SCAMP Nature Finance

Feasibility Study – Executive Summery for publication

March 2024

Report prepared for the SCAMP Nature Finance project funded by the Facility for Investment Ready Nature in Scotland (FIRNS)

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1. Executive Summary

This report assesses the investment readiness of the coastal habitat restoration pipeline within the Solway Firth, focusing on saltmarsh, seagrass and oyster beds. The Solway Firth has nationally-significant stocks of important coastal habitats, presenting opportunities for restoration. The pipeline for restoration is currently in its early stages and information on habitat extent, condition and potential sites for interventions is mixed. However, the Solway Coast and Marine Project (SCAMP) is already developing further baseline data and working to establish new restoration projects in the Solway. Additionally, while marine natural capital markets are in their early stages, SCAMP has the opportunity to actively shape the development of these markets – for instance, by informing the ongoing development of the Saltmarsh Code. The improvement of current data on key coastal habitats will also enable more detailed assessments of ecosystem service opportunities open to SCAMP.

SCAMP can develop towards investment readiness by applying the Green Finance Institute (GFI) investment readiness toolkit. In the first instance, SCAMP should build on existing work to identify specific targets and sites for restoration, further develop habitat baseline data, evaluate ecosystem service generation potential, and explore the potential methods and costs for restoration. Fully costed proposals can then be used to refine the business model and engage with potential buyers. There may also be opportunities to engage corporate funders or investors with an interest in acting as market enablers by supporting projects like SCAMP. In turn, SCAMP can help inform the development of marine natural capital markets in the UK.

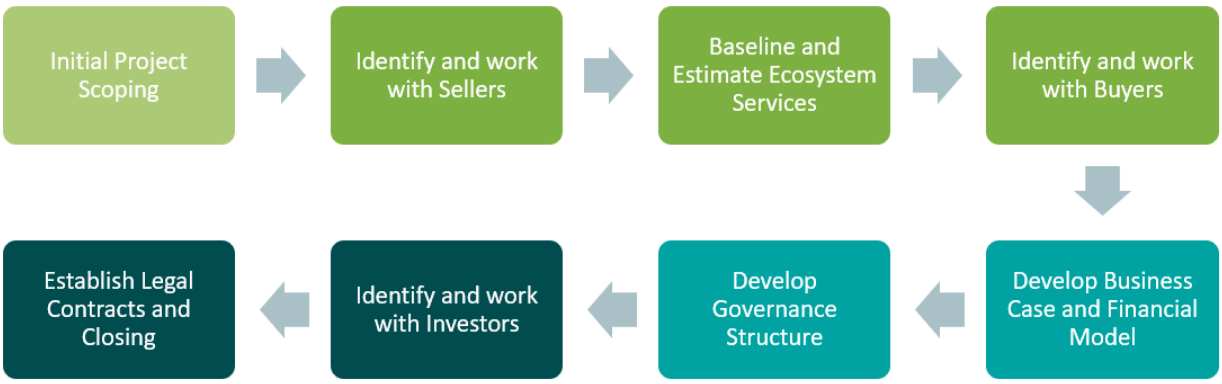
2. Introduction

SCAMP is a programme led by Dumfries and Galloway Council and the Solway Firth Partnership (the SCAMP partners). SCAMP aims to increase understanding of coastal and marine natural capital in the Solway Firth and undertake interventions to restore and expand key habitats, in order to support biodiversity, climate mitigation and adaptation, water quality, coastal tourism, and to benefit local communities. A SCAMP Pilot (SCAMPP), funded by the Borderlands Inclusive Growth Deal, will establish a research centre for habitat restoration and community engagement in Stranraer.

Recognising the need for private sector interest and capital to support larger scale restoration of natural capital in the Solway, D&G Council commissioned Finance Earth to support SCAMP towards becoming "investment ready", as part of a project funded by the Facility for Investment Ready Nature in Scotland (FIRNS). This feasibility study presents a high-level assessment of SCAMP and its investment readiness. The study reviews the existing habitat restoration pipeline in the Solway Firth, focusing on saltmarsh, seagrass and oyster beds, before analysing the potential ecosystem service opportunities for these habitats. The study concludes with an assessment of the barriers to investment readiness in the Solway Firth and the pathway to scaling up investment.

The framework for assessment is informed by the GFI investment readiness toolkit (see Figure 1 below).

Figure 1: Milestones of the GFI Investment Readiness Toolkit



Source: Adapted from the GFI Investment Readiness Toolkit

3. Overview of Current Pipeline

Identifying a pipeline of sites for habitat restoration or creation is critical for achieving investment readiness at scale. This should include assessing the existing extent and condition of habitats and identifying target sites for conservation or restoration. This will enable the assessment of potential ecosystem services, as well as the project development needs, delivery methods, legal and ownership considerations, and costs involved in any intervention.

The below sections provide an overview of the current restoration pipeline in the Solway Firth, based on available data.

Saltmarsh

Figure 2: Extent of existing saltmarsh in the Scottish Solway

Sources: Haynes, T.A. (2016) Scottish saltmarsh survey national report. Scottish Natural Heritage Commissioned Report No. 786; The Land App; FE Analysis

Historically regarded as low value land, saltmarsh in the UK has undergone significant decline due to coastal development, agriculture and other pressures.[1] Existing UK saltmarshes could potentially disappear entirely due to climate change-induced sea level rises.[2] It is therefore notable that the Solway Firth has important areas of existing saltmarsh that are currently accreting.

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[1] Environment Agency (2022) The extent and zonation of saltmarsh in England: 2016-2019. An update to the national saltmarsh inventory

[2] Horton, B.P., et al (2018) Predicting marsh vulnerability to sea-level rise using Holocene relative sea-level data. Nature Communications

In Scotland, surveys of 249 sites above 3ha identified a total 7,704ha of saltmarsh, 67% of which failed one or more condition targets.[3] The largest areas of these occur in the Scottish Solway, although the exact condition of these saltmarshes is unclear and their extent may have changed in the years since publication (2016). Areas of saltmarsh have also been identified on the English coast of the inner Solway Firth, west of Carlisle.[4] Further baseline data is due in 2024.

While the Solway has large extant areas of saltmarsh, the precise opportunities for saltmarsh restoration and creation in the Solway are currently unclear. A 2023 survey commissioned by the Solway Firth Partnership identifies c.1,537ha of land in the Scottish Solway with the potential to become pseudo-saltmarsh or wetland under inundation from predicted sea level rises.[5] See Annexe 2: Satellite imagery of saltmarsh opportunity areas, below. The report suggests that some of this area could become saltmarsh even under current sea levels. Although the report provides a guide to opportunity areas, it does not detail the specific types of interventions that could be delivered to restore saltmarsh through active restoration. The report does not cover the English Solway.

Only managed realignment projects are expected to be eligible for accreditation under the first iteration of the Saltmarsh Code. While some low-level and informal embankments have been identified in the Solway, the full extent of embankments and seawalls within the Solway which may be suitable for managed realignment is currently unclear. SCAMP may need to test other approaches for saltmarsh restoration, which are less well understood.

Therefore, the baseline evidence for saltmarsh in the Solway indicates high-level opportunities, but will need to be developed further to understand specific site requirements and options for interventions in more detail. There are currently a limited number of small scale projects to restore saltmarsh in the English or Scottish Solway, and SCAMP has identified two potential areas for demonstration projects. The SCAMP partners should build on this to identify and confirm any further potential areas for active restoration and the methods by which this restoration would be carried out.

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[3] Haynes, T.A. (2016) Scottish saltmarsh survey national report. Scottish Natural Heritage Commissioned Report No. 786

[4] Hanson, J. D. (2014) Solway Firth: North Shore. Volume 28: Coastal Geomorphology of Great Britain

[5] Griffin, L.R. (2023). The potential for saltmarsh (merse) and pseudo-saltmarsh reinstatement or creation through managed realignment on the Solway Firth, Dumfries & Galloway. Solway Firth Partnership Commissioned Report

Seagrass

Figure 3: Identified areas of seagrass in the Scottish Solway

Sources: Carstairs, M. and Carstairs, S. (2023) The Status of Seagrass Populations in The Solway Firth & Loch Ryan 2022 Interim Report. Solway Firth Partnership Commissioned Report; The Land App; FE analysis

The extent and condition of seagrass in the UK remains poorly understood and an estimated 44% of seagrass in the UK has been lost since 1936.[6] Pressures include coastal development, water pollution, and activities such as shipping and mooring.[7] Records of seagrass in the Solway Firth and Loch Ryan are limited, however a 2022 survey found that seagrass beds exist at multiple locations along the northern shore of the Solway Firth and Loch Ryan (see Figure 3).[8] These are comprised of largely intertidal seagrass (*Zoster noltei* and *Zostera marina stenophylla)* with more limited areas of subtidal seagrass (*Zostera marina)*. The survey focuses on intertidal seagrass. The SCAMP partners are currently assessing potential costs and methodologies for undertaking subtidal surveys.

The identification of two areas of natural regeneration is significant. At Stranraer, the 2022 survey observed an eight-fold increase in seagrass extent since 2013, from 83,700m^2 (8.4ha) to 697,422m^2 (69.7ha), likely due to reduced human pressures arising from the relocation of a ferry terminal and the removal of the majority of existing wastewater discharges from the Loch between 2011 and 2013.[9] Efforts to actively restore seagrass typically suffer high failure rates in seeding and planting.

[6] Green, A.E. et al. (2021) Historical Analysis Exposes Catastrophic Seagrass Loss for the United Kingdom. *Front. Plant Sci*. 12:629962
[7] Unsworth, R. K. F., et al. (2017) Rocking the boat: damage to eelgrass by swinging boat moorings. *Front. Plant Sci*. 8:1309
[8] Carstairs, M. and Carstairs, S. (2023) The Status of Seagrass Populations in The Solway Firth & Loch Ryan 2022 Interim Report. Solway Firth Partnership Commissioned Report.
[9] Ibid.

The growth of seagrass in Loch Ryan, representing an increase of over 61ha, is much greater than current UK seagrass projects focusing on active restoration.[10]

While this demonstrates the possibility for natural regeneration in the area, the precise reasons for apparent recovery and the potential for wider restoration or natural regeneration outside Stranraer remain uncertain. Evidence of seagrass extent on the English coast of the Solway is especially limited, due to be supplemented by a further report in 2024. Additionally, there are currently no identified active seagrass restoration projects in the Solway and no specific targets to restore seagrass in the area, beyond the 1ha target set by SCAMPP.[11] As with saltmarsh, potential sites for restoration should be identified and selected once further baseline data, including subtidal surveys, is available.

Oyster beds

In the UK, native oyster beds have declined by up to 95% since the mid-19th century due to over-harvesting, trawling, disease and other pressures.[12] The presence of a substantial disease-free native oyster bed in Loch Ryan is unique in the UK. A recent stock assessment of oysters in Loch Ryan estimates that the native oyster population exceeds 23 million and identifies opportunities to increase oyster numbers through the deployment of "cultch" (substrate) for oysters to grow on.

While there is demonstrable potential for restoration, there is currently limited evidence on the potential for oyster bed restoration in the wider Solway Firth; although there is evidence of substantial oyster fishery activity in the past, suggesting there may be wider opportunity areas suitable for restoration.[13]

Analysis

Solway Firth has nationally significant areas of coastal habitat, with evidence of regeneration in some areas. However, current knowledge of the extent, condition and potential for conservation and restoration across habitats and geographies in the Solway Firth is mixed. The pipeline for projects that can harness ecosystem service revenue opportunities in the Solway is also early stage, as there are a limited number of existing or planned restoration projects and specified targets for restoration (beyond the initial technical proving targets for SCAMPP). Therefore, the SCAMP pipeline is generally in its early, "initial project scoping" stages. Specifying target areas for restoration (where feasible), any relevant ownership, leasehold or other legal considerations, and the methods by which restoration would be carried out, are important next steps. The following section explores implications for quantifying potential ecosystem service revenue opportunities and attracting private investment.

[10] For instance, the Plymouth Seagrass Restoration Project aims to restore 4ha of seagrass in the Plymouth Sound SAC. See: Ocean Conservation Trust. LIFE Recreation ReMEDIES Project. Web: https://oceanconservationtrust.org/project/remedies-project/

[11] Written communication with Solway Firth Partnership (December 2023)

[12] Native Oyster Network. European Native Oyster. Web: https://nativeoysternetwork.org/

[13] Dumfries and Galloway Council and Solway Firth Partnership (2023) SCAMP Project Investment Case, prepared for the Borderlands Natural Capital Programme - Scotland

4. Assessment of Ecosystem Service Opportunities

Market overview

There is growing interest in marine natural capital markets and ecosystems service opportunities in the UK. This has been driven in part by the ongoing development of compensation policies for marine development (e.g. Marine Net Gain in England) or compensation policies for marine development, as well as wider regulatory and market pressures for businesses, investors and other stakeholders to address their impacts and deliver "nature positive" outcomes. Key markets which are relevant to SCAMP include voluntary and mandatory biodiversity markets, "blue" carbon markets, coastal protection and marine nutrient markets.

The Scottish Government is playing an active role in developing initiatives and frameworks to underpin the development of natural capital markets. Key policy drivers include:

- The ongoing development of the Scottish Marine Environmental Enhancement Fund (SMEEF);
- The Blue Economy Vision for Scotland;
- The National Strategy for Economic Transformation, and;
- The Interim Principles for Responsible Investment in Natural Capital.

Markets for marine natural capital and ecosystem services generally lag terrestrial markets. For instance, while the Woodland and Peatland Carbon Codes are well established in the UK, there are currently no similar carbon codes for the marine environment. The Centre for Ecology and Hydrology (CEH) is leading development of a UK Saltmarsh Code, but the code is in its early piloting stages. While there has been some work to develop a proposed UK Seagrass Carbon Code (for instance, Plymouth City Council has received funding through the Natural Environment Investment Readiness Fund (NEIRF) to carry out sediment sampling), efforts to develop such a code are nascent and lack a clear lead.

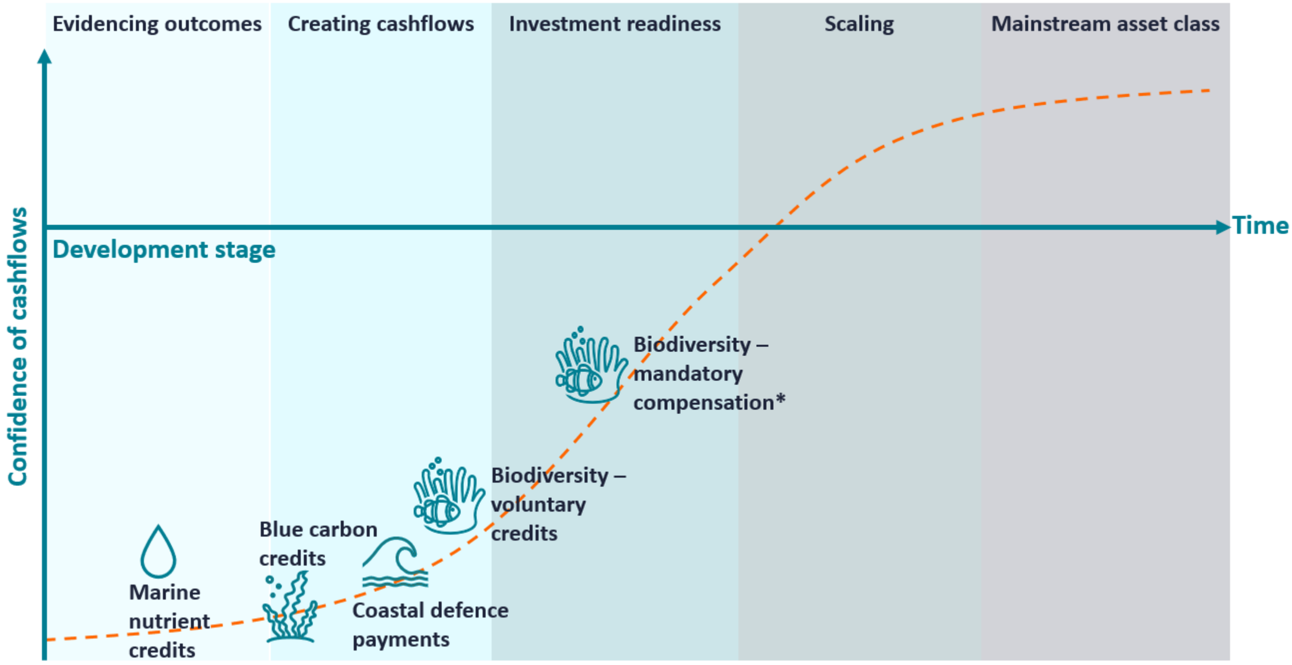
Defra has introduced mandatory biodiversity net gain (BNG) for terrestrial developments in England. The Defra metric used for calculating BNG includes coastal habitats such as saltmarsh and intertidal seagrass. This requires developers to deliver habitat restoration to compensate for the impacts of their developments, either onsite or offsite. Analysis suggests the market for offsite BNG mitigation could reach £100-300million per year.[14] While there is currently no similar policy in Scotland, the Scottish Government is supporting the development of the nascent voluntary biodiversity credit market, for instance through a NatureScot-sponsored Civtech challenge on biodiversity credit design.[15] However, the market is in its early stages. The development of policy for marine compensation could eventually provide impetus for the development of the biodiversity market and an important source of funding for habitat restoration projects.

[14] Eftec (2021) Biodiversity Net Gain: Market analysis study. Commissioned by Defra
[15] For more information, see here: https://www.civtech.scot/civtech-8-challenge-6-simplifying-and-enabling-investment-in-scotlands-nature

Moreover, marine and coastal habitats are typically costly to restore, and restoration techniques for seagrass and oyster beds in particular are generally unproven in the UK.[16] In Scotland, there is a limited track record of saltmarsh restoration (five sites over 1997-2018) and limited funding overall for restoration projects. There is no dedicated grant programme comparable to the England Woodland Creation Offer for the creation of specific marine habitats in the UK, although there are general grant funding opportunities for marine restoration projects (for example, through the Nature Restoration Fund and SMEEF in Scotland). SMEEF has raised c.£3.3 million and has so far deployed grants of c.£30,000-£250,000 to pilot projects.[17]

Figure 4 summarises the maturity of potential ecosystem service income streams for SCAMP. These opportunities for SCAMP are explored in more detail below.

Figure 4: Market maturity of ecosystem service revenue streams relevant to SCAMP



**Terrestrial, England only*

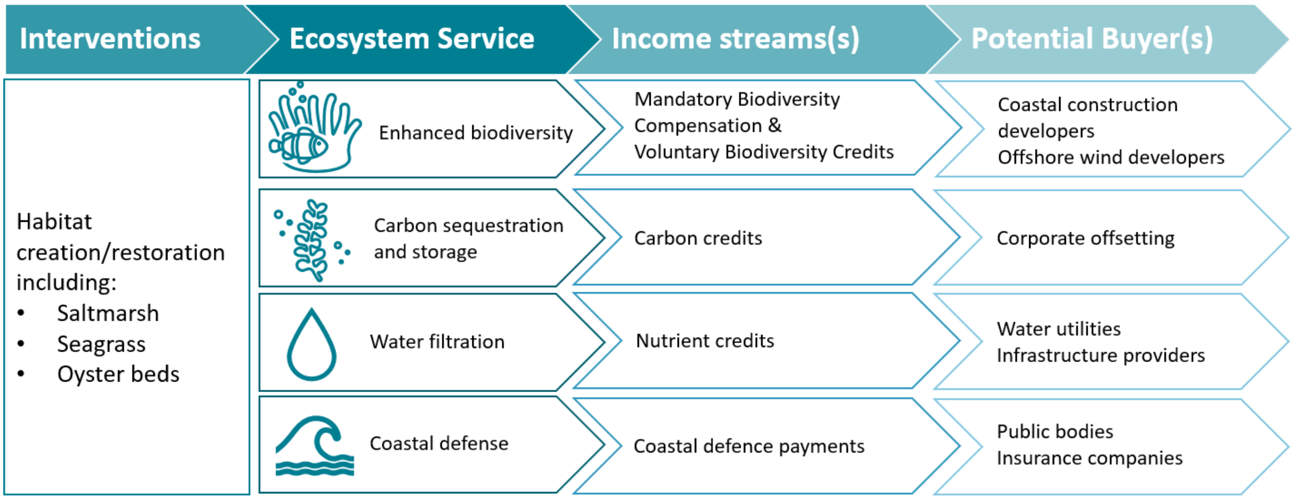
Source: FE analysis

[16] MMO (2019) Identifying sites suitable for marine habitat restoration or creation.
[17] Scottish Marine Environmental Enhancement Fund (SMEEF) – Impact report. Web: [Impact Report 2021-2023 (smeef.scot)](smeef.scot)

Potential opportunities for SCAMP

The potential for engagement with ecosystem service markets varies across habitats and the different jurisdictions (Scotland and England) in the Solway. Where data allows, Finance Earth has modelled the potential revenues and costs associated with these opportunities. The potential ecosystem service opportunities are summarised in Figure 5. Given there are no targets set for saltmarsh and seagrass bed restoration, the below analysis assumes a low case of 50ha, moderate case of 250ha, and high case of 750ha for saltmarsh restoration. For seagrass restoration, the analysis assumes a low case of 5ha, moderate case of 10ha and high case of 50ha. The analysis does not include any modelling for oyster restoration as the data on ecosystem services from oyster beds is currently too limited, and the relevant markets too nascent, to provide indicative modelling.

Figure 5: Potential ecosystem service opportunities for SCAMP



Source: FE analysis

Biodiversity

Biodiversity markets enable buyers to compensate for their impacts on biodiversity or support their "nature positive" objectives. They are typically based on purchases of credits or other units generated by projects that deliver an uplift for biodiversity.

Saltmarsh

Saltmarsh can play a key role in supporting marine and coastal biodiversity, for instance by providing nursery areas for fish, including commercially important species, and breeding sites for birds.[18] In the Scottish Solway, the SCAMP project could engage with the emerging voluntary biodiversity credit market to test the market for saltmarsh.

The below analysis of potential revenues and costs uses the Defra Metric for BNG as a proxy for voluntary biodiversity credits. The baseline habitat is assumed to be modified grassland in moderate condition, which is frequently recurring habitat adjacent to the coast. The target habitat

[18] WWT. Online: https://www.wwt.org.uk/discover-wetlands/wetlands/saltmarsh/

is coastal saltmarsh – saltmarshes and saline reedbeds, moderate condition, which generates 7.5 biodiversity units per ha. The BNG units are sold from the point the habitat reaches the target condition, over a 15 year time period in order to minimise lumpy income streams. As per the Defra BNG metric, the proposed creation results in units being delivered in 2025 (sold over 2025-2039) and in 2031 (sold over 2031-2045).

Other habitats adjacent to the coast include coastal and floodplain grazing marsh, which has high distinctiveness and therefore there is only a biodiversity uplift if the floodplain grazing marsh is in a lower condition than the envisaged coastal saltmarsh.

Since the modelling uses BNG as a proxy for voluntary biodiversity credits, it assumes a prudent indicative price of £10,000 per biodiversity unit, which represents a c. 50% discount from the expected price biodiversity units in the compliance market in England, and is based on the fact that voluntary carbon credits are currently priced at c. 50% of the price of UK ETS, the carbon compliance market. Moreover, Finance Earth has assumed that c. 85% of units generated are actually sold.

Costs of saltmarsh restoration can range from c.£25,000 per hectare to over £100,000 per hectare (for managed realignment), depending on ground conditions, need for secondary embankment and replacement of infrastructure. Given the lack of significant existing embankments in the Solway, further details on potential restoration methods are required in order to refine costing estimates. For prudence, the below calculations use costs of £60,000 per hectare, but costs could be lower.

The financial modelling demonstrates that there could be financial uplift from biodiversity enhancement on saltmarsh. The internal rate of return (IRR)[19], the return of the project, for the low, medium and high case is c. 3.5%, which aligns with the 3.5% return UK Government uses when considering cost/benefit.[20]

However, since BNG legislation does not apply in Scotland, and the voluntary biodiversity market is nascent, further demand assessments are required to refine biodiversity revenue forecasts. Moreover, further work into restoration interventions is required in order to understand if saltmarsh restoration in the Solway could be more cost effective given that the extent of seawalls is limited.

Table 1: Projected saltmarsh biodiversity revenues and costs (30 years)

Undiscounted figures:	Low case (50ha)	Moderate case (250ha)	High case (750ha)
Biodiversity revenues	£5,131,685	£25,658,426	£76,975,279
Capital expenditure	(£3,005,000)	(£15,025,000)	(£45,037,500)
Operating costs	(£489,768)	(£2,324,215)	(£6,972,645)
Operating profit	£1,636,917	£8,309,211	£24,965,134
Internal Rate of Return	3.49%	3.54%	3.55%

[19] The IRR is a common metric used in financial analysis to estimate the profitability of potential investments and reflects the discount rate at which the net present value of all cash flows equal zero. Investors typically compare a potential investee project's IRR against their internal cost of capital to assess whether a project is investable.
[20] The Green Book (2022) - GOV.UK (www.gov.uk)

The assumptions exclude land acquisition / lease costs and tax / financing implications. All revenues and costs are increased by assumed inflation of 2.5% per year.

Seagrass - intertidal

Seagrass can either be found in intertidal or subtidal waters, with *Zostera Noltei* occurring generally in intertidal beds and *Zostera Marina* occurring in subtidal beds. As the Defra Metric for BNG does not cover subtidal habitats, the modelling for seagrass biodiversity assumes that the seagrass is purely intertidal. This aligns with the SFP Seagrass survey[21] which found that *Zostera Noltei* was present at all of the sites surveyed, while *Zostera Marina* was only recorded as floating and washed-up material. This is due to a current lack of data on sub-tidal seagrass in the Solway area, though, as noted above, this is due to be supplemented by further surveys.

Seagrass habitat is unlikely to be created over an area with a baseline of modified grassland. It would be more realistic to create littoral seagrass, with *Zostera noltei,* in an area of existing littoral mud or sand. However, owing to the current design of the Defra Metric, there would be no gain in biodiversity units for sale in this case. This is because littoral mud and littoral sand are both high distinctiveness habitats. As such, the loss of biodiversity units would balance out any gains derived from new littoral seagrass habitat. To generate surplus biodiversity units for sale, littoral seagrass units may have to be generated by enhancement of degraded seagrass habitat e.g., from poor to moderate or moderate to good condition. This aligns with the Marine Management Organisation (MMO), which emphasizes the need to focus on natural regeneration close to existing sites, and at large enough scale to ensure long-term survival.[22]

In the below modelling, the baseline habitat is assumed to be Littoral Seagrass in Poor Condition, which is enhanced to Moderate Condition. The modelling assumes that enhancement takes c. 13 years (i.e. 2037), after which the units are sold over 15 years (i.e. 2037-2051), which is in line with the Saltmarsh Biodiversity Modelling. As per above, an indicative price of £10,000 per unit has been assumed.

Further information is required on the exact interventions to restore seagrass, and in particular the protections put in place to avoid disturbances, which is key to the success of regeneration. This is demonstrated by the regeneration of seagrass in Loch Ryan, noted above.

The financial modelling demonstrates that there could be financial uplift from biodiversity enhancement on seagrass. The internal rate of return (IRR)[23], the return of the project, for the low, medium and high case is c. 4%, which is above 3.5% return UK Government uses when considering cost/benefit[24].

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[21] SFP (2023) The Status of Seagrass Populations in The Solway Firth & Loch Ryan
2022 Interim Report

[22] MMO (2019) Identifying sites suitable for marine habitat restoration or creation. A report produced for the Marine Management Organisation by ABPmer and AER, MMO Project No: 1135.

[23] The IRR is a common metric used in financial analysis to estimate the profitability of potential investments and reflects the discount rate at which the net present value of all cash flows equal zero. Investors typically compare a potential investee project's IRR against their internal cost of capital to assess whether a project is investable.

[24] The Green Book (2022) - GOV.UK (www.gov.uk)

However, given BNG legislation does not apply in Scotland, and the voluntary biodiversity market is nascent, further demand assessments are required to refine biodiversity revenue forecasts. Moreover, further work into restoration interventions is required in order to understand the costs of seagrass restoration and protection in intertidal habitat.

Table 2: Projected seagrass biodiversity revenues and costs (30 years)

Undiscounted figures:	Low case (5ha)	Moderate case (10ha)	High case (50ha)
Biodiversity revenues	£462,252	£924,504	£4,622,520
Capital expenditure	(£155,000)	(£350,000)	(£1,750,000)
Operating costs	(£90,758)	(£156,592)	(£658,334)
Operating profit	£216,494	£417,912	£2,214,186
Internal Rate of Return	4.10%	4.36%	4.63%

The assumptions exclude land acquisition / lease costs and tax / financing implications. All revenues and costs are increased by assumed inflation of 2.5% per year.

Oyster beds

The biodiversity revenue potential for oyster beds cannot yet be assessed. While the Defra metric includes biogenic reefs as a habitat for BNG, it does not include oysters. The Blue Marine Foundation is carrying out work in the Solent on ecosystem service evidence building for oyster restoration.[25] Similarly, recently funded a UK pilot project exploring the potential for oyster reef restoration to generate voluntary biodiversity credits.[26] Although there are some evidenced biodiversity benefits to restoring native oyster beds, there is currently insufficient scientific and market data to model potential revenues from the biodiversity benefits of oyster bed restoration.

Carbon

Carbon markets enable buyers to purchase carbon credits to compensate for or offset their greenhouse gas emissions, measured as CO2 equivalent (CO2e). Carbon credits are generated by projects that lead to avoided emissions (for instance, restoration of degraded peatland that would otherwise continue to emit greenhouse gases) or remove emissions from the atmosphere (for instance, through woodland creation).

Saltmarsh

The Saltmarsh Code is currently under development, with a pilot version of the code due to be published from summer 2024 for testing and feedback. The developers of the Saltmarsh Code aim for it to be operational by summer 2025. As part of the FIRNS-funded project "Advancing the Saltmarsh Code", the UK Centre for Ecology and Hydrology (UKCEH) have estimated the Solway carbon curve. In the absence of any managed realignment in the Solway, there is no available data regarding accretion rates in the initial period post restoration. Therefore, the below modelling uses accretion data from Tollesbury, a managed realignment project in England, as a proxy for accretion rates in the Solway.

[25] For more information, see: https://www.bluemarinefoundation.com/projects/solent/

[26] Carbon Pulse (2024). INTERVIEW: Pet food company invests in oyster reef biodiversity credit pilot. Web: https://carbon-pulse.com/264643/

UKCEH reviewed Lidar data for Skinflats, in the Firth of Forth, but this has been deemed inappropriate given the limited time since restoration (i.e. 2018) and the error/accuracy of the Lidar images available. In the Solway, accumulation rates (t CO2e ha-1 yr-1) are estimated as 0-20yrs: 20.86t CO2e ha-1 yr-1; 20-50yrs 15.93t CO2e ha-1; 50-100yrs 15.86t CO2e ha-1 yr-1, based on the Tollesbury data. Given the lack of seawalls in the Solway, managed realignment is generally not a feasible approach. UKCEH will be conducting a systematic review of non-managed realignment saltmarsh restoration over the next 12 months. At this stage, there is insufficient information to understand impact on the above carbon accumulation rates. In order to compare biodiversity modelling with carbon modelling, the timeframe for the carbon modelling is also set to 30 years.

Based on anecdotal evidence of "premium" pricing for 'charismatic carbon' projects (e.g., Trees for Life sales at £50 for a Pending Issuing Unit (PIU), Wilder Carbon demand at £75/PIU), the modelling assumes a price of £60 per saltmarsh carbon credit rising at 1% real growth and a nominal price cap of £150 per saltmarsh carbon credit.

As the Saltmarsh Code is still under development, the buffers for potential failure are not yet known. The modelling therefore uses risk buffer estimates from the Peatland Code. The restoration and maintenance costs are the same as the biodiversity section above.

The financial modelling demonstrates that the forecasted revenues are not sufficient to meet the capital cost (restoration costs) and operating costs (maintenance, project development and validation & verification costs). In this scenario, substantial grant funding will be required in order to make saltmarsh restoration financially viable.

The below case assumes a 30 year time horizon, whilst it is estimated that restored saltmarshes take 100years for the carbon stock levels to align with natural saltmarshes. Therefore, from a carbon point of view, it is beneficial to extend the time period to 100 years. Additionally, as stated in the biodiversity modelling for saltmarsh, further research is required to understand the restoration cost of saltmarsh creation in the Solway.

Table 3: Projected saltmarsh carbon revenues and costs (30 years)

	Low case (50ha)	Moderate case (250ha)	High case (750ha)
Carbon revenues	£2,243,627	£11,218,135	£33,654,405
Capital expenditure	(£3,005,000)	(£15,005,000)	(£45,005,000)
Operating costs	(£284,851)	(£1,330,319)	(£3,990,958)
Operating profit	(£1,041,224)	(£5,112,184)	(£15,336,553)
Internal Rate of Return	n/a – negative operating profit		

Assumptions: In the Solway, accumulation rates (t CO2e ha-1 yr-1) are estimated as 0-20yrs: 20.86t CO2e ha-1 yr-1; 20-30yrs 15.93t CO2e ha-1; Starting carbon price: £60 with 1% real price growth, Cost of Sales 3% of revenues, Inflation 2.5%. The assumptions exclude land acquisition / lease costs and tax / financing implications. All revenues and costs are increased by assumed inflation of 2.5% per year.

Seagrass - subtidal

Seagrass meadows have the potential to sequester carbon, however, the capacity to sequester carbon varies by locale, as does the potential for seagrass meadows to emit other greenhouse gases such as methane.[27] This is an issue especially with intertidal areas of seagrass. There is more evidence of the ability for subtidal *Zostera marina* to sequester carbon than for intertidal *Zostera noltei*.[28] For instance, the NEIRF-funded Plymouth seagrass pilot focused on the carbon sequestration potential of subtidal beds of *Zostera marina.* In Scotland, there is a need for more site-level data to understand variability in both the existing stock and sequestration potential of seagrass meadows.[29]

The below analysis uses carbon sequestration data from the South of England (Bideford) as a proxy for carbon sequestration for *Zostera marina*. As with saltmarsh, the analysis assumes a carbon price of £60 per credit rising at 1% real growth and a nominal price cap of £150. Restoration and maintenance costs are based on those required for subtidal seagrass restoration, protection and monitoring. Further assessment of sites, once selected following subtidal surveys, will help inform costings – for instance whether subtidal seagrass meadows would benefit from the installation of "eco-moorings" to protect the seagrass from damage caused by conventional moorings.

Table 4: Projected seagrass carbon revenues and costs (30 years)

	Low case (5ha)	Moderate case (10ha)	High case (50ha)
Carbon revenues	£172,463	£344,925	£1,724,626
Capital expenditure	(£310,815)	(£620,130)	(£3,139,648)
Operating costs	(£498,702)	(£787,162)	(£3,094,844)
Operating profit	(£637,054)	(£1,062,367)	(£4,509,866)
Internal rate of return	n/a – negative operating profit		

Assumptions (based on Plymouth subtidal seagrass project): Carbon credit starting price of £60 per credit with 1% annual growth to a nominal price cap of £150. The assumptions exclude any lease costs, eco-moorings, and tax / financing implications.

Oyster beds

The carbon revenue potential for oyster beds cannot yet be assessed. Although there is evidence that oyster beds can sequester carbon, the evidence base is mixed and at an early stage.[30] Therefore it is not possible to evaluate the income potential as if a suitable accreditation standard were in place.

Water filtration

Saltmarsh and oyster beds can act as "coastal filters" by intercepting nutrients from sources such as sewage outputs and rain runoff from adjacent land.[31] This can reduce the level of nutrients such as nitrogen or phosphorous entering the marine environment, helping to prevent eutrophication (excessive enrichment of nutrients).

[27] Agile Initative (2023) A blue carbon code for UK seagrass
[28] Thomas, O. (2021) Restoring seagrass boosts carbon storage
[29] Potouroglou, M. (2017) Assessing the role of intertidal seagrasses as coastal carbon sinks in Scotland; Potouroglou, M., et al. (2020) The sediment carbon stocks of intertidal seagrass meadows in Scotland
[30] Lee, H.Z.L., Sanderson, W.G. (2020) Real-time carbon budgets and the native oyster: carbon sink or source? Native Oyster Restoration Alliance
[31] Nelson, J.L., Zavaleta, E.S. (2012) Salt Marsh as a Coastal Filter for the Oceans: Changes in Function with Experimental Increases in Nitrogen Loading and Sea-Level Rise. PLoS ONE 7(8): e38558

Numerous projects are exploring options for such habitats to generate revenues from water filtration through "nutrient credits". For example, in the Chesapeake Bay in the US, the Chesapeake Bay Partnership has established a nutrient credit trading system. Under the system, oyster farmers can claim credits based on the number and size of oysters harvested, which can then be sold to organisations to help them meet their water quality targets[32].

Natural England has designated nutrient neutrality advice areas where new housing developments are not allowed to add more nutrient pollution to the catchment. This has led to the establishment of credit schemes such as EnTrade, which enables payments to farmers to reduce nutrient inputs, and a new scheme in the Tees Valley, through which developers can purchase credits at £1,825 per credit to deliver mitigation through wetland creation.[33] A similar policy does not exist in Scotland, and the market is currently focused on terrestrial interventions. Additionally, further evidence is required to provide accurate nutrient benefit estimates of UK coastal habitats.

Coastal defence

Coastal habitats including saltmarsh and seagrass can provide coastal protection by lowering the risk of flooding and erosion. For instance, the Office for National Statistics (ONS) values the flood protection potential of saltmarsh at an average of £1,126 per ha per year, based on the reduction in flood risk. However, the benefits vary greatly and are much higher in urban and suburban areas (up to £9,436 per ha) than in rural areas (as low as £27 per ha)[34].The ONS does not provide similar figures for seagrass and empirical evidence for the role of seagrass meadows in flood prevention is limited.

The market for coastal protection and flood management is currently unproven. It can be difficult identify and engage insurers and other potential buyers, often due to challenges in precisely quantifying the benefits of interventions. Moreover in Scotland, private landowners are responsible for maintenance of seawalls, whilst they are not the only ones to benefit from flood protection.

There are pilot river catchment projects involving some private funding for natural flood management, such as the River Wyre project, which blends public funding with a private loan from Triodos and payments from beneficiaries of reduced flood risk. [35] However, Finance Earth is not aware of similar projects for marine or coastal habitats in the UK. The SCAMP partners could explore opportunities for public funding for coastal protection or flood prevention. This may include the Scottish Government's Coastal Change Adaptation Programme[36] or SMEEF, which includes a focus on marine and coastal nature-based solutions to climate related impacts.

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[32] TNC (2021) Global Principles of Restorative Aquaculture

[33] Defra (March, 2023) Teesside first area to benefit from new scheme to unlock development and drive nature recovery. Press release

[34] Saltmarsh flood mitigation in England and Wales, natural capital - Office for National Statistics (ons.gov.uk)

[35] For the River Wyre project, see: https://www.greenfinanceinstitute.com/gfihive/case-studies/the-wyre-river-natural-flood-management-project/

[36] Sottish Government (January, 2024) Learning to adapt to coastal change

Analysis

Table 5: Summary of ecosystem service opportunities for SCAMP

Market	Viability		
	Saltmarsh	Seagrass	Oyster beds
Biodiversity	Financially viable using BNG as a proxy; voluntary market is nascent and BNG is England and terrestrial only	Financially viable using BNG as a proxy; voluntary market is nascent and BNG is England and terrestrial only	Currently insufficient evidence; voluntary market is nascent and BNG is England and terrestrial only
Carbon	Not currently financially viable; carbon code in development	Not currently financially viable; carbon code not anticipated in near-term	Currently insufficient evidence
Water filtration	Potential to filter nutrients; nutrient neutrality is England-only	Currently insufficient evidence	Model markets exist internationally; nutrient neutrality is England-only
Coastal defence	Mixed evidence base; no proven market and buyers can be difficult to engage; potential to explore grant funding opportunities		

Based on indicative modelling, biodiversity enhancements for saltmarsh and intertidal seagrass restoration are the most financially viable when using the Defra BNG Metric as a proxy. Given BNG only applies to England, and the voluntary biodiversity credit market is very nascent, further research and engagement with potential buyers is required to refine income estimates.

Alternatively, carbon sequestration for saltmarsh restoration could provide a monetisation route, but indicative modelling shows grants will still be required alongside the carbon income. Although potential saltmarsh restoration in the Solway is not currently eligible for the pilot Saltmarsh Code, which focuses on managed realignment, there is an opportunity for SCAMP to shape the development of this code, as the code developers are open to integrating other approaches to restoration. Once sites are selected for restoration, the financial modelling can be further refined with more specific costs. The potential carbon opportunity and costs for seagrass are dependent on species and will also need to be refined based on selected sites and interventions. This work could be supported by further grants or other potential funders (see section 5 below).

Finally, it is currently challenging to provide accurate modelling for ecosystem services from oyster beds, water filtration and flood management benefits due to a mixed evidence base, limited exemplar projects and frameworks that quantify environmental benefits.

5. Pathway to Scaling Up and Investment

Barriers

This study has identified several barriers to investment. Table 6 below summarises the key barriers, while the following section sets out recommendations to develop investment readiness.

Table 6: Summary of key barriers to investment readiness

Barrier	Description
Market-wide barriers	
Market maturity	Marine natural capital markets are in early stages of development, due to factors including a limited evidence base, lack of standards and uncertain revenue streams.
Limited track record	There is a limited track record for saltmarsh restoration in Scotland, and a limited track record of seagrass restoration in the UK generally.
Cost hurdles	High restoration / maintenance costs for marine restoration, with saltmarsh restoration costs ranging between c.£25,000-100,000/ha and seagrass up to c.£140,000 /ha, vs terrestrial restoration (for instance, the mean for peatland restoration in Scotland is £1,896/ha).[37]
Policy challenges	Policy frameworks to support marine natural capital markets are relatively underdeveloped and there is limited funding for restoration projects.
Ownership	The great majority of seabed in Scotland is owned by Crown Estate Scotland, which is still developing its natural capital strategy. Further clarity from Crown Estate Scotland is also required with respect to impact of sea level rise on landownership (as CE Scotland owns all land from mean low water (MLW) up to the 12 nautical mile (22km) limit). Responsibility of seawall maintenance sits with private landowners, whilst they are not the only ones benefitting from flood protection.
Solway-specific barriers	
Lack of pipeline	There is currently a lack of active saltmarsh, seagrass and oyster bed restoration projects in the Solway, resulting in a lack of empirical evidence.
Limited targets	There are limited targets for restoration outside of the targets for the SCAMPP technical proving trials. While supporting policies such as the Dumfries and Galloway Local Biodiversity Action Plan recognise the importance of

[37] SEFARI (2023), The cost of peatland restoration in Scotland. Work in progress.

	saltmarsh, seagrass and oyster beds, there are no specified restoration targets for these habitats.
Ineligibility for Saltmarsh Code	It is likely that most of the potential saltmarsh restoration in the Solway is ineligible for the pilot Saltmarsh Code in its current form due to its focus on managed realignment projects.
Unclear baseline	There is limited information on the scale and state of seagrass outside of Loch Ryan and for saltmarsh (especially in the English Solway). The potential for oyster bed restoration outside of Loch Ryan is also unclear.
Split jurisdiction	Jurisdiction over the Solway Firth is split between England and Scotland, resulting in differing market conditions.

Roadmap towards investment readiness

SCAMP is forward looking and recognises the need to explore new ways to attract private funding. This flexibility, as well as the important stocks of coastal habitats in the Solway, mean there is clear potential to overcome these barriers and support the wider development of marine natural capital markets. The following recommendations aim to supplement the existing work of SCAMP, to help orient the project towards investment readiness. Table 7 below summarises this roadmap of actions within the framework of the GFI Investment Readiness Toolkit.

Table 7: Roadmap of recommended actions to develop investment readiness

	Investment Readiness Milestone	Existing SCAMP Milestones and Deliverables	Roadmap to Investment Readiness (recommended actions)
Phase 1	**Initial project scoping**	• Baselining studies • Feasibility study • SCAMP restoration "vision"	1. Select potential sites for restoration 2. Quantify high-level costs and potential investment need 3. Identify grant funding opportunities & early-stage corporate funders
	Identify and work with Sellers	• Farmer engagement (saltmarsh) • Loch Ryan Oyster Company engagement	4. Soft engagement with landowners & sellers based on selected sites 5. Identify and engage with wider delivery partners (e.g., communities)
Phase 2	**Baseline and Estimate Ecosystem Services**	• Baselining studies • Marine Research Centre • Borderlands-funded pilot work: habitat restoration pilots and monitoring	6. Select key ecosystem service opportunities 7. Identify appropriate methodologies and interventions for restoration and clarify restoration costs 8. Carry out baselining on selected sites 9. Develop initial financial model
Phase 3	**Identify and work with Buyers**	• Engagement with local communities and businesses to inform SCAMP (existing and planned)	10. Map and shortlist key buyers and beneficiaries for engagement (local, regional and national) 11. Develop "teaser"/buyer engagement materials and hold engagement calls with key buyers 12. Refine ecosystem service revenue potential
Phase 4	**Develop Business Case and Financial Model**	• Feasibility study • SCAMPP Business Case and investment prospectus • Identified £20m investment need 2026-36 (of which c.£10m private investment)	13. Refine financial modelling assumptions based on costs, revenues and stakeholder input 14. Identify full investment need 15. Prepare business case
Phase 5	**Develop Governance Structure**	• Coastal community engagement • SCAMPP governance structure & project steering group	16. Understand risk appetite of stakeholders 17. Confirm preferred governance option/ legal entity to manage investment (e.g., independent company) 18. Establish governance structure
	Identify and work with Investors		19. Define investment ask 20. Shortlist key investors based on suitability 21. Hold investor calls/ meetings to understand investor appetite 22. Ongoing investor engagement
	Establish Legal Contracts and Closing		23. Identify required contracts 24. Instruct legal counsel 25. Draft and finalise contracts between key parties

6. Conclusion

SCAMP is an ambitious project that covers an area of important marine and coastal habitats. There is substantial opportunity for restoration within the Solway Firth, as evidenced by the reported regeneration of seagrass, the unique Loch Ryan oyster bed and the nationally significant extent of saltmarsh. Over the next year, the SCAMP partners should focus on selecting sites to develop further detail on potential ecosystem services and costs for restoration. This will enable SCAMP to prepare fully costed implementation plans to bring to potential buyers and investors. Such demonstration pilots will be crucial to provide a track record and evidence base for the development of marine natural capital markets and to build landowner confidence. Meanwhile, the biodiversity credit and carbon markets, and marine compensation policy, will continue to develop and mature. Given SCAMP's unique advantages, and the potential to trial new approaches to habitat restoration through SCAMPP, the project partners should engage actively with initiatives such as the development of the Saltmarsh Code. The SCAMP partners should also investigate further grant funding opportunities and identify corporates who may be interested in early-stage funding opportunities, and should engage with policymakers for support for the delivery of habitat restoration.

Annexe 1: Glossary of key terms

Biodiversity Net Gain: BNG is an approach to development that requires developers in England to enhance biodiversity in order to mitigate biodiversity loss due to development, such that an overall increase in natural habitat and ecological features is achieved. If BNG cannot be achieved within the development site, developers must purchase offsite biodiversity units, measured using Natural England's biodiversity metric, to meet requirements. BNG became a legal requirement for nearly all terrestrial development in England in February 2024.

Blended Finance: The strategic use of capital from public or philanthropic sources to mobilise private capital flows towards impact-orientated investments. Originally used in the context of sustainable development, the strategy is increasingly being utilised to stimulate climate and nature-related investment.

Blue Carbon: The term use to refer to carbon captured by and stored in the world's marine and coastal ecosystems.

Blue economy: Economic activities related to sustainable use of ocean resources. This includes ecosystem services such as carbon storage, coastal protection, cultural values and biodiversity.

Blue Finance: The financing of environmental goods, services and projects that aim at restoring, protecting or enhancing ocean related natural capital assets. In addition to environmental benefits, it may also involves social improvements and financial returns.

Carbon credits: Carbon credits are transferrable tokens representing the avoidance or removal of greenhouse gas emissions, measured in tonnes of carbon dioxide equivalent (tCO_2e). The purchaser of carbon credit can "retire" it to claim the underlying reduction towards their own GHG reduction goals.

Carbon markets: Trading systems in which carbon credits are sold and bought. Companies or individuals can use carbon markets to compensate for their greenhouse gas emissions by purchasing carbon credits from entities that remove or reduce greenhouse gas emissions. Carbon markets can therefore provide a flow of capital to marine restoration projects that are proven to sequester carbon, such as the restoration of wetland habitats.

Carbon offsets: A carbon offset is a reduction or removal of emissions of carbon dioxide or other greenhouse gases made in order to compensate for emissions made elsewhere. Blue carbon (see above) projects such as mangrove or seagrass restoration can register the impact of their activities on reducing or removing emissions and issue an equivalent volume of carbon credits for sale, provided their net carbon removal is quantified and adheres to certain standards set by governments or independent certification bodies.

Coastal Defence: Management techniques designed to protect shorelines from flooding and erosion caused by waves and rising water levels. Historically these have consisted of hard engineering solutions such as the construction of sea walls and groins; in recent years however there has been an increase in the deployment of schemes inspired and supported by nature. Coral reefs, seagrass meadows, mangrove forests, salt marshes, and sand dunes are all effective at dissipating wave energy and acting as a buffer against tidal storms and surges. A key benefit of nature-based interventions over hard interventions is that they often increase the resilience of existing ecosystems, and provide a wide range of benefits for other sectors, such as tourism and fisheries, as well as coastal protection..

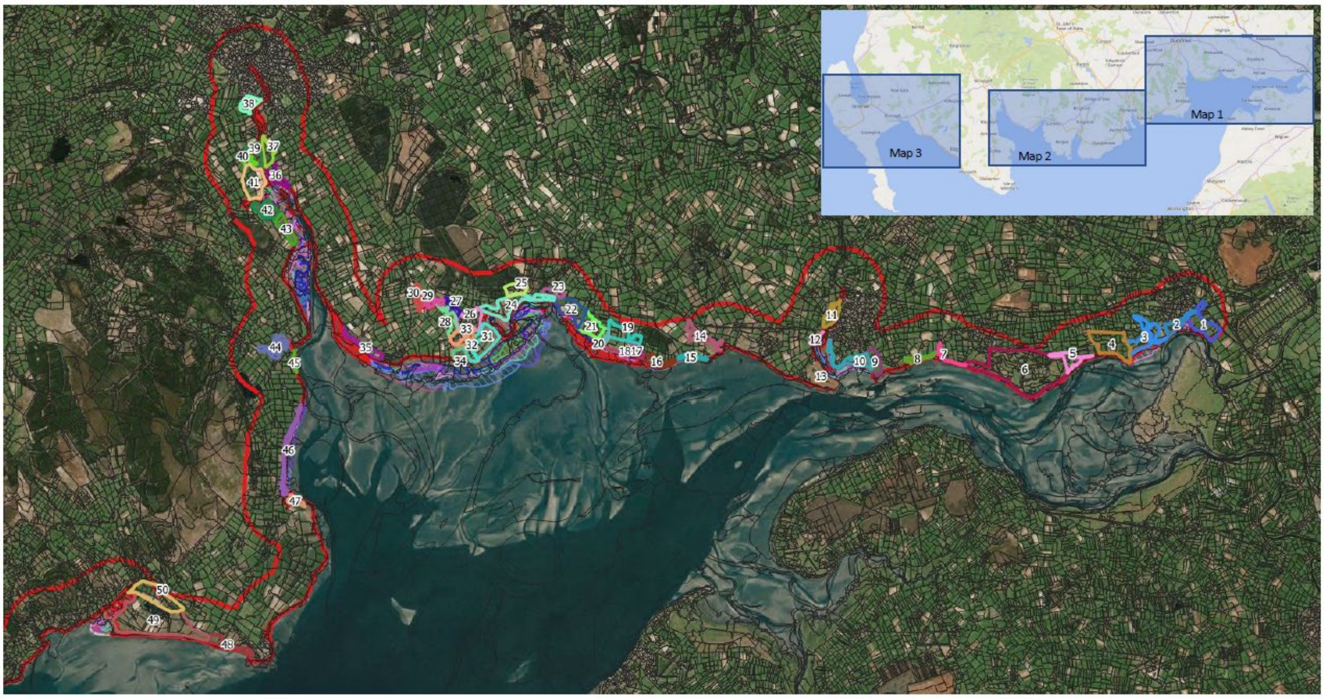
Ecosystem service markets: are used to trade positive outcomes resulting from an intervention on the management of a natural capital that aims to enhance the underlying ecosystem services. Ecosystem service markets are also called environmental markets or natural capital markets.

Managed realignment: Managed realignment is the planned breach of, or relocation of, sea defences further inland which creates sustainable, environmentally beneficial intertidal habitat in the form of mud flats and salt marshes. These coastal marshes help to dissipate wave energy and protect against erosion.

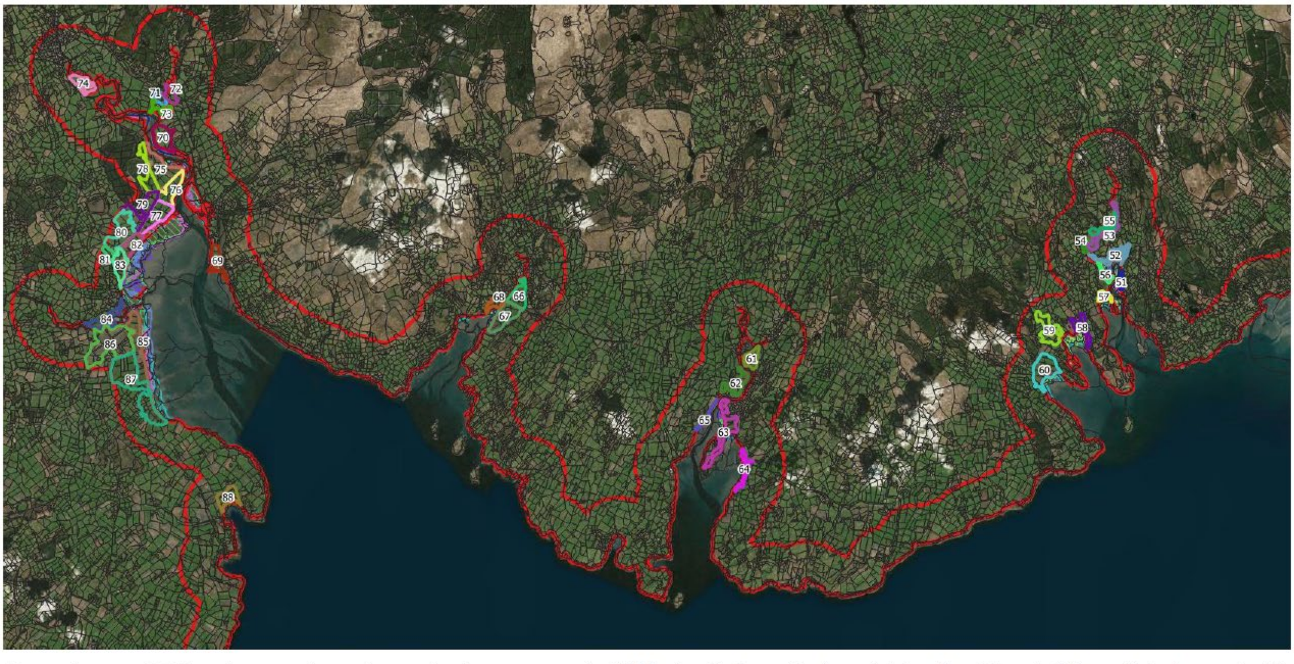
Voluntary Biodiversity Credits: Standardised units of positive biodiversity outcomes. These biodiversity units are generated by one or more actors through conservation or restoration of biodiversity, monitored over time, and verified. The credits could be acquired by those wanting to invest in positive biodiversity outcomes on a voluntary basis.

Annexe 2: Satellite imagery of saltmarsh opportunity areas

Credit: Reproduced from *Griffin, L.R. (2023). The potential for saltmarsh (merse) and pseudo-saltmarsh reinstatement or creation through managed realignment on the Solway Firth, Dumfries & Galloway. Solway Firth Partnership Commissioned Report*



Site overview – map 1. Saltmarsh opportunity mapping overview from east to west for D&G for sites 1-50 spanning the north Solway from Gretna to Southwick. Coloured site polygon boundaries shown alongside hatched areas of NVC "SM-prefix" habitat types. Red lines denote mean high water springs and its "buffer" to 1.5km inland. Field boundaries overlaid onto BING imagery.



Site overview – map 2. Saltmarsh opportunity mapping overview from east to west for D&G for sites 51-88 spanning the north Solway from Colvend to Wigtown (& Garlieston = site 88). Coloured site polygon boundaries shown alongside hatched areas of NVC "SM-prefix" habitat types. Red lines denote mean high water springs and its "buffer" to 1.5km inland. Field boundaries overlaid onto BING imagery.

Site overview – map 3. Saltmarsh opportunity mapping overview from east to west for D&G for sites 89-92 spanning the north Solway from Luce Bay to Loch Ryan. Coloured site polygon boundaries shown alongside hatched areas of NVC "SM-prefix" habitat types. Red lines denote mean high water springs and its "buffer" to 1.5km inland. Field boundaries overlaid onto BING imagery.

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