specific local context. These data collation processes should be led by the statistics departments of each OT, who have expertise in generating accurate and consistent data sets, and can align to the SEEA-EA statistics guidance.

While progress needs to be made, it does not necessarily have to be resource intensive once accounting systems are set up, which can then evolve over time rather than requiring significant investment in any one time period. Updates can be streamlined so that as new data is generated, it is fed into the ecosystem accounting system as a matter of routine. While the accounts should be produced on an annual basis, it is not necessary to update every element of them every year – so long as it is transparent what is updated and what is not.

The frequency of updates needs to take into account how sensitive different variables are to change, and aspects of the accounts which would not be expected to change much year on year, or for which resource intensive primary research is needed, may be updated less regularly. However, a significant benefit of the accounts is their ability to monitor trends and provide up to date information to decision makers, and as such they should be reproduced regularly. Any progress or improvement, even if incomplete, will add value to the overall process, and its ability to effectively feed into decision making. As the accounts become increasingly complete records of the value that ecosystems provide, they should become further embedded in the OTs policy and planning systems and a vital component of government statistics and public record.

In the context of sustained pressure to develop, and focus on economic growth in the OTs, it is especially critical to understand what impacts development has on the environment and its ability to provide ecosystem services which benefit people. By initiating and building on the Ecosystem Accounts in the OTs, it is hoped that additional information will be generated that will directly contribute to this understanding and improved management of the economy and environment for the sustainable prosperity and well-being of the people of the OTs.

3.2 Use of Ecosystem Accounts

The ultimate purpose of Ecosystem Accounts is to facilitate improved management of the economy and environment. Better evidence leads to better informed decisions, but those decisions are reliant on understanding and interpretation of the evidence. A considerable advancement of Ecosystem Accounts is their ability to compile ecological, biophysical, socioeconomic, economic, and other diverse data and produce evidence in a readily useable format. The structure of Ecosystem Accounts provides a consistent means to present this evidence, but it can also be adapted to specific uses, producing indicators and other information fit for purpose.

There are many areas that the evidence from Ecosystem Accounts can contribute to, such as:

- Link to progress on the SDGs
- Link to progress on domestic policy
- Inform on land use planning
- Monitor progress (growth) / deterioration (decline) over time
- Engage with the private sector
- Understand distribution of benefits (sectoral, individuals)
- Understand proportion of economy dependent / at risk
- Understand scale of potential economic impact in from specific decisions
- Identify priority areas for value provision and maintenance
- Identify targets for investment and enhancement
- Information for public awareness campaigns
- Inform industrial and economic strategy
- Understand tax base effects
- Understand resident use and benefit of environment
- Investigate future impact and sustainability
- Conduct economic planning through scenario analysis
- Consider potential climate change impacts
- Target spending for a green economic recovery
- Create indicators to track success management / highlight areas for improvement
- Improve data management and flow across departments and sectors creating efficiencies
- *Many other specific uses are possible

Future work should aim to link the Ecosystem Accounts to relevant policy aims and initiatives. The next phase of the current project will begin to explore this by working with the local government departments to establish priority areas for further development.

4. Conclusion

The 2020 Ecosystem Accounts represent progress towards establishing an evidence base on the value that the environment provides. However, it should not be considered a one-off assessment, but rather a part of an ongoing process of data collection, methodological improvement and policy and planning implementation that should occur annually. As the SEEA-EA becomes more widely adopted, Ecosystem Accounts will increasingly inform government policy and planning internationally. The OTs are at the forefront of this process with the current set of accounts, but will need to commit to their ongoing development and uptake to maintain this position as the practice evolves.

Specifically, future effort to further develop ecosystem accounting can focus on:

- **Stakeholder engagement** – presenting the approach and results to a wide range of stakeholders to build awareness and support.
- **Capacity building** – support for the continued development of the technical skills required to compile and update Ecosystem Accounts.
- **National Statistics Offices** – working with government statisticians to embed the SEEA-EA in National Accounts.
- **Policy and planning implementation** – develop and promote the use of Ecosystem Accounts to support policy and planning aims and objectives.
- **Draw on regional ecosystem accounting practitioners** – share knowledge and experiences across the OTs, including data, methodologies and applications of Ecosystem Accounts.
- **Link with regional and international organisations and initiatives** – make connections with Caribbean regional and international organisations with an environmental, national statistics, or ecosystem accounting focus.
- **Continued alignment with evolving SEEA guidance** – update the accounts alongside the recommendations of SEEA on methodological development and emerging good practice.

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Appendix A - Methodology

This annex sets out the input data and methods used to develop the British Virgin Islands (BVI) 2020 Ecosystem Account (Virgin Islands-Ecosystem Account-2020) and provides guidance on how to update each component of the account.

For each component, a description of the input data, its' source and a workbook reference for where it is applied are provided, along with how often the data should be updated (definitions for frequency are described in **Table A.1).**

Table A.1: Definitions of frequency of input data updates

Frequency	Definition
Annually	The source should be updated on an annual basis and the accounts should reflect the most up to date data.
As source is updated	The source is expected to be updated in the future (and the accounts should be updated when new data is available.
As new evidence becomes available	The source is not expected to be updated; a new source would be required to update this data input

The data collection and analysis for the Virgin Islands 2020 Ecosystem Account occurred in parallel to the development and publication of the SEEA-EA standard. As such while the Virgin Islands 2020 Ecosystem Account is generally aligned with the direction and intention of the SEEA-EA standard, full compatibility should be worked towards as the implementation of the SEEA standard continues to evolve globally over time.

The remainder of this section is structured as follows:

- Ecosystem Extent Account (Section A.1);
- Ecosystem Condition Account (Section A.2;
- Ecosystem Service Flow and Asset Accounts and supplementary information (Section A.3); and
- Input tabs (Section A.4).

A.1 Ecosystem Extent Account

The Ecosystem Extent Account records information on the area of terrestrial and marine ecosystems within the ecosystem accounting area, i.e. the Virgin Island's terrestrial and marine boundary. **Table A.2** sets out the data sources used to estimate the terrestrial and marine ecosystem extent, which have been applied by GIS specialists at JNCC using GIS modelling software QGIS. The extent account should be updated when the source GIS layers are updated. The Extent Account is tab: **'A1. Asset Register'** of the Ecosystem Account workbook. Note that there is around 2% of overlap between the terrestrial and marine habitat layers.

Table A.2: Input data for the Extent Account

Description	Source	Frequency	Workbook reference
Terrestrial habitat map	JNCC (2018)	As source is updated	A1. Asset register tab
Marine habitat map	TNC (2020)	As source is updated	A1. Asset register tab

A.2 Ecosystem Condition Account

The Ecosystem Condition Account records information on the quality of ecosystems within the ecosystem accounting area. Condition indicators can be associated with ecological communities and species, freshwater, land or soil elements of ecosystems. **Table A.3** provides an overview of the data used within the Ecosystem Condition Account. Additional condition indicators can be added from the Environmental Profiles of the BVIs[4] in future accounts. The Condition Account is set within the tab: '**A1. Asset Register**'.

Table A.3: Input data for the Condition Account

Description	Source	Frequency	Workbook reference
Ecological communities and species			
Fisheries Priority areas	National Parks Trust (2020a)	As source is updated	A1. Asset register tab
Protected fisheries area	National Parks Trust (2020a)	As source is updated	A1. Asset register tab
Tropical Important Plant (TIP) areas	National Parks Trust (2020b)	As source is updated	A1. Asset register tab
Number of leatherback nesting sites	National Parks Trust (2020c)	As source is updated	A1. Asset register tab
Christmas bird count	National Parks Trust (2020d; 2020e); National Parks Trust (2021a; 2021b)	Annually	A1. Asset register tab
Land			
National park area	National Parks Trust (2020f)	As source is updated	A1. Asset register tab
SCTLD treatment areas	MNRLI (2021)	As source is updated	A1. Asset register tab

There are additional indicators linked to the Ecosystem Account which are useful to include alongside the account but do not fit directly into one of the account components. These indicators can be related to spatial configuration of assets, other forms of capital (e.g. public moorings), other economic indicators (e.g. the percentage of GDP linked to natural capital) or environmental monitoring (e.g. number of projects related to restoration activities). These indicators are set within the tab: '**A1. Asset Register**'.

A.3 Ecosystem Service Flow and Asset Accounts

This section covers the benefits included in the account. For quantified and monetised benefits it outlines the methods used to value each benefit and the input data needed to be updated for future accounts. For unquantified or non-monetised benefits, a summary of the existing data, sources and next steps are outlined.

A scope and materiality[5] assessment was conducted to show which benefits are likely to be provided by these ecosystems, and which have been possible to include in this account and which not. The scope and materiality assessment should be updated as new benefit are added or when new ecosystems are included in the Ecosystem Account. This assessment is set within the tab: **'Scope & materiality assessment.'**

[4] See: http://www.irf.org/an-update-on-the-status-of-bvi-environmental-profiles/
[5] An impact or dependency on natural capital is material if considering it, as part of the set of information used for decision making, has the potential to alter that decision.

Within the accompanying Excel workbook (Virgin Islands-Ecosystem Account-2020), each benefit has a separate calculation tab, with all estimates of annual flows summarised within the Ecosystem Service Flow Account (physical terms) (tab **'A2. Physical terms'**) and the Ecosystem Service Flow Account (monetary terms) (tab **'A3. Monetary terms'**). The monetary terms tab also presents an estimate of the ecosystem asset value[6] (Ecosystem Asset Account) expressed as a present value of the estimated flow of benefits over the accounting period (25 years).

The account has been set up to include additional benefits for future accounts when data becomes available. **Table A.4** provides an overview of the data included in the account and highlights the data gaps. The physical and monetary flow has been estimated for carbon sequestration, coastal protection and tourism benefits. Monetary data for fisheries and water supply has been sourced, but there are data gaps for the physical flow measures. Future iteration of the accounts will work towards filling these data gaps. This table is set within the tab: **'Ecosystem Account data'**.

Table A.4: Overview of available data

Tab in account	Physical flow		Monetary flow	
	Potential indicator	Included in account?	Potential indicator	Included in account?
S1. Fisheries	Volume of fish landings (by species if available)		Market price of fish (by species if available)	Yes
S2. Agriculture	Weight of agricultural produce		Market price of each item	
S3. Water supply	Cubic metres of water abstracted		$ per cubic metres of water abstracted	Yes
S4. Carbon sequestration	tCO_2e sequestered	Yes	Non-traded central carbon value BEIS (2019)	Yes
S5. Coastal protection	Infrastructure protected by natural capital	Yes	Estimated damage costs to properties/infrastructure.	Yes
	Properties/roads at risk of flooding	Partial	Estimated damage costs to properties/infrastructure.	
S6. Flood hazard regulation	Properties/roads at risk of flooding	Partial	Estimated damage costs to properties/infrastructure.	
S7. Beach erosion prevention	Properties at risk of beach erosion	Yes	Estimated damage costs to properties/infrastructure.	
S8. Air quality regulation	Air pollutants removal by vegetation		Avoided healthcare costs	
S9. Local recreation	Number of local visits		Expenditure of local visits	
S10. Tourism	Number of tourist visits	Yes	Tourist expenditure (value added to tourism industry attributed to ecosystems)	Yes
S11. Water quality regulation				
S12. Cultural values	Number of beneficiaries		WTP for iconic species	
S12. Cultural values	Number of beneficiaries		WTP for scenic beauty	

The **'Output and outcome indicators'** tab Links between the Ministry of Natural Resources, Labour and Immigration and components of the Ecosystem Account. Appendix B provides more information on the output and outcome indicators.

[6] One of the five core accounts in SEEA EA, this account records information on stocks and changes in stocks (additions and reductions) of ecosystem assets, as well as accounting for ecosystem degradation and enhancement (UN, 2021).

A.1.1 Overview

An overview of the flow and monetary valuation metrics and methods are provided in **Table A.5.** The benefits are split into the following sections:

- **Ecosystem service flow account –** The approach to monetary valuation aligns with the System of Environmental Economic Accounting- Ecosystem Accounting (SEEA-EA) standard which applies exchange values[7] to be comparable to other national accounts (e.g. as applied in the System of National Accounts (SNA)).

  Monetary values based on data from previous years have been inflated to 2020 prices (Central Statistics Office, 2020a; 2021a; HM Treasury, 2021). The monetary values of benefits are calculated per year and summed and discounted over time to estimate present value of benefits using a declining discount rate (starting at 3.5%) (HM Treasury, 2020) and a 25-year study period. **Table A.6** describes the assumptions used to estimate the future flows of benefits over this assessment period. These assumptions should be revisited as new evidence becomes available.

- **Supplementary information** – The SEEA-EA guidance recognises that exchange values do not capture all information useful for decision makers. This section includes additional information outside the scope of the ecosystem account, under the following categories:
  - **Other exchange values –** Additional monetary benefits based on exchange values but are outside the scope of the Ecosystem account, e.g., remaining visitor expenditure attributed to ecosystems. This includes economic values which is dependent on ecosystems, but which might not be entirely attributable to ecosystems within the SEEA-EA framework. For example, expenditure on some activities may not be feasible without the support of ecosystem assets, but only a subset of this expenditure would be attributable to ecosystems within SEEA-EA, as labour and other capitals might also contribute to the production of the good or service.
  - **Welfare values –** Monetary benefits that are based on welfare value metrics such as willingness to pay values. Note that this value includes the consumer surplus that is additional to the exchange value as adopted in the SEEA-EA framework, which also makes it an extension of the value reported within SNA.
  - **Non-monetised benefits –** There are two types of non-monetarised benefits. Firstly, where data for quantifying the physical flow is available and is useful to monitor over time, but there is currently insufficient data or a appropriate methodological approach to conduct monetary valuation. Secondly, where material benefits exist that are not feasible or not desirable to monetise (e.g. biodiversity, spiritual value, iconic species).

Table A.5: Overview of benefits

Benefit	Physical indicator	Monetary valuation metric and method
Ecosystem service flow account		
Carbon sequestration	Total tCO_2e sequestered	Cost of achieving emission reductions
Coastal protection	Infrastructure protected by natural capital	Estimated damage costs to properties if coral reefs were damaged
Tourism	Number of tourist visits	Tourist expenditure (value added to tourism industry attributed to ecosystems)
Supplementary information		
Other exchange values		

[7] Exchange values are equivalent to the price as set by a market (i.e. the price at which supply equals demand) or the price at which a an exchange would occur in a hypothetical market. Notably this differs from welfare values which include the surplus value created in addition to the exchange value (i.e. the consumer surplus).

Tourism	Number of tourist visits	Remaining visitor expenditure attributed to ecosystems
Welfare values		
	-	-
Non-monetised benefits		
Coastal protection	Length of roads at risk of storm surge	-
Flood hazard regulation	Length of roads at risk of flooding	-
Beach erosion prevention	Number of properties at risk of beach erosion Length of roads at risk of beach erosion	-

Table A.6: Assumptions about future flows of benefits

Benefit	Physical flow	Monetary value
Ecosystem service flow account		
Carbon sequestration	No change in sequestration rates over time	Value of carbon emissions increase over time in line with BEIS (2019)
Coastal protection	Assumed constant physical flow of benefit over time	Assumed constant economic value of benefit over time
Tourism	Average visit numbers from 2016-2020	Average expenditure from 2016-2020
Supplementary information		
Other exchange values		
Tourism	Average visit numbers from 2016-2020	Average expenditure from 2016-2020
Welfare values		
Non-monetised benefits		
Coastal protection	-	-
Flood hazard regulation	-	-
Beach erosion prevention	-	-

A.1.2 Carbon sequestration

Carbon sequestration refers to the ability of the natural environment (both terrestrial and marine) to remove carbon from the atmosphere. This contributes towards global climate regulation.

Method overview

This benefit is estimated using the sequestration rates for each habitat (tonnes CO_2 equivalent per hectare), the area per habitat and the non-traded price of carbon.

Table A.7 shows the global average per hectare carbon sequestration rates for terrestrial and marine habitats. Two main sources are used as the basis of the carbon sequestration rate estimates – Murray et al. (2011); as cited in IUCN (2017) and Alongi (2014). The midpoint sequestration rates between the two sources are used in the analysis.

Table A.7: Carbon sequestration rates by habitat type (tCO_2e/ha/yr)

Habitat	Murray et al. (2011); IUCN (2017)	Alongi (2014)[1]	Midpoint

Terrestrial			
Mature tropical forest	2.3	-	2.3
Marine			
Seagrass	4.4	2.0	3.2
Saltmarsh	8.0	5.5	6.8
Mangroves	6.3	6.4	6.3
Estuaries	-	1.7	1.7
Shelves	-	0.6	0.6

Notes:
[1] The values reported were converted from $gC/m^2/yr$ to $tCO_2e/ha/yr$ using the IPCC (2018) tC to tCO2e conversion factor of 3.67, gram to tonne and m2 to ha conversion factors.

The total amount of CO_2 equivalent sequestered is estimated by multiplying these per hectare rates with the total hectare of the respective habitat type, as recorded in the Ecosystem Extent Account. The carbon sequestration rates are assumed to remain constant over time.

The amount of CO_2e sequestered is then valued following the BEIS (2019) guidance. The economic value of carbon sequestration is estimated using the non-traded central price, £76 per tonne of CO_2e in 2020. The UK carbon prices were converted to US dollars, and then multiplied by the relative GDP per capita in BVI (ONS, 2020; Government of the Virgin Islands, 2021a). The carbon price is then multiplied by the estimated tonnes of CO_2e sequestered. Future monetary values of carbon sequestration change in line with the UK carbon price series (BEIS, 2019).

How to update the account

The benefits are estimated in the tab: **'S4. Carbon sequestration'**.

Table A.8 provides an overview of the input data for the benefit, including the frequency data should be updated and the workbook reference in the account.

Table A.8: Input data for carbon sequestration benefits

Description	Source	Frequency	Workbook reference
	Physical flow		
Ecosystem extent	JNCC (2018); TNC (2020)	As new evidence becomes available	4.1a
Terrestrial and marine carbon sequestration rates	Murray et al. (2011), as cited in IUCN (2017); Alongi (2014)	As new evidence becomes available	4.1b, 4.1c
	Monetary flow		
BVI GDP per capita	Government of the Virgin Islands (2021)	Annually	4.2a
UK GDP per capita	ONS (2020)	Annually	4.2b
UK Carbon prices	BEIS (2019)	As source is updated	4.2c; UK Carbon prices full tab
GBP to US$ exchange rate	HMRC (2020)	Annually	4.2e
UK GDP deflator	HM Treasury (2021)	As source is updated	UK GDP deflators tab

Data inputs for the physical flow can be updated as science and understanding of carbon sequestration rates of ecosystems improves. The 2020 Ecosystem Account for the Virgin Islands applies UK carbon values as per BEIS (2018). The UK carbon values were updated in September 2021 to reflect the UK's net zero policy commitment. Future iterations of the account could be aligned to the updated UK values and/or to

voluntary carbon market exchange values. The values used should reflect the Virgin Islands climate policy, abatement technologies and other context from the accounting year.

A.1.3 Coastal protection

The natural capital of VI's marine coastal habitats provides protection to VI from damage and flooding due to sea surge from storms and other adverse weather events. Coral reefs, sand bars, mangrove stands, dunes and even seagrass beds all help to absorb energy and mitigate the impact of waves and rising waters. This can have the significant effect of defending vulnerable built infrastructure on VI. The account provides values for both the protection from coral reefs and from mangroves.

Method overview

Protection from coral reefs

The physical and monetary flow of coastal protection from coral reefs in the account is based on modelling set out in Wood (2019). The approach compares the storm damage from current coral reef conditions to two different hypothetical scenarios: (i) coral degradation, where the coral friction element of protection is lost, and (ii) a situation where the coral reef is completely lost. The account reports the value in the absence of the coral reefs (i.e. if coral reefs are destroyed) compared to the current baseline situation where reefs are present in their current form.

The physical flow value is measured in terms of infrastructure protected by natural capital, i.e. the difference in the number of properties at risk of storm surge between the baseline and without coral reef scenario. The valuation approach considers cost of repair for damaged properties, interruption to business activities and interruption to resident occupancy. The values are annualised based on a flood event occurring every 5 years. For more information on the methodology to value for coastal protection from coral reefs see Wood (2019).

Protection from mangroves

JNCC (2020) modelled flooding risk as a result of storm surge. This modelling was overlaid with the BVI road map to provide an estimate for the length of roads in high risk flood zones (i.e. Category 4 or 5). This data is held within the non-monetised benefit section of the reporting table.

How to update the account

The benefits are estimated in the tab: **'S5. Coastal protection'**.

Table A.9 provides an overview of the input data for the benefit, including the frequency data should be updated and the workbook reference in the account.

Table A.9: Input data for coastal protection benefits

Description	Source	Frequency	Workbook reference
Physical flow			
Infrastructure protected by natural capital	Wood (2019)	As source is updated	5.1a
Total length of roads in high risk flood zones	JNCC (2020)	As source is updated	5.1c
Monetary flow			

Estimated damage costs to properties if coral reefs were destroyed and damaged	Wood (2019)	As source is updated	5.2b

The model from JNCC (2020) also provides estimates for the changes in flood risk areas under three different natural capital scenarios: (i) buffer mangroves, where mangrove habitats are buffered by 10m to simulate mangrove creation, (ii) degrade mangroves, simulating the reduction in friction that the mangroves provide and their ability to attenuate surge, and (iii) remove mangroves. This modelling can provide the basis for valuation for the next iteration of the account -the physical flow can be measured by the difference in the number of properties and length of roads at risk of storm surge with/without natural capital. The monetary flow can be estimated by applying the difference in property damage costs, estimated as the average repair cost by the change in the number of properties impacted. Further research should be undertaken to determine the appropriate monetary valuation approach for this benefit.

A.1.4 Flood hazard regulation

Extreme rainfall has caused severe inland flooding in recent years across the British Virgin Islands. The steep topography of VI can lead to flooding in towns and cities in the lowlands, destroying homes and livelihoods. The natural capital of VI's inland vegetation provides protection from damage due to inland flooding from storms and other adverse weather events.

Method overview

JNCC (2020) modelled inland run-off and flooding risk as a result of precipitation. This modelling was overlaid with the BVI road map to provide an estimate for the length of roads in high risk flood zones (i.e. Category 4 or 5). This data is within the non-monetised benefit section of the reporting table.

How to update the account

The benefits are estimated in the tab: **'S6. Flood hazard regulation'**.

Table A.10 provides an overview of the input data for the benefit, including the frequency data should be updated and the workbook reference in the account.

Table A.10: Input data for flood hazard regulation benefits

Description	Source	Frequency	Workbook reference
Physical flow			
Total length of roads in high risk flood zones	JNCC (2020)	As source is updated	6.1b

The JNCC model (2020) also provides estimates for the changes in flood risk areas under three different natural capital scenarios: (i) removed all roads, where the roads were converted to grassland, simulating a scenario where these were all removed, (ii) low roads, where hilltop roads at elevations over 100m were removed and converted to grassland, and (iii) expand urban, where the urban areas were buffered by 10m to simulate urban expansion on VI. This modelling can provide the basis for valuation for the next iteration of the account -the physical flow can be measured by the difference in the number of properties and length of roads at risk of inland flooding with/without natural capital. The monetary flow can be estimated by applying the difference in property damage costs, estimated as the average repair cost by the change in

the number of properties impacted.

Further research should be undertaken to determine the appropriate monetary valuation approach for this benefit as part of the next iteration of the account.

A.1.5 Beach erosion prevention

Coastal vegetation, such as seagrass, coral reefs, mangroves and other shoreline habitats, prevent sand loss as a result of wave backwash during both storm events and high-water levels. While some beach movement is normal over time, excessive movement following disruption of ecosystems can lead to significant changes to coastal margins and the extent and quality of beaches over time. The prevention of erosion helps to maintain these ecosystem assets, and preserve the benefits they provide such as by maintaining the aesthetic quality of coastal habitats that attract tourists and recreational users.

While the value maintaining beaches for tourism and recreational use is captured in the assessment of these benefits, the focus of this benefit is specifically on the avoidance of damage to beach and coastal infrastructure due to erosion.

How to update the account

The current estimate for the number of properties at risk of beach erosion and the length of roads at risk of beach erosion were provided by the Department of Disaster Management (2021).

Further research is needed to understand the current rate of erosion, as well as the rate of erosion in the absence of ecosystems, such as reefs and mangroves, that provide protection to beaches. Additionally, a monetary value for the avoided damage to infrastructure should be derived, avoiding double-counting and value attributed to tourism and local recreation which rely on the beach and coastal infrastructure to support use.

A.1.6 Tourism

Tourism is a major contributor to the economic prosperity of VI, and the major attraction for tourism is BVI's natural environment. In particular, it is BVI's beautiful beaches and coastal marine habitats which attract tourists. The tourism industry has grown over the past decades to become the largest sector in BVI's economy contributing significantly to society through tourist expenditure, employment opportunities, and tax revenue contributions to the country.

Method overview

The value of tourism is broken down into the following categories: overnight visitors, day trippers and cruise ship passengers. To estimate the number of overnight visits per year, the number of visitors is multiplied by the length of stay (Central Statistics Office, 2020b; 2021b). The number of day trip and cruise visitors visits are taken from Central Statistics Office (2020b; 2021b) – these visits are classified as visitors who do not stay overnight.

The value of tourism is estimated by multiplying the total expenditure by spending type and visitor type (Central Statistics Office, 2020b; 2021b) by the assumed proportion (25%) of total spend that corresponds to added value of the tourism industry (Wolfs Company, 2016). The value added is then multiplied by the

assumed factor of ecosystem dependence of that expenditure on natural capital (Wolfs Company, 2016).

The remaining annual visitor expenditure (i.e., remaining 75% of total expenditure) is likewise adjusted for ecosystem dependence and applied to the number of total visitors to BVI. In the absence of projection data, the attributable expenditure is assumed to remain constant over future time periods. This additional ecosystem dependent[8] value is reported as supplementary information to the Ecosystem Account.

How to update the account

The benefits are estimated in the tab: **'S10. Tourism'**.

Table A.11 provides an overview of the input data for the benefit, including the frequency data should be updated and the workbook reference in the account.

Table A.11: Input data for tourism benefits

Description	Source	Frequency	Workbook reference
Physical flow			
Number of visitors by type of visits	Central Statistics Office (2020b;2021b)	Annually	10.1a
Number of overnight stays by accommodation type	Central Statistics Office (2020b;2021b)	Annually	10.1b
Average length of stay for overnight visitors	Central Statistics Office (2020b)	Annually	10.1c
Monetary flow			
Total expenditure by visitor type	Central Statistics Office (2020b;2021b)	Annually	10.2a
Total expenditure by overnight visitors by spending type	Central Statistics Office (2020b;2021b)	Annually	10.2b
Factor of ecosystem dependence	Wolfs Company (2016)	As new evidence becomes available	10.2c
Estimate the value added by the tourism sector	Wolfs Company (2016)	As new evidence becomes available	10.2d

A.4 Input tabs

There are several input tabs that are linked throughout the workbook as background information (e.g., ecosystem classification) and as inputs to calculations (e.g., CPI index, discount factors) across multiple benefits. **Table A.12** provides an overview of these input tabs and the frequency each tab should be updated.

Table A.12: Input data updates

Tab name	Description	Source	Frequency
BVI GDP deflators	BVI Central Statistics Office inflation rates.	Central Statistics Office (2020a; 2021a)	As source is updated
UK GDP deflators	HM Treasury GDP deflators used throughout workbook.	HM Treasury (2021)	As source is updated

[8] See A.1.1 on ecosystem dependent expenditure versus ecosystem attributable expenditure.

UK Discount Factors	HM Treasury discount factors used throughout workbook.	HM Treasury (2020)	As source is updated
UK Carbon prices full	BEIS modelled carbon prices (£) used throughout workbook.	BEIS (2019)	As source is updated
BVI IUCN habitats	Comparison of habitat classifications used within JNCC, TNC and the IUCN classifications used in A1. Asset register	JNCC (2018); TNC (2020); Keith, D. et al. (2020)	As source is updated

Table notes:

[1] The HM Treasury released updated UK GDP deflators every quarter as well as part of the Spring or Autumn budget.

[2] UK carbon prices are currently under review, with an update due to be released soon.

Appendix B - Links to Ministry of Natural Resources & Labour Key Programme Strategies

Table B.1 sets out the link between the Ecosystem Accounts and the output and outcome indicators in the Ministry of Natural Resources & Labours' Key Programme Strategies (KPS). Some of the KPS indicators can be directly linked to the Ecosystem Accounts (e.g. KPS 7 (area of functioning salt ponds) and the Ecosystem Extent and Condition Accounts). The KPS and the respective links to the Ecosystem Account is ongoing work and are expected to be updated as the Ecosystem Accounts are updated.

Table B.1: Key Programme Strategies and the Ecosystem Account

#	Key Programme Strategies	Output indicators					Output indicators				
		Output indicators	Component of account	Included in account?	Indicator	Value	Outcome indicators	Component of account	Included in account?	Indicator	Value
1	To establish an environmental legislative and regulatory framework.	Number of Cabinet Papers for the Environment Bill prepared for Cabinet					Environment Act enacted.				
2	Establish a framework for environmental data collection and management to provide evidence to support the implementation of the Environment Bill.	Number of environmental aspects being monitored.	Other indicators				Number of ongoing sampling programmes with routine data collection.	Other indicators			
		Number of ecosystem services with natural capital valuation estimates.	Ecosystem Service Flow Account (monetary terms)	Count of benefits included in the account	3	Yes	% of GDP being spent on environmental monitoring, reporting and verification.	Other indicators			
3	To establish environment enforcement capability.	Available hours for enforcement.	Other indicators				% of GDP linked to natural capital.	Other indicators	Yes		

4	To develop and implement a marine water quality policy and strategy to support improvements to natural capital assets that enhance biodiversity and provide coastal flood protection services.	Number of water quality samples taken at specific locations.	Other indicators				No. of prosecutions.	Other indicators			
5	Establishing yacht sewage collection infrastructure and introduce incentives for yacht modification to install effluent tanks to reduce pollution into the marine environment.										
6	Creation, maintenance and restoration of natural capital assets (coral reefs, mangroves, beaches) to reduce coastal flooding.	Number of projects focusing on coral reef creation, maintenance and restoration.	Other indicators				Number of days marine water quality at locations meets or exceeds standards.	Other indicators			
		Number of projects focusing on mangrove creation, maintenance and restoration.	Other indicators				Percentage of territorial marine water within standards.	Other indicators			
		Number of projects focusing on beach creation, maintenance and restoration.	Other indicators				Area (m2) of natural capital assets affected by projects.	Other indicators			
7	To develop and implement a policy and strategy prevent illegal reclamation and future loss of salt ponds to protect against flooding, biodiversity degradation and beach erosion.	Number of projects focusing on salt pond restoration.	Other indicators				Economic value of built infrastructure protected by natural capital.	Ecosystem Service Flow Account (monetary terms) and Ecosystem Asset Account			
		Number of salt ponds with legal protection.	Other indicators				Area (m2) of functioning salt ponds.	Extent Account / Condition Account	Partial	Area of salt ponds (ha), no condition data	643

8	The establishment of a beach management policy and strategy to support and enhance biodiversity and coastal protection.	Number of beaches with management plans.	Other indicators				% of beaches without negative human impacts.	Other indicators			
		Number of leatherback turtle hatchlings observed.	Condition Account	Partial	Number of leatherback nesting sites	11	Population of leatherback turtles.	Condition Account			
9	Develop and implement a management plan to address impacts from mass sargassum events.	Response capacity to sargassum per event ($, man days).	Other indicators				No. of days where sargassum is causing negative impacts after mass events.	Other indicators			
10	To develop and implement a policy and strategy to promote the use of natural capital for climate change adaptation.										
11	To develop and implement an air quality policy and strategy to reduce significant emissions of pollutants with local impacts (e.g. NOx, SOx, soot, fine particulate matter (PM2.5)).		Ecosystem Service Flow Account (physical and monetary terms) and Ecosystem Asset Account				Avoided healthcare costs	Ecosystem Service Flow Account (physical and monetary terms) and Ecosystem Asset Account			
12	To establish an implement a policy and strategy to ban the use of specific hazardous substances (e.g. specific paints, sun cream containing oxybenzone and octinoxate) to protect natural capital assets (e.g. coral reefs).										
13	To develop and implement a policy and strategy to reduce the use of single use plastics to increase resource efficiency and reduce litter.										

Note: Indicators are sourced from Ministry of Natural Resources & Labour (2021) LFA_Environment_Climate_Change 2021_Modified21Jan.xlx; Wood and JNCC (2020) The role and value of natural capital and development of indicators for use in disaster preparedness in the UK's Overseas Territory of the British Virgin Islands C19-0303-1361.

Table B.2: Additional indicators and the Ecosystem Account

Indicator	Component of account	Included in account?	Indicator	Value
Output indicators				
Area of coral reef under direct restoration initiatives (sq. m)	Other indicators			
Area of mangrove creation or restoration (sq. m)	Other indicators			
Number/area of salt ponds reinstated	Condition account			
No. of days water quality at beaches exceed safety standards	Other indicators			
Number of development projects assessed and undertaken by established environmental standards and safeguards	Other indicators			
Outcome indicators				
Percentage of land and marine space being declared as protected areas	Condition account	Yes	Protected fisheries area (ha)	5,020
			National park area (ha)	447
Number of environmental and climate adaptation projects delivered at the community and national levels	Other indicators			
Change in value of protected economic assets directly linked to natural capital	Ecosystem Service Flow Account (monetary terms) and Ecosystem Asset Account			

Note: Associated output and outcome indicators that were derived by MNRLI are summarised in Table 3.5 and Table 3.6 (Wood and JNCC, 2020)

Appendix C - Ecosystem service classification comparison

The Common International Classification of Ecosystem Services (CICES) was chosen as a reference point for ecosystem service typology to enable comparison of ecosystem services between accounts (EEA, 2018). CICES is a globally recognised classification of ecosystem services and referenced within the SEEA EA guidance (UN, 2021). The typology structure consists of four levels – section, division, group and class. See EEA (2018) for more guidance on using CICES.

Table C.1 compares the benefit typology used in this account with the CICES class.

Table C.1: Ecosystem services typology comparison

Shorthand	CICES Class
Fisheries	Animals reared by in-situ aquaculture for nutritional purposes
Agriculture	Animals reared for nutritional purposes
Water supply	Surface water for drinking
Carbon sequestration	Regulation of temperature and humidity, including ventilation and transpiration
Coastal protection	Hydrological cycle and water flow regulation (Including flood control, and coastal protection)
Flood hazard regulation	Hydrological cycle and water flow regulation (Including flood control, and coastal protection)
Beach erosion protection	Control of erosion rates
Local recreation	Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions
Tourism	Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions
Water quality regulation	Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals
Cultural value	Characteristics of living systems that are resonant in terms of culture or heritage

Appendix D - Ecosystem classification comparison

To allow the national accounts to be aggregated with other Overseas Territory accounts and compared between countries, the International Union for Conservation of Nature (IUCN) Global Ecosystem Typology (GET) Ecosystem Functional Groups (EFG) was cross-referenced with the terrestrial and marine ecosystem typology used within the Joint Nature Conservation Committee (JNCC) and The Nature Conservancy (TNC), respectively. The IUCN GET is a global typological framework that applies an ecosystem process-based approach to ecosystem classification for all ecosystems around the world. The typology structure consists of six levels. The top three levels – realm, biome and ecosystem functional group - are aligned with the System of Environmental Economic Accounting (SEEA) Ecosystem Type reference (UN, 2021), s*ee Section 3.4 – Classifying ecosystem assets for more guidance*.

Table D.1 sets out the alignment between the habitat classifications completed by eftec and JNCC.

Table D.1: Ecosystem classification comparison

Terrestrial /marine	BVI classifications	IUCN classification			Notes on alignment
		Realm	Biome	Ecosystem functional group	
Terrestrial	Algae	n/a	n/a	Algae	
Terrestrial	Agriculture	n/a	T7 Intensive land-use	-	Classed as the 'Biome' rather than the 'Group' level. Under IUCN classification, agricultural habitats are 'intensive land-use'.
Terrestrial	Bare ground	n/a	n/a	Bare ground	Same as BVI classification - could not find a matching IUCN GET Group as it includes both bare rock and disturbed ground near urban/roads
Terrestrial	Beach	n/a	n/a	MT1.3 Sandy shorelines	
Terrestrial	Grassland	Terrestrial	T7 Intensive land-use	T7.4 Urban and industrial ecosystems	Looks like disturbed ground mostly - near urban areas, includes sports stadium. Classed as "Urban and industrial ecosystems" as these areas include gardens, grassy areas etc.
Terrestrial	Mixed forest	Terrestrial	T1 Tropical-subtropical forests biome	-	Includes drought-deciduous/semi-deciduous and evergreen
Terrestrial	Drought deciduous scrub	Terrestrial	T1 Tropical–subtropical forests	T1.2 Tropical-subtropical dry forests and scrubs	
Terrestrial	Evergreen forest	Terrestrial	T1 Tropical–subtropical forests	T1.3 Tropical-subtropical montane rainforests	At elevations >200m so think more suited to the mountain rainforest group

Terrestrial	Semi-deciduous forest	Terrestrial	T1 Tropical–subtropical forests	T1.2 Tropical-subtropical dry forests and scrubs	
Terrestrial	Mangrove	Marine-Freshwater - Terrestrial	MFT1 Brackish tidal	MFT1.2 Intertidal forests and shrublands	
Terrestrial	Rock	n/a	n/a	Rock	Same as BVI classification includes both rocky shorelines and bare ground areas near urban areas. Under IUCN habitat classification, this contains both MT1.1 Rocky shorelines T7.4 Urban and industrial ecosystems.
Terrestrial	Salt pan	Freshwater	F2 Lakes	F2.7 Ephemeral salt lakes	
Terrestrial	Salt pond	Freshwater	F2 Lakes	F2.7 Ephemeral salt lakes	
Terrestrial	Scrub	Terrestrial	T1 Tropical–subtropical forests	T1.2 Tropical-subtropical dry forests and scrubs	
Terrestrial	Sediment	n/a	n/a	Sediment	Same as BVI classification, refers to sand beacghes and subtidal sands. Under IUCN habitat classification, this contains both MT1.3 Sandy shorelines and M1.7 Subtidal sand beds. This would need to be manually split, this has not been done for this set of accounts.
Terrestrial	Thicket	Terrestrial	T1 Tropical–subtropical forests	T1.2 Tropical-subtropical dry forests and scrubs	
Terrestrial	Urban	Terrestrial	T7 Intensive land-use	T7.4 Urban and industrial ecosystems	
Marine	Coral/Algae	Marine	M1 Marine shelfs	M1.3 Photic coral reefs	Represents fringind patch/bank/shelf reefs, <25m deep, macroalgae
Marine	Dredged	Marine	M1 Marine shelfs	M1.8 Subtidal mud plains	Represents dredged areas near docks/ports
Marine	Hardbottom Dense Algae	Marine	M1 Marine shelfs	M1.6 Subtidal rocky reefs	Represents low relief, gorg/spong/algae, deeper >8m
Marine	Hardbottom Sparse Algae	Marine	M1 Marine shelfs	M1.6 Subtidal rocky reefs	Represents sparse to medium living cover, gorg sea fans, plumes etc
Marine	Muddy Bottom	Marine	M1 Marine shelfs	M1.8 Subtidal mud plains	Represents inland lagoons/estuaries, sediment/dredged areas
Marine	Reef Back	Marine	M1 Marine shelfs	M1.3 Photic coral reefs	Represents 2-3m depth landward of crest, coral rubble, hard corals, sea fans and sponges
Marine	Reef Crest	Marine	M1 Marine shelfs	M1.3 Photic coral reefs	Represents break zones of barriers and fringing reefs (btw back and fore reefs)
Marine	Reef Fore	Marine	M1 Marine shelfs	M1.3 Photic coral reefs	Represents exposed seaward >8m depth, sparse coral cover, sandy substrate

Marine	Sand	Marine	M1 Marine shelfs	M1.7 Subtidal sand beds	Represents sparse living cover, low relief
Marine	Seagrass Dense	Marine	M1 Marine shelfs	M1.1 Seagrass meadows	
Marine	Seagrass Sparse	Marine	M1 Marine shelfs	M1.1 Seagrass meadows	
Marine	Spur and Groove	Marine	M1 Marine shelfs	M1.3 Photic coral reefs	Represents high relief reef framework, 10-30m depth, alternating sand/coral

Appendix E - Virgin Islands ecosystem maps

This appendix contains the close-up ecosystem maps for the Virgin Islands.

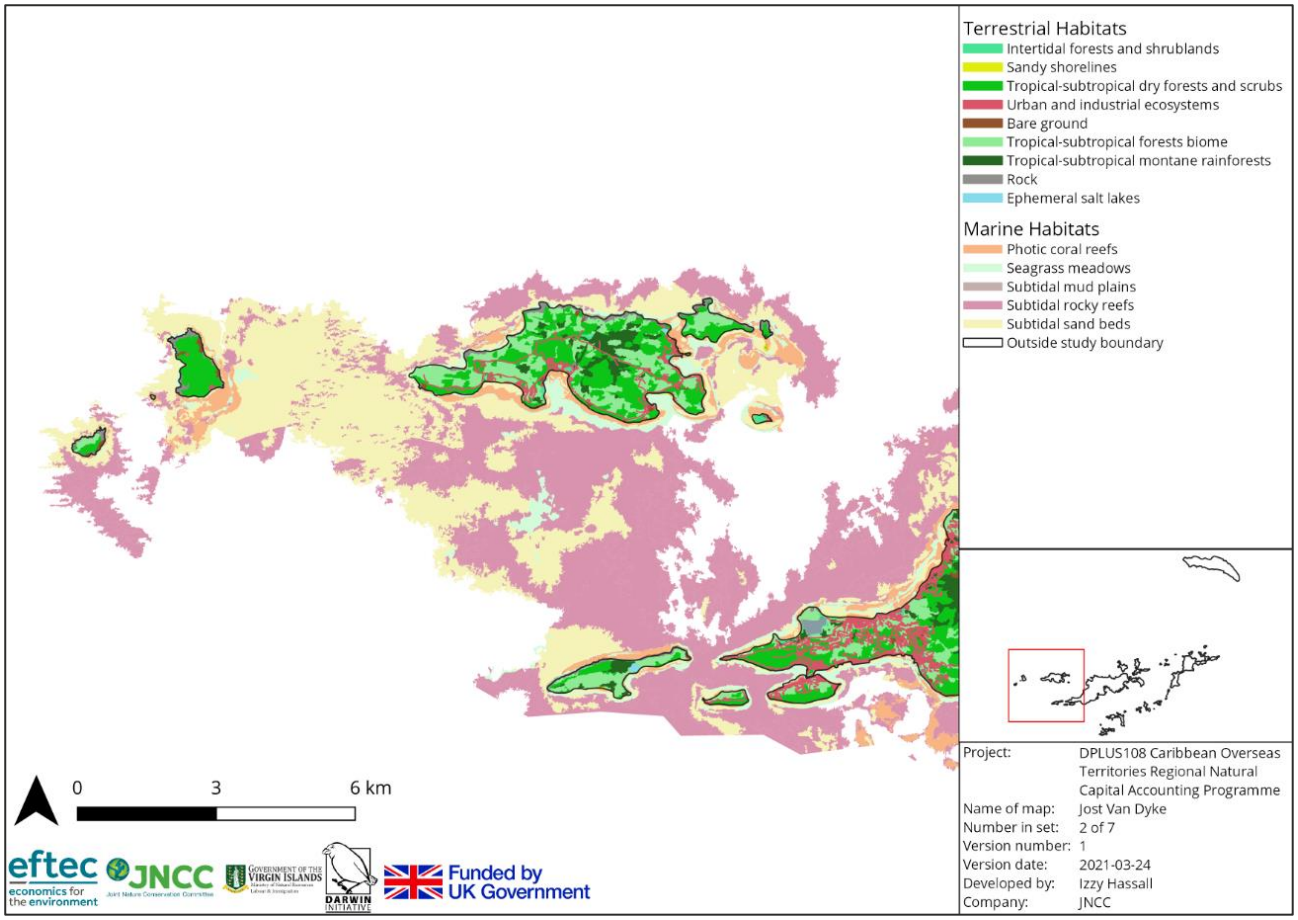

Figure E.1: Ecosystem map of Jost Van Dyke

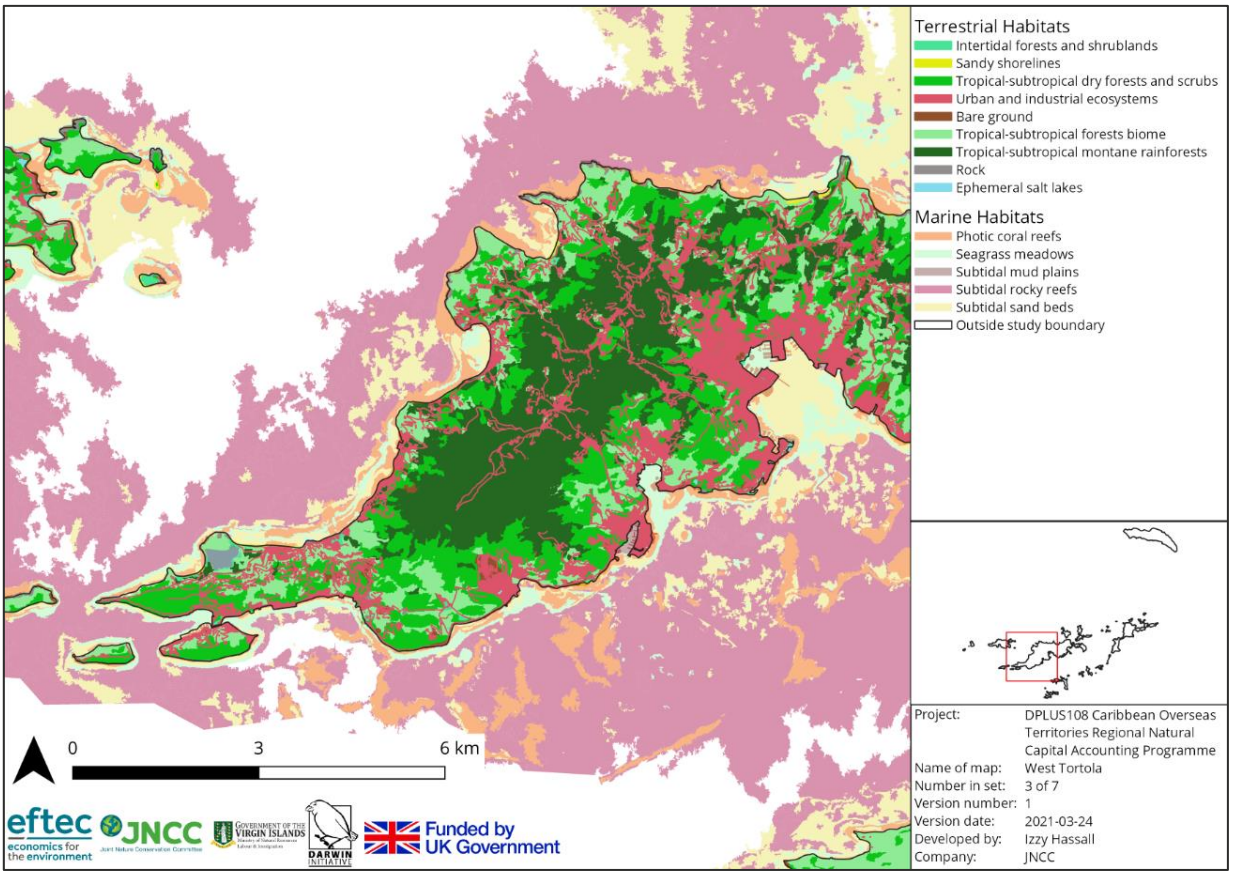

Figure E.2: Ecosystem map of West Tortola

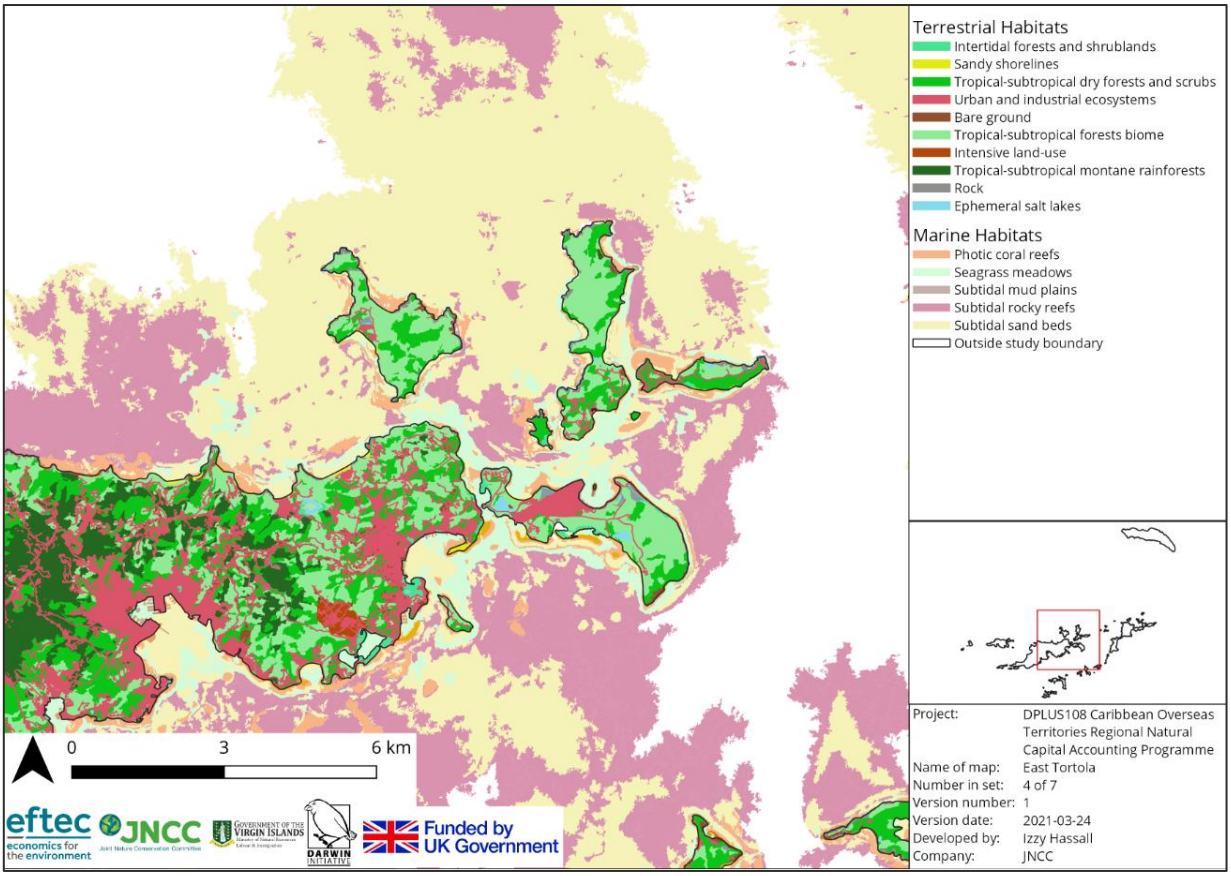

Figure E.3: Ecosystem map of East Tortola

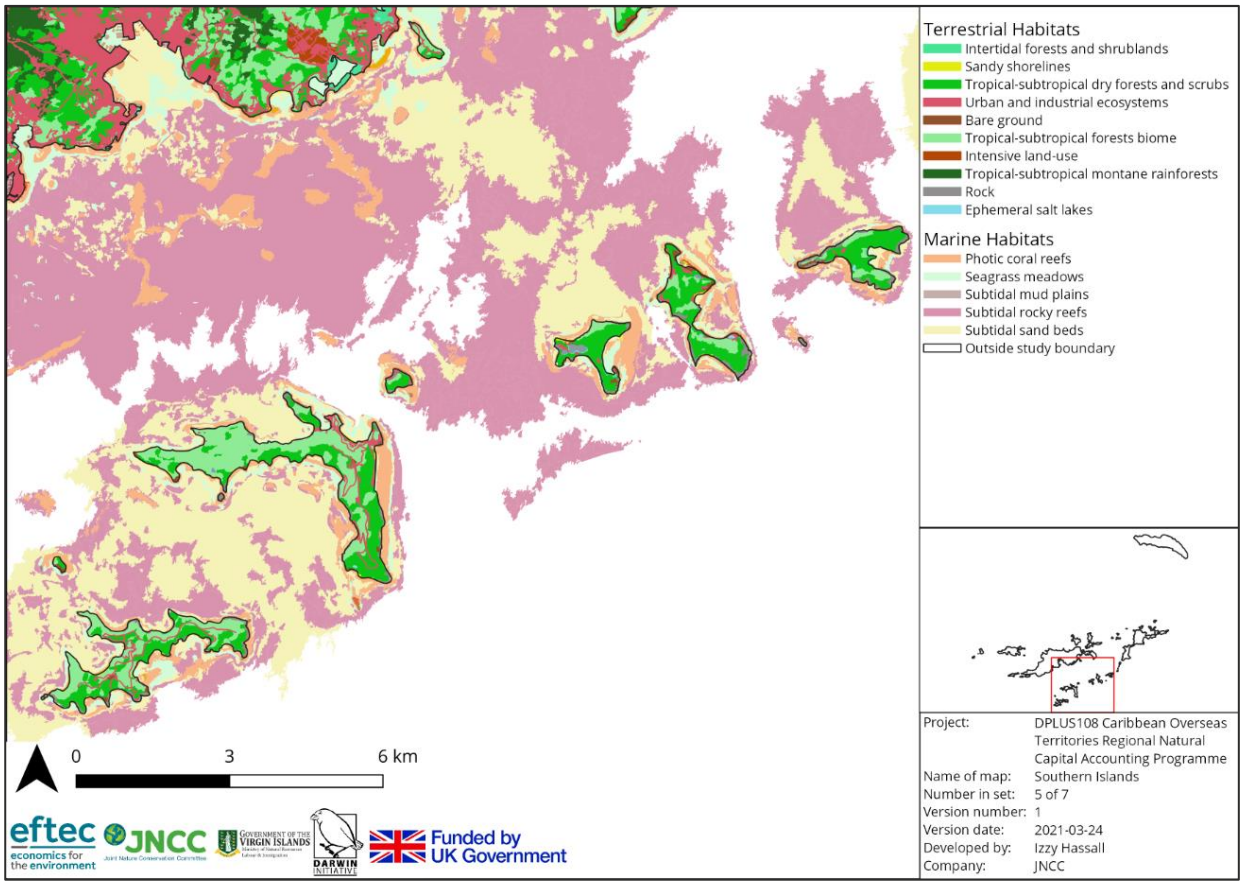

Figure E.4: Ecosystem map of Southern Islands

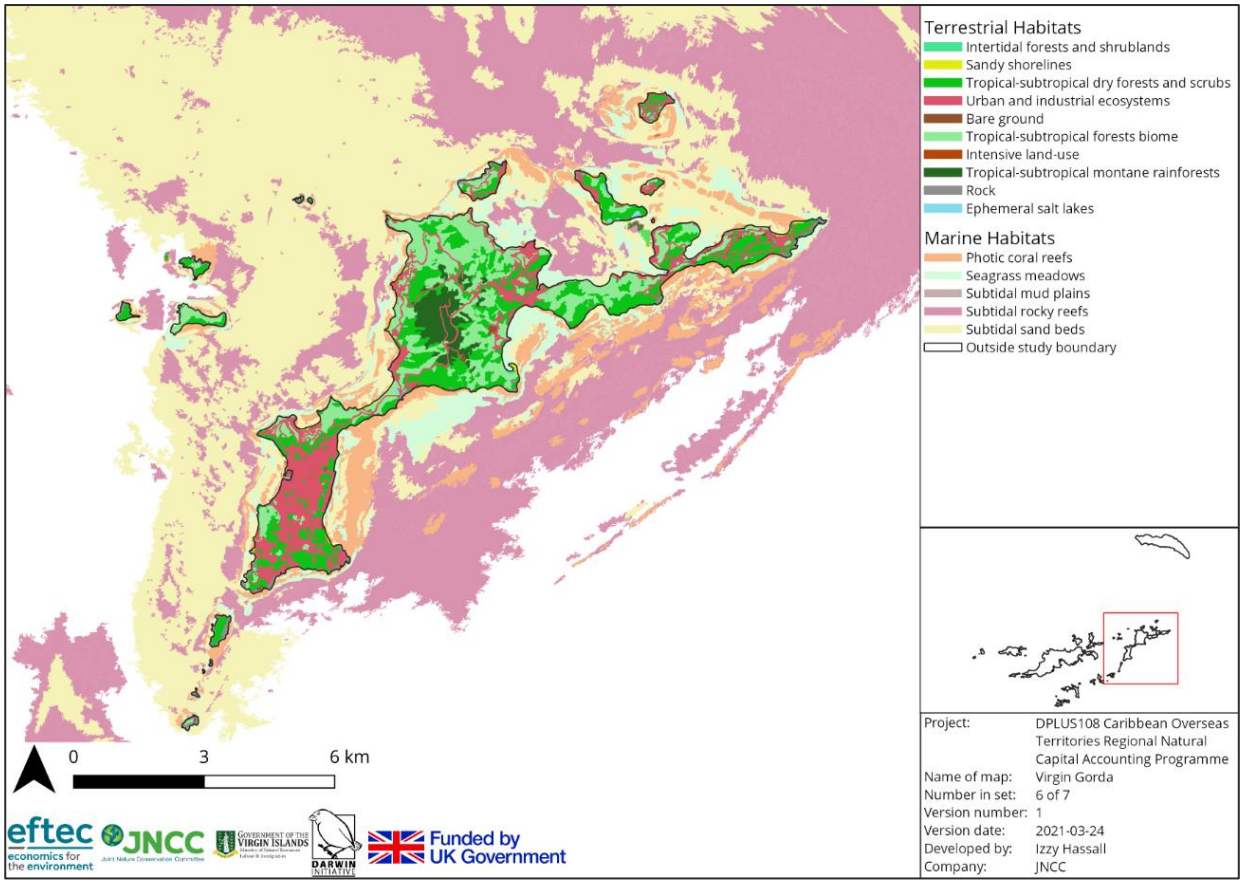

Figure E.5: Ecosystem map of Virgin Gorda

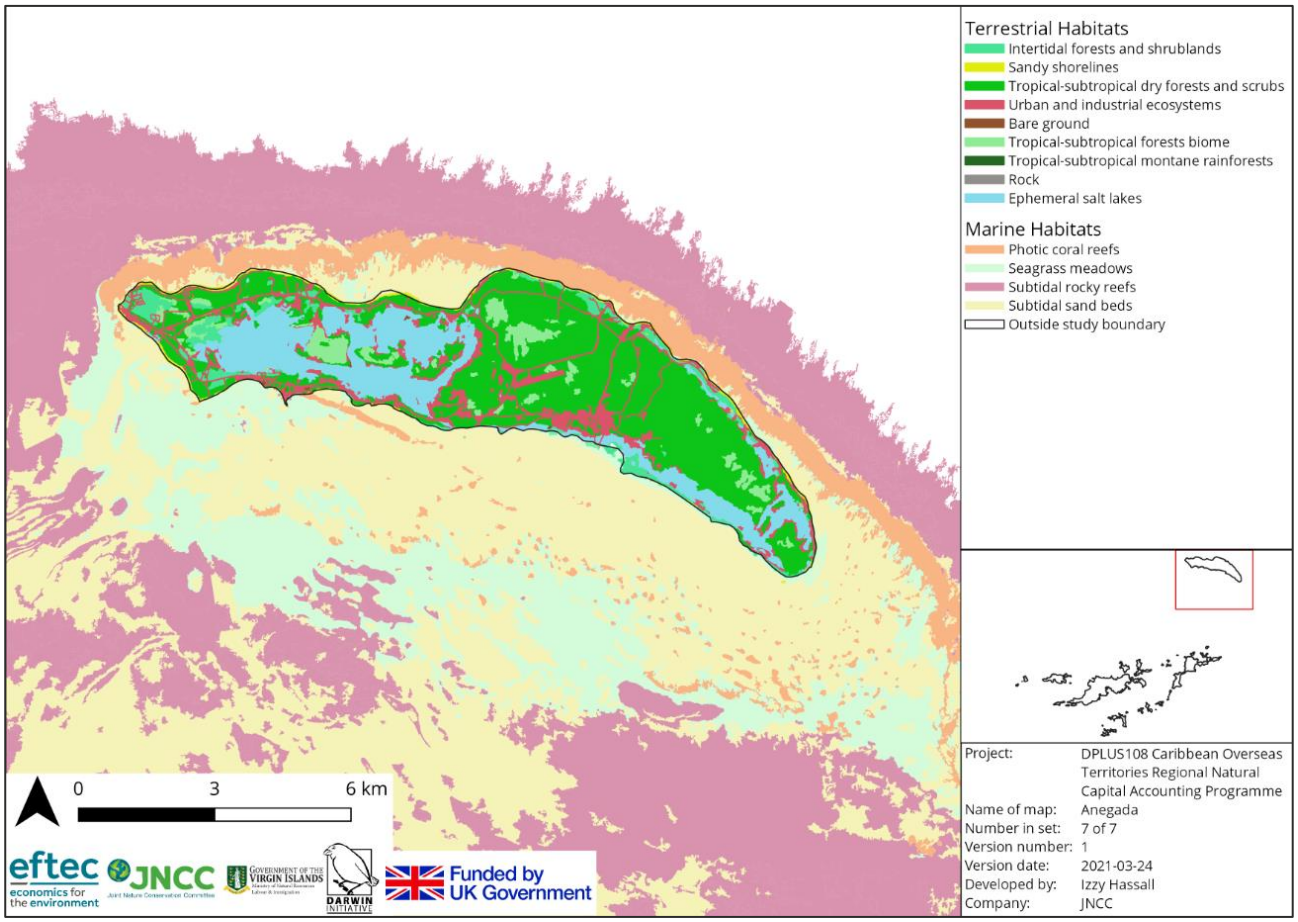

Figure E.6: **Ecosystem map of Anegada**

Appendix F - Changes in account values

Table F.1 and Table F.2 sets out the value estimated in the previous Virgin Islands Ecosystem Account and notes key reasons for the changes in values. All monetary values are presented in the reporting year price year, e.g. 2020 account values are reported in 2020 prices etc.

Table F.1: Changes in Ecosystem Service Flow and Asset Accounts

		2019			2020/			
	Physical indicator	Ecosystem Service Flow Account		Ecosystem Asset Account (PV25 US$m)	Ecosystem Service Flow Account		Ecosystem Asset Account (PV25 US$m)	Key changes from 2019 to 2020
		Physical terms	Monetary terms (US$m)		Physical terms	Monetary terms (US$m)		
Carbon sequestration	Total carbon sequestered (tCO2e/yr)	40,403	4	90	40,403	4	100	Changes in value due to GDP deflator (new source used)
Coastal protection	Total number of buildings protected by coral reefs (buildings/yr)	2,234	74	1,267	2,234	75	1,285	Changes in value due to inflation rate
Tourism	Total number of visits (visits/yr)	3,300,355	47	841	978,086	13	669	Updated tourist numbers. Change due to the impacts of COVID-19
		Total	125	2,198	Total	93	2,054	

Table F.2: Supplementary information changes

		2019			2020			
	Physical indicator	Physical terms	Monetary terms (US$m)	Present Value 25 yr (US$m)	Physical terms	Monetary terms (US$m)	Present Value 25 yr (US$m)	Key changes from 2019 to 2020
Other exchange values								
Tourism	Total number of visits (visits/yr)	3,300,355	188	3,364	978,086	43	2,080	Updated tourist numbers. Change due to the impacts of COVID-19
		Total	188	3,364	**Total**	43	2,080	
Welfare values								

					Total	-	-	
Non-monetised benefits								
Coastal protection	Total length of roads at high risk of storm surge (km/yr)	148			148			
Flood hazard regulation	Total length of roads at high risk of inland flooding (km/yr)	362			362			
Beach erosion protection	Total number of buildings at risk from beach erosion (Buildings/yr)	-			71			New data for 2020
	Total length of roads at risk from beach erosion (km/yr)	-			10			New data for 2020

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