Paul Watkiss Associates

Adaptation Finance Case Study 2023 - Craigleith Retail Park Demonstrator

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Lead Author: Kit England
Contributing Authors: Paul Watkiss, Alistair Hunt

The authors are grateful for the support, comments and input provided from the Craigleith Partnership Ecosystem and project steering group: Ben Connor, Jonathan Casey, Dawn Lochhead, Fraser McNaughton, Fraser O'Halloran, Kerstin Marx, Katiera Donnelly, Mike Harrison, Liz Leech, Ellie Awford, Michelle Wormald, Emilie Wadsworth, Chris Arnold, Jenny McEwan, Raoul Curtis-Machin.

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Registered in Edinburgh. Registered Office: Caledonian Exchange, 19a Canning Street, Edinburgh, EH3 8HE

w: www.adaptationscotland.org.uk e: adaptationscotland@sniffer.org.uk

Executive Summary

This report presents the findings of the second phase of 'Finance and Economic advisory support services for the Adaptation Scotland Programme'. The work was undertaken by Paul Watkiss Associates (PWA) and was commissioned by Sniffer, as part of the Adaptation Scotland programme.

Craigleith Retail Park, in northwest Edinburgh, is owned by Nuveen, and managed by Savills. A 'partner ecosystem' of NatureScot, Royal Botanic Gardens Edinburgh, Hydro Nation, Green Action Trust, City of Edinburgh Council, SEPA and Scottish Water have been supporting Nuveen to explore the retrofit of blue-green infrastructure at the site. This project developed a business model to finance the work, reducing current and future flood risk (and to an extent, future heat risk) whilst increasing property values, footfall, biodiversity and air quality. To do this, the project reviewed the concept design, and assessed benefits, beneficiaries, and revenue streams, as well as exploring:

- Possible funding and financing sources.
- The strategic case for the private sector to invest based on financial risk.
- Existing business model typologies that could be transferrable.

Ecosystem services, benefits, beneficiaries and revenue streams

The study started with an analysis of the adaptation benefits of the project and potential revenue streams. This looked at both the economic benefits, which give the perspective of society, and the financial benefits, which give the private sector perspective. These are shown below:

Table 1: Benefits, beneficiaries and revenue streams associated with ecosystem services.

Category	Benefit type	Nature of good	Beneficiary	Revenue streams
Adaptation benefits	Moderation of extreme events – Drainage Infrastructure	Public	Scottish Water	Avoided infrastructure investment costs, Avoided running costs
	Moderation of extreme events – Surface water	Public and Private	City of Edinburgh Council, Tenants, Nuveen	Avoided infrastructure investment costs, Avoided running costs.
	Moderation of extreme events – Insurance claims	Private	Tenants, Insurance industry	Reduced insurance premiums
	Wastewater treatment	Public and Private	Scottish Water, Tenants	Avoided infrastructure investment costs, Reduced wastewater charges
Co-benefits, environment (Regulating services)	Local climate and air quality regulation	Public	City of Edinburgh Council, Nuveen, Tenants	Grant finance
	Carbon sequestration and storage	Public / private	Edinburgh City Council, NatureScot, high emitting companies	Government net zero / carbon credits (note private Carbon Credit markets would have lower values)
Wider Amenity benefits	Economic growth and property value uplift	Private	Nuveen Real Estate	Increased rental fees

The analysis of the private sector benefits found these to be modest, with the biggest benefits being the potential uplift in value of the retail park, followed by the potential savings from water entering the drainage system and thus reduced wastewater charges, though these benefits are highly uncertain.

A set of wider economic benefits were considered, that included carbon benefits and ecosystem service value, along with the potential to monetise these. These were found to be lower, and in many cases, it would be difficult to realise these benefits, due to the small size of the scheme.

Funding and financing sources

The analysis evaluated the deliverability, acceptability and quantum of finance arising from 31 available funding and finance sources from public and private sector perspectives. Unsurprisingly, the public sector is keen to mobilise private sector investment, whilst private sector actors tend to seek public funds to minimise or reduce investment costs given the limited short-term benefits or revenue streams. This indicates that there will need to be discussion and 'brokering' to get an agreed way forward on the scheme, and to agree with the relevant actors the potential for public and private blended finance.

Transferrable business models

The study then investigated possible business models. It reviewed different business models or ways of monetising adaptation benefits, with a strong focus on generating private sector revenues. This included analysis of good practice examples for these various approaches. Each of these is unique, including a combination of partners and solutions, and as this is a nature-based solution scheme they are also specific to the local context. However, a number of promising business model typologies are beginning to emerge. Risk reduction partnerships, green densification and urban offsetting all have potential to be applied to Craigleith. These promising business models were discussed with the stakeholders.

Proposed Business model

The findings were used to develop a business model and Strategic Outline Case for implementation. The rationale was to test if there are sufficient incentives for the private sector to invest without public sector support, and if not, the degree to which public support might be needed.

Based on the analysis above, the study considers a blended finance model might work for this scheme. In the model, public and private capital is blended to invest in the scheme, with revenue streams created from higher value of the units, and reduced pressure on the drainage systems to repay the private investment. This would be managed on a day-to-day basis by Savills, in their capacity as managing agents for the site. The various partners involved in this model is shown below.

The proposed programme would have a strong strategic fit with government policy, as well as with Nuveen's own stated objectives and aspirations as well as those of its owner, TIAA.

From an economic (societal) perspective, the scheme has a low economic justification, with a Benefit to Cost Ratio of less than 1 - i.e., the economic benefits are lower than the economic costs, when using government discount rates and a 30 year time period (note estimated BCR is 0.63:1 which indicates a small negative present value). The economic benefits predominantly arise from uplifts in property valuation and reductions in wastewater drainage. There are only very small benefits from other economic benefits streams associated with air quality and also from carbon sequestration.

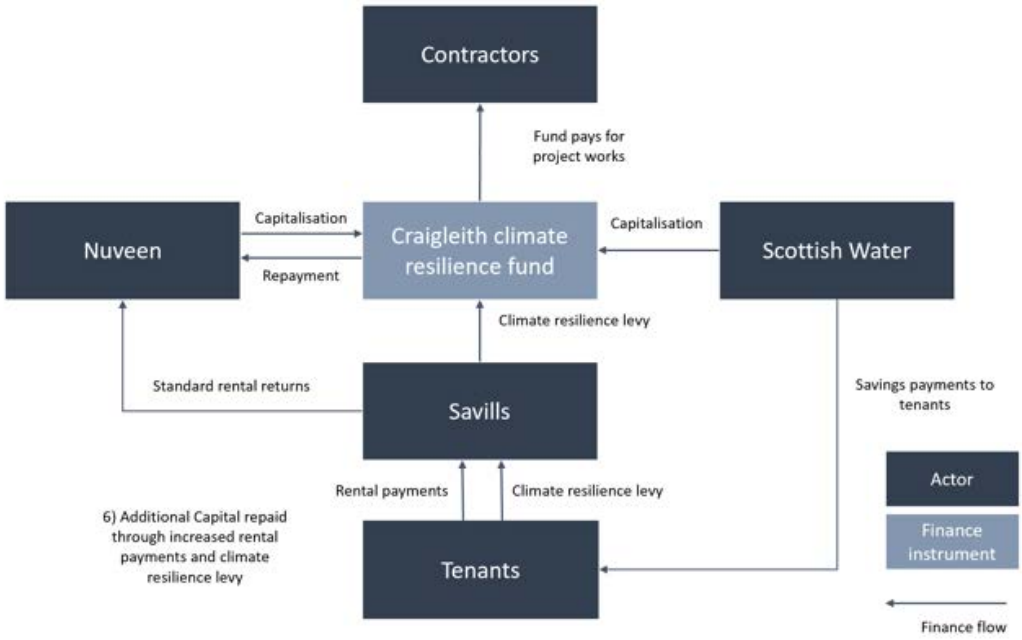

Figure 1: Craigleith Climate Resilience Fund.

From a private (financial) perspective, the scheme has to be at least revenue neutral, and potentially positive when considered over a 30 year period. This means that with gap finance from Scottish Water, the project should be able to generate sufficient revenues to pay back the investment costs. Such gap finance would also ensure a positive financial internal rate of return (IRR).

However, there are significant uncertainties around revenue generating, not least from the cost savings arising to Scottish Water and the rental value uplifts that Nuveen may be able to charge. A further analysis of benefits estimates and associated cost savings would be needed to be able to generate the final cashflow and reduce the risks with progressing the scheme.

Notwithstanding these issues, there are a number of reasons for Nuveen to fund or contribute more to the investment, including management of climate-related financial risk, first mover advantage ahead of regulatory framework changes, climate taxonomies and ESG scores. There are also potential benefits from developing public sector partnership, and capacity building within Nuveen.

The analysis above has also only focused on one option, the nature-based solutions. In normal economic appraisal, projects generate a long list of potential solutions to address objectives and then shortlist these and appraise to assess their relative value for money. This project only explored one scheme and it is recommended that a light touch appraisal of other solutions, including traditional 'grey' adaptation investments be undertaken to allow for comparative analysis.

Depending on the climate risks and benefits, the model may have a degree of transferability and replicability across Nuveen's wider portfolio, helping to reduce overall investment costs in adaptation through the use of a blended finance model.

Next steps

To take forward the model to implementation, the next steps involve collating further detail on the costs and benefits, finalisation of the financial model, and confirmation of roles and responsibilities. Partners could consider applying to NatureScot's new Facility for Investment-ready Nature in Scotland. FIRNS provides grants of up to £240,000 to help develop viable business cases and

financial models to attract investment. Partners should consider whether there is appetite to develop and submit an application.

Potential for scaling and replicating the model

The partnership ecosystem approach has been helpful for engaging the private sector. There are a range of aggregation platforms that partners could use in if there was appetite to explore scaling and replicating the model. Replication or aggregation could be undertaken in a number of ways:

- Across Nuveen's portfolio or wider real estate sector
- Across the city of Edinburgh
- At the Scottish or UK level through initiatives such as 3Ci, or Scottish Government's Green Investment Portfolio

However, all options are likely to have high development costs given the need for site-specific costs and benefits quantification and the high number of actors to engage, coordinate and manage. The partnership ecosystem should consider the extent to which TCFD could be used to scale this, based on an understanding of those companies in scope with physical risk which could also reduce flood risk in Scotland.

The new water charging principles for 2027 onwards in Scotland need to ensure they enable financial innovation which could enable this approach. The model employed here could be simplified, with reduced transaction costs, if Scottish Water could agree contracts directly with asset owners rather than billpayers.

Case study lessons

The work on the project identified several learnings, and particular challenges:

- Adaptation revenues are challenging to monetise, requiring significant effort and evidence to generate credible numbers, and many benefit streams are quite low.
- Despite being a strategic driver for large real estate companies, work under the TCFD framework has not progressed significantly enough to be a large driver for investment in adaptation options at the present time.
- Realising benefits face several barriers, including coordination and multiple actors.
- There are differing perceptions about who should pay (public or private).
- Value transfer methods for drainage savings as a result of implementing NBS are challenging, and likely to overestimate the savings – Scottish Water's own estimates were considerably lower over the project lifetime.
- The requirements to depreciate assets on a cashflow can represent a significant challenge to positive cashflow of NBS projects where the revenue streams are relatively low.

Despite this, it is positive that a bankable solution may be possible. In many contexts, it is not possible to identify and fund bankable projects. Finally the ability to design and deliver complex projects in this manner is likely to become a more important issue as climate impacts increase, making more work on such business cases important.

Key learnings for future projects

There are a range of key learnings for future projects, including:

- Being clear on the range of metrics and information that are required at an earlier stage of design to be able to quantify benefits and maximise revenue streams.
- Business model design could be conducted in tandem with concept designs to ensure that all options for revenue streams can be explored.
- Schemes could consider climate change mitigation, climate risk and adaptation options together to maximise the benefits and revenue streams.
- Standard economic appraisal techniques encourage longlisting analysis of a number of options. Without comparator schemes, the single solution adopted here makes it challenging to provide assurance of value for money, especially given the low economic benefits and revenue generation potential.

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1. Introduction

The Adaptation Scotland programme is delivered by Sniffer and funded by the Scottish Government. Previous work under the programme has included the production of an Adaptation Finance Guide[i], supported by an Adaptation Climate Finance Working Group.

Paul Watkiss Associates (PWA) has been commissioned by Sniffer to provide 'Finance and Economic advisory support services' for the Adaptation Scotland Programme. The first phase of this work undertook three adaptation finance business cases[ii].

This second phase complements these existing cases by focusing on an urban case study, with a private sector focus.

The case study commissioned by Sniffer focused on support for Craigleith Retail Park, a retail park in northwest of Edinburgh, owned by Nuveen, and managed on their behalf by Savills. A 'partner ecosystem' of NatureScot, Royal Botanic Gardens Edinburgh, Hydro Nation, Green Action Trust, City of Edinburgh Council, SEPA and Scottish Water have been supporting Nuveen to explore a retrofit of blue-green infrastructure at the site. Their vision is that this could be an exemplar demonstrator project, with the potential to be replicated or scaled-up across Scotland, in line with Scottish Government's aspirations for Water Resilient Places[iii].

With the early concept design already completed and indicative costings obtained, PWA was commissioned to:

1) Explore how the design could be funded or financed and develop a business case.
2) Identify learnings and recommendations from the project development process which could enhance development of future projects,
3) Assess the potential to use the project as the basis of wider replication or aggregation across Scotland, and the implications of such an approach for individual project dynamics.

Box 1: Key Definitions

Finance - For this study, we include all sources of funding and financing for adaptation from the public, private and third sector, and all financial instruments including grant, debt, equity and other. This follows the convention in the adaptation finance literature (see CPI, 2021) and uses 'finance' as a broad term to represent all investment in adaptation. However, it is noted that financing and funding are sometimes defined differently. Funding is sometimes defined as money (especially grants) that is provided by government / public sector. Finance is often defined as capital raised from financial institutions or other lenders (such as debt) which requires repayment. However, these definitions might be confusing here, for example, public funding of adaptation can be through debt that has to be repaid. We use the generic term of 'finance' for all investment in adaptation but note the differences between public and private sources and various instruments.

Blue-Green Infrastructure - Given the lack of a formal Scottish Government definition of Blue-Green Infrastructure, for the purpose of this study, blue-green infrastructure is defined in line with the EC definition (European Commission, 2021[1]), which defines BGI as:

"a *strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services such as water purification, air quality, space for recreation and climate mitigation and adaptation*"

2. Craigleith Retail Park overview and proposed design

Craigleith Retail Park is a small retail park located to the west of Edinburgh City Centre. It is 182,180 square ft, and receives over 30,000 visitors a week[iv]. The site is shown below:

Figure 2: Craigleith Retail park. Source: Nuveen Real Estate Management, 2023.

The site, including the land and the buildings is owned by Nuveen Real Estate (who in turn are owned by TIAA, the Teachers Insurance Annuity Association). Nuveen have over $1.1 trillion under management, with the Craigleith site sitting as part of their overall real estate portfolio. In this instance the fund in which the asset sits is capitalised by external investors. The site is managed on a day-to-day basis by Savills. The units are rented to well-known high street chains, including Homebase, M&S, Lidl, Currys, Boots, TK Maxx, Costa, Starbucks, and Superdrug.

The site itself currently has parking for 550 vehicles, but it is subject to a series of issues of pooled water / standing water. Whilst the site is currently connected to the Scottish Water sewer system rather than a culverted watercourse, SEPA's flood maps[v] highlight that the site is at high risk of flooding (a 1 in 100-year return period) and is located in Potentially Vulnerable Area 02/10/19. The site is also upstream of a series of sites which are vulnerable to flooding, including the Royal Botanic Gardens Edinburgh and Inverleith Park.[vi]

Figure 3: Overland Surface water flood risk and downstream impacts from a 1 In 100-year flood. Source: Harrison Stevens, 2023.

Scottish Water and the wider partnership ecosystem of public sector actors provided financial support to Nuveen to develop a new concept design for the site which sought to reduce the impacts on the drainage system, as well as realise the wider benefits of blue-green infrastructure. Harrison Stevens undertook the work - the outcomes are shown in Box 2:

Outcomes

This project will create an opportunity to showcase the possibility of retrofitting private grey infrastructure with blue-green infrastructure, to maximise site amenity and value while supporting best practice for surface water management and climate adaptation. The primary levers will be formed through sustainable drainage systems (SuDS) and other natural assets.

Outcome-based priorities for the Landscape Architect Brief, which will need to be baselined and measured through the project and beyond.

Primary outcomes (must have)
1. Support Nuveen's ESG credentials, & GRESB score through outcomes associated with water efficiency, community management and tenant engagement 2. Improvement in site amenity and user shopping experience 3. Site drainage compliance 4. Enhanced surface water management (reduction of water into drainage network) 5. On-site flood risk reduction 6. Documented processes to ensure a replicable process for BGI in the real estate sector 7. Enhanced biodiversity
Secondary outcomes (should have)
1. Increased footfall 2. Enhanced staff wellbeing and employee experience 3. Improve Climate Resilience and reduce heat island effect (car park and shop units)

Box 2: Site-specific outcomes for the redesign of Craigleith

To address the site-specific outcomes of the brief, Harrison Stevens visited the site to baseline the situation and identify practical constraints, developed a design concept, engaged with the tenants, the workers and visitors, and the partner ecosystem. This has resulted in a proposed scheme below, comprising a series of trees, planters and gravel strips, aimed at reducing the amount of standing water, the flood risk on the site, and downstream.

Figure 4: Proposed scheme design at Craigleith – Tree element. Source: Harrison Stevens.

In terms of the finance case study, the starting point for this has been different from many adaptation studies, as the site is in private sector ownership and the car park is reaching the end of its asset lifetime. Therefore, this represents an ideal window to consider the potential for private sector investment in adaptation options, and the associated role(s) of the public sector to unlock that investment.

A particular focus has been on bridging the gap between the traditional amounts paid to deliver a standard car park resurfacing and the additional cost of a blue-green infrastructure scheme. Outline costings for both a standard design and a blue-green concept indicate a funding gap of ~£633k – with a traditional resurface costing £586,000 and the revised blue-green concept design costing £1.219m. The costs also account for contingency and inflation. The breakdown is shown below:

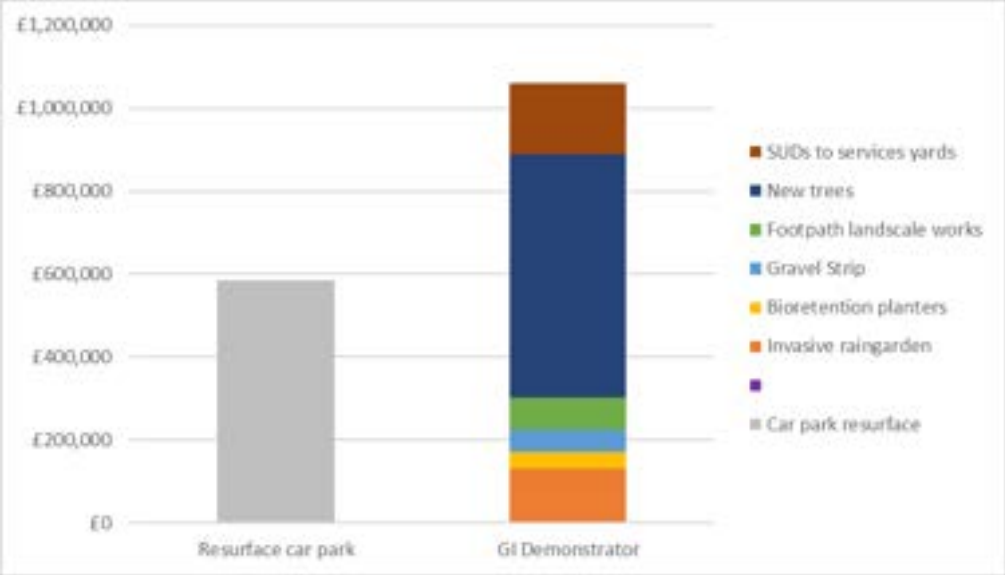


Figure 5: Comparative assessment of concept design costs for traditional resurfacing vs. BGI design at Craigleith. Source: Harrison Stevens.

Whilst a standard Treasury-compliant business case normally involves generating a long list of options to meet policy objectives, the existing commission of a concept design meant that to arrive at the preferred business model and funding approach for the scheme, the study adopted a four-step process:

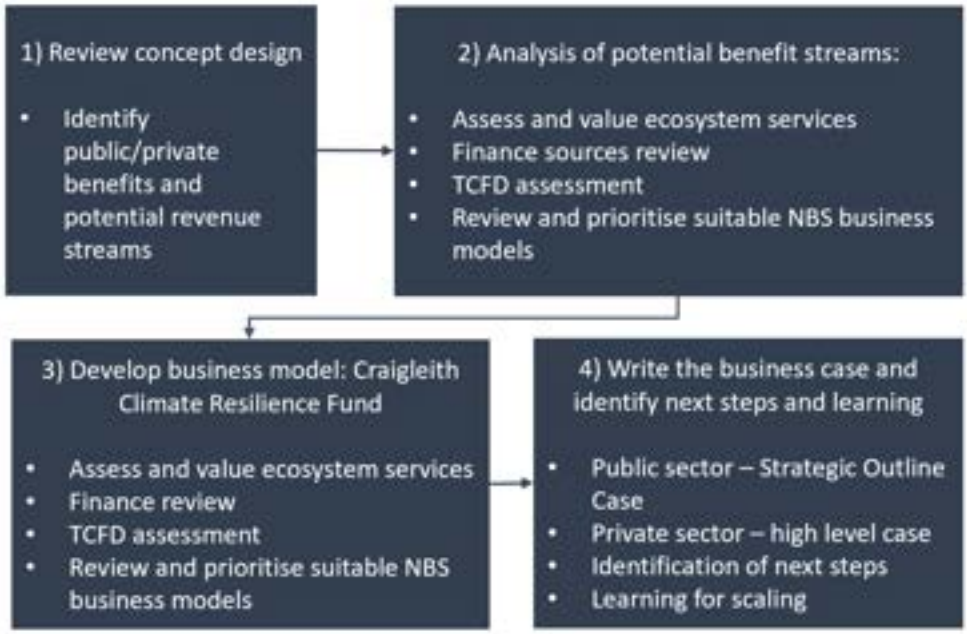


Figure 6: Adaptation financing options development process.

Stage 1) Review of concept design - The starting point was to review the concept design to identify a range of activities which would help identify the types of benefits provided, both adaptation and the wider co-benefits, the potential revenue streams from these benefits and their potential beneficiaries.

Stage 2) Analysis of potential benefit streams -The next step was to understand the potential size of the benefits and to look at the potential to monetise these, i.e., in terms of potential revenues.

- **Ecosystems services valuation -** The analysis reviewed the ecosystem services of the concept design and where possible quantified these in monetary terms. The focus was on assessing the co-benefits of a blue-green approach, again to expand the potential list of revenues and also the possible partners willing to pay. In addition to the concept design, the project explored the potential for a green roof but this was excluded from the final analysis due to the limited additional benefits and high costs.

- **Finance sources review** - The analysis identified thirty-two funding and finance options with potential for use in the Craigleith project. The list identified funding sources and instruments that could be used to address the issues of surface water flood risk. However, where there was potential to realise wider co-benefits (mitigation, health, wider adaptation etc) such sources were also included. These were reviewed with stakeholders to develop an initial long list, which was then prioritised based on acceptability, deliverability and quantum. Sources were scored from public and private sector perspectives, to identify differences of attitudes and potential overlaps.

- **TCFD Assessment** – The analysis reviewed the current approach of Nuveen and its owner TIAA, to the emerging framework of climate-related financial risk, before identifying the climate-related financial risks of the current site and how the adaptation options would address them.

- **Review and prioritisation of nature-based solutions business models –** The analysis reviewed the literature on promising business models for financing nature-based solutions. These identified three relevant typologies to consider for the development of a unique business model, as well as successful examples, strengths, barriers and solutions to overcome them.

Stage 3 – Business model development - The next step was to use these findings to develop a potential business model to finance and deliver the proposed concept design – the Craigleith Climate Resilience Fund.

Stage 4 – Business case, next steps and learning – The final step was to develop a high-level business case for the fund, including a cost-benefit analysis (CBA). This included a light-touch private sector business case, and a strategic outline case for the public sector. Whilst a range of economic appraisal techniques were potentially suitable, CBA was selected to provide an approximation of societal preferences given the likely presence of public sector funds in any solution, the availability of quantitative data, and the low/no regret nature of the project solutions identified. Finally, the analysis identified a range of next steps, and learnings from the case study which had wider implication for the successful uptake and scaling of NBS in Scotland.

In all cases, a design lifetime of 30 years was used for the assessment, in line with the Green Book's guidance on refurbishment of existing buildings. Further information on the detail of each of the methods used in each of the tasks is included in their relevant section.

3. Analysis of Benefits and Revenues

4.1 Task 1 - Ecosystem Services assessment for economic appraisal

As the proposal is centred on blue-green infrastructure, the study considered the ecosystem service benefits arising from the proposed concept design and mapped these to the associated potential beneficiaries. This was used to help identify a potential business model and support the economic case for the use of public sector funds in the final business case.

Ecosystem services refers to the concept that there are direct and indirect economic benefits of ecosystems to human-wellbeing, and that they can be measured, providing an input to economic appraisal. This is related to 'Natural Capital Accounting', which considers the stock of natural capital that generates this flow of ecosystem services. These are broadly divided into four categories:

Table 2: Categories of ecosystem services. Source: TEEB (2010)

Category	Description
Provisioning Services	Ecosystem services that describe the material outputs from ecosystems. They include food, water and other resources.
Regulating Services	Services ecosystems provide by acting as regulators e.g., regulating the quality of air and soil or by providing flood and disease control.
Supporting services	These underpin almost all other services. Ecosystems provide living spaces for plants or animals; they also maintain a diversity of different breeds of plants and animals.
Cultural services	Cultural services include the non-material benefits people obtain from contact with ecosystems. They include aesthetic, spiritual and psychological benefits.

Blue green infrastructure (BGI) provides a range of these ecosystem services, and associated benefits. These include managing flooding, increasing water quality, improving amenity, health and wellbeing, as well as potentially education and biodiversity. The study compared the concept design for the retail site and BGI against the TEEB categories above to identify which to take forward for quantification and valuation. The authors used expert judgement on the range of benefits likely to arise, and whether they were likely to deliver a material benefit. In addition, given available evidence around the impacts on real estate and property prices, economic growth (in the form of rateable values), was also included in the assessment. The full scope is shown below:

Table 5. Ecosystems services of concept design assessed.

Category	Service	In scope?
Provisioning	Food	N
	Raw Materials	N
	Fresh Water	N
	Medicinal resources	N
Regulating	Local climate and air quality regulation	Y
	Carbon sequestration and storage	Y
	Moderation of extreme events	Y
	Wastewater treatment	Y
	Erosion prevention and maintenance of soil fertility	N
	Pollination	N

	Biological control	N
Supporting	Habitats for species	N
	Maintenance of genetic diversity	N
Cultural	Recreation and mental and physical health	N
	Tourism	N
	Aesthetic appreciation and inspiration for culture, art and design	N
	Spiritual experience and sense of place	N
Other	Economic growth and property value uplift	Y

Having identified the longlist of potential benefits arising from the scheme, the analysis reviewed the concept designs to identify evidence on the quantitative benefits delivered and so to quantify (indicatively) the market and non-market benefits. These were quantified over a thirty-year period, which is a normal period for a real estate asset.

The values generated were intended for use in a government type economic appraisal. This is based on the overall societal costs and benefits and uses a cost-benefit analysis (CBA) which assesses a project by estimating the economic benefits it produces over time, and comparing these to the costs, in present-value terms. These benefits can include direct financial benefits, but they also include non-market benefits, such as environmental benefits. Together these represent the societal (or socio-economic) benefit. Note that a government economic appraisal includes market and non-market values, and so is different to a private sector financial analysis. For this study, an analysis of all benefits is made first, and then the potential for which of these might be possible to capture as revenues is made. More detail on the key terms used in economic and financial appraisal is set out in Box 3 below:

Box 3: Key economic terms

Cost Benefit Analysis (CBA). CBA is an economic decision support tool that compares all relevant costs and benefits to society (including non-market effects) of a project, program, or policy over a certain period. Costs and benefits are expressed in present value terms by applying a discount rate. This allows the analysis of the economic value of the project, program, or policy, expressed in metrics such as a net present value (NPV) or benefit-to-cost ratio (BCR).

Discounting. In economic appraisal and CBA, costs and benefits are estimated in 'real' base year prices, which means the effects of inflation are removed. Costs and benefits that arise in different future years are adjusted to provide equivalent, directly comparable values using discount rates, and expressed in present values terms. This is the standard approach in economic appraisal, and takes account of the fact that individuals and society prefer to receive goods and services now rather than later. The choice of the discount rate will depend on the context and country.

Net Present Value (NPV). The present value is the sum of a stream of future values that have been discounted to bring them to into a single present value. Once the present value of costs and of benefits are assessed, these can be used to estimate an overall net present value, calculated as the present value of benefits minus the present value of costs.

Benefit to Cost Ratio (BCR). The BCR presents the total present value of benefits divided by the total present value of costs. Interventions that have a benefit to cost ratio of >1 have a positive net present value.

The results from the ecosystem services assessment are set out below.

Air quality regulation, carbon storage and sequestration

In order to estimate the environmental benefits of the scheme in monetary terms we used the following input data:

1) Number of trees proposed to be planted by the site developer;
2) Annual absorption rates of pollutants – including nitrogen dioxide (NO2), sulphur dioxide (SO2), particulate matter (PM), carbon dioxide (CO2) – expressed as tonnes per tree based on an average mature tree over the lifetime of the scheme;
3) Unit values of the benefits - in economic terms (societal benefits, from reduced health impact), and on a per tonne basis – of pollutant absorption.

The data for the local air pollutants – NO2, SO2 and PM – for (2) and (3) above are those provided by the B£ST tool (Benefits Estimation Tool – Valuing the benefits of blue-green infrastructure (B£ST), CIRIA (2019)[vii] The B£ST tool is an established database of unit values derived from the scientific literature. While these benefits are estimated, they have low potential to generate revenues, as they are non-market in nature.

The data for CO2 sequestration for (2) and (3) are taken from the Woodland Trust[1] and the European Environment Agency,[2] respectively. The data is presented in the table below, together with the total annual benefits that are estimated by multiplying the tonne/tree data by the unit value (£/tonne/year) for each of the four pollutants. It is stressed that this is the societal value used for carbon sequestration in appraisal, but current financial or traded prices are much lower. Therefore, while the high value is shown in the table below, the actual value of carbon that could be realised from the scheme, especially from the private sector, would be very much lower.

Table 3: Annual site-specific benefits of 23 proposed trees.

Medium tree			£/tonne/year			Total Annual Benefits			
Pollutant		tonne/tree	Low	Central	High	No. trees	Low	Central	High
NO2		3.6288E-05	£10,736	£26,840	£42,945	23	£23.39	£23.97	£24.56
SO2		3.1752E-05	£1,680	£2,079	£2,364	23	£23.05	£23.07	£23.08
PM		0.00013154	£48,372	£61,780	£70,205	23	£29.36	£31.13	£32.24
CO2		0.022	£152	£305	£457	23	£26.34	£29.71	£33.05
Totals							£102.15	£107.88	£112.92

These amounts were then aggregated over a thirty year period, and the UK Government discount rate of 3.5% applied to provide an discounted present value of benefits over thirty years. These present value estimates are given in the table below.

[1] https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/british-trees/how-trees-fight-climate-change/
[2] https://www.eea.europa.eu/articles/forests-health-and-climate-change/key-facts/trees-help-tackle-climate-change

Table 4: Total benefits provided from tree planting over 30 years.

	Total Benefits (30 years, Present Value)		
Pollutant	Low	Central	High
NO2	£442	£453	£464
SO2	£436	£436	£436
PM	£555	£588	£609
CO2	£498	£562	£625
TOTALS	**£1,931**	**£2,039**	**£2,134**

Moderation of extreme events and wastewater treatment

The use of NBS as a way to tackle extreme events and support waste water treatment can deliver significant economic and financial cost savings, arising from

- Reduced sewer flooding and property damage remediation costs / potential for reduced insurance premiums.
- Improved compliance with CSO targets.
- Reduced sewage pumping costs.
- Reduced demand for new and expensive infrastructure (bigger pipes) and consequent uplift in development land values.
- Improved climate resilience of critical drainage infrastructure.

For Craigleith, the main water-related benefits arising from the NBS are estimated to be:

- Reduced costs of water treatment in the Sewer Network for Scottish Water
- Reduced risk of sewer flooding
- Reducing surface water flooding more broadly (i.e. within the car park)

Some of these are direct financial costs, and therefore might translate more easily to potential revenue streams, for example, the reduced cost of water treatment might be translated through to reduced waste water or sewage charges.

Some studies have sought to quantify these costs and benefits. For example in London[viii], the costs of distributed Sustainable Urban Drainage systems (SuDS) were identified and compared to providing the same levels of water retention in storage tanks. These were found to be beneficial on average, with significant levels of savings for street trees and living roofs. Given these figures were based on unoptimized average scenarios, benefits are likely to be higher than for this scheme.

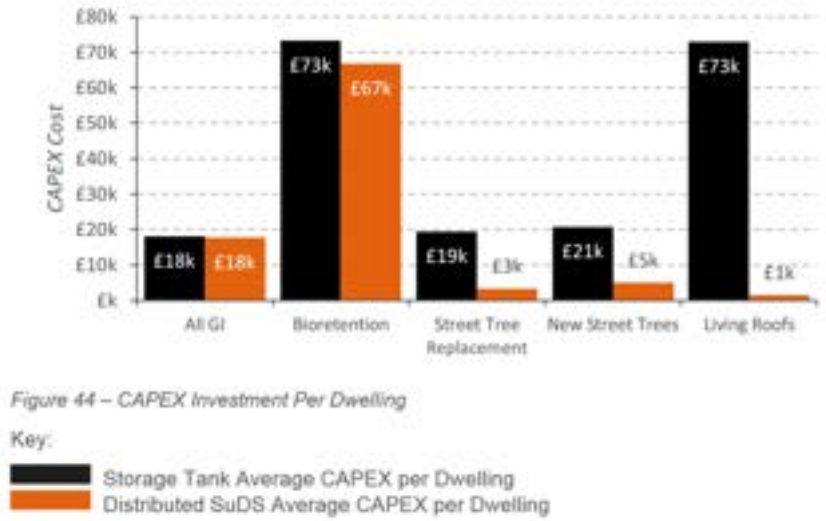


Figure 7: Relative CAPEX costs of storage tanks vs. distributed SuDS. Source: Arcadis (2020).

Whilst the moderation of extreme events and sewer flooding risk was cited as a key driver in the scheme design, during the concept design stage, no estimates of reduced peak flows into the drainage were developed. As such, in the early stages of valuation, it was not possible to quantify the potential benefits of this service provided by the scheme design either directly to Scottish Water, or through alternative measures such as CAPEX costs of storage tanks.

To try and overcome this limitation, the analysis undertook some value transfer of potential reductions from previous schemes. The value transfer of SUDS is very challenging as they are site and context specific. A variety of factors contribute to overall performance and associated economic and financial benefits – such as the localised pressure on drainage systems, risk appetites of stakeholders as well as different regulatory contexts. Despite this, some limited comparison is possible. This focused on the most promising benefit stream and associated revenue potential, from reduced run-off and therefore potential reduced drainage charges.

In England drainage charges are not uniform, but banded based on area, offering incentives to reduce surface water drainage[ix]. The Ignition project in Greater Manchester quantified the relative annual savings for a pipeline of 111 SUDS projects of varying sites across non-domestic properties based on moving the portfolio of sites to lower charging bands. On average, annual benefits were shown to be between 3.5% and 5.6% of the total costs:

Table 5: Savings percentages from IGNITION project. Source: Author, adapted from Evans et al. (2022)

	School Sites	Non-school sites	All sites
Number of sites	61	50	111
Area of SuDS	91,778 m^2	27,711 m^2	119,489m^2
Annual Savings	£91,874	£43,942	£135,816
Installation Costs	£2,569,784	£775,908	£3,345,692
Savings as % of install costs	3.58%	5.66%	4.06%

For the Craigleith project, these values were considered as a proxy for potential savings associated with handling waste water entering the Sewer system. The percentage values were transferred to

the green infrastructure costs associated with Craigleith to generate estimates of annual revenue savings to Scottish Water. These were then summed over 30 years and discounted.

Table 6: Indicative revenue savings for Craigleith site

.	Scenario		
	Low	Medium	High
Savings as % of install costs	3.58%	4.06%	5.66%
Annual savings	£29,177.00	£33,089.00	£46,129.00
Total benefits (30 years)	£875,310.00	£992,670.00	£1,383,870.00
Total benefits (present values)	£551,445.30	£625,382.10	£871,838.10

These figures solely measure direct savings to Scottish Water related to collecting and treating foul sewage, surface water drainage, highway drainage and trade effluent and therefore are likely to exclude wider benefit flows to Scottish Water such as savings on pumping costs. This was a very limited approach, and the figures should be treated with caution.

A key limitation is that the Craigleith scheme has relatively high capital costs compared to other tree planting solutions, meaning that there is the potential for these savings to be overestimated. The values do not include uplifts for climate change, though rainfall events are likely to be more frequent and extreme in future climate scenarios.

Having undertaken this value transfer approach, Scottish Water subsequently provided their own estimates of financial savings from the costs of treating water (Scottish Water, 2023). These estimated that based on 18,000m2 area of the car park, and the average annual rainfall of 727mm over the last 30 years, around 13,000m3 of water would be used

Scottish Water assumed that savings could be between 25p - 50p /m^3. This is based on the fact that Scottish Water's 2023/24 wholesale volumetric sewage charge is 94p / m^3, but that around 30-40% of that will relate to financing the £800m capital investment programme- plus other non-volume related costs and foul specific costs (sludge treatment).

The results of the assessment suggest a much lower saving to Scottish Water, than the Manchester value transfer approach, of between £3,250 / £6,500 per year – which is £98k / £196k over 30 years and c. £60k – £120k benefit in present values. Adopting a higher annual rainfall assumption would further increase the benefit.

Table 7: Indicative revenue savings for Craigleith site – Scottish Water assumptions

Scottish Water Estimates	Unit price[(i)]	Annualised savings [(ii)]	Totals over 30 years	Present values
Low	0.25	£3,250	£97,500	£61,425
Medium	0.475	£6,175	£185,250	£116,708
High	0.5	£6,500	£195,000	£122,850

Although both are estimates, the Scottish Water values were selected for use in appraising the economic and financial cases in the business case, since they are based on institutional knowledge and estimations, and the limitations of the value transfer method from Manchester outlined above. A priority in future project development should be to develop more accurate local estimates to understand the potential added value and add financial certainty to contracting based on this potential revenue stream.

Habitats for species

It is likely that some biodiversity-related benefits would be obtained from the enhanced and additional green infrastructure areas within the scheme, though given the urban context and size of area these are likely to be very small. In the past it was very difficult to capture the revenues from these non-market benefits, but initiatives such as biodiversity net gain offer some direct potential.

However, it is much more difficult to generate economic benefits for species, and unit monetary values are not available from the BEST database and do not appear readily available in the wider literature.

To address this, the study looked at the potential for applying the new Biodiversity Net Gain metrics in England[x]. This new approach in England provides outputs in 'biodiversity units', though further work is needed to provide a monetary valuation to this metric, which was beyond the scope of this project. We therefore are limited to a qualitative positive indication for this benefit component, though the potential for monetary valuation of Biodiversity Net Gain is an area which warrants future investigation.

Economic growth and value uplift

The final main source of financial benefit arising from the installation of green infrastructure relates to the land value and property value uplift. This is a more direct financial benefit that might be more usually considered in a private sector analysis of a scheme. This recognises that a more scenic area might increase the land value and property asset value, although this benefit would accrue to the site owner. However, a more attractive site might increase footfall, and therefore could have benefits for retail units at the park.

The installation of green infrastructure has been linked to the uplift in property values (Forest Research, 2010[xi]), but the range of benefits experienced varies widely, from between 1% to 15% (B£ST).

In this circumstance, given the limited number of beneficiaries, as well as the relatively modest nature of the scheme, the analysis adopted a cautious scenario of 1% uplift over thirty years. These additional benefits were then translated through to the rateable value. Rateable values provide an estimate of what it would cost to rent a property for a year, on a set valuation date. Two units (Nandos and Bensons Beds) were given average values of the wider units as rateable values were not available given they were subject to change of use or a combination of two units. All values were updated to reflect the new valuations released on 1st April 2023.

Table 8: Rateable values uplift over 30 years (present value)

Tenant	Rateable Value	Annual Uplift (1%)	30 yr undiscounted uplift (0.5%)	30 yr undiscounted uplift (1%)	30 yr undiscounted uplift (3%)	30yr discounted uplift (0.5%)	30 yr discounted uplift (1%)	30 yr discounted uplift (3%)
Currys	£294,500	£2,945	£44,175	£88,350	£265,050	£27,830	£55,661	£166,982
Lidl	£264,500	£2,645	£39,675	£79,350	£238,050	£24,995	£49,991	£149,972
Puregym	£225,000	£2,250	£33,750	£67,500	£202,500	£21,263	£42,525	£127,575
Trespass	£87,300	£873	£13,095	£26,190	£78,570	£8,250	£16,500	£49,499
Nandos	£235,339	£2,353	£35,301	£70,602	£211,805	£22,240	£44,479	£133,437
M&S	£452,500	£4,525	£67,875	£135,750	£407,250	£42,761	£85,523	£256,568
Nike	£205,250	£2,053	£30,788	£61,575	£184,725	£19,396	£38,792	£116,377
Homebase	£494,000	£4,940	£74,100	£148,200	£444,600	£46,683	£93,366	£280,098
TK Maxx	£241,750	£2,418	£36,263	£72,525	£217,575	£22,845	£45,691	£137,072
Homestore and More	£339,000	£3,390	£50,850	£101,700	£305,100	£32,036	£64,071	£192,213
Pets at Home	£146,750	£1,468	£22,013	£44,025	£132,075	£13,868	£27,736	£83,207
Bensons Beds	£235,339	£2,353	£35,301	£70,602	£211,805	£22,240	£44,479	£133,437
Superdrug	£136,500	£1,365	£20,475	£40,950	£122,850	£12,899	£25,799	£77,396
Boots	£259,500	£2,595	£38,925	£77,850	£233,550	£24,523	£49,046	£147,137
Card Factory	£74,400	£744	£11,160	£22,320	£66,960	£7,031	£14,062	£42,185
Starbucks	£73,800	£738	£11,070	£22,140	£66,420	£6,974	£13,948	£41,845
Total	**£3,765,428**	**£37,654**	**£564,814**	**£1,129,628**	**£3,388,885**	**£355,833**	**£711,666**	**£2,134,998**

The results showed that the planned investment could generate over £700,000 of benefit to Nuveen by 2052 compared to a status quo. This would extend to £1.86m under a 3% scenario. This value uplift could be turned into a revenue stream for the project from an uplift in rents that Nuveen is able to charge. However, a key consideration is ensuring it is unlikely to be big enough to trigger a revaluation, so as not to have immediate implications for costs and rental charges to tenants, as well as recalculation of drainage charging. The Scottish Assessors Association has not indicated that green infrastructure is a material consideration in its approach to the 2023 revaluation[xii].

Following the quantification of benefits, the study mapped the benefits above to the range of potential beneficiaries and associated revenue streams to help inform the potential identification of relevant financiers and potential revenue streams.

Table 9: Benefits, beneficiaries and revenue streams associated with ecosystem services.

Category	Benefit type	Nature of good	Beneficiary	Revenue streams
Adaptation benefits	Moderation of extreme events – Drainage Infrastructure	Public	Scottish Water	Avoided infrastructure investment costs Avoided running costs
	Moderation of extreme events – Surface water	Public and Private	City of Edinburgh Council, Tenants, Nuveen	Avoided infrastructure investment costs. Avoided running costs,
	Moderation of extreme events – Insurance claims	Private	Tenants, Insurance industry	Reduced insurance premiums
	Wastewater treatment	Public and Private	Scottish Water, Tenants	Avoided infrastructure investment costs, Reduced wastewater charges
Co-benefits, environment (Regulating services)	Local climate and air quality regulation	Public	City of Edinburgh Council, Nuveen, Tenants	Grant finance
	Carbon sequestration and storage	Public / private	Edinburgh City Council, NatureScot, high emitting companies	Government net zero / carbon credits (note private Carbon Credit markets would have lower values)
Wider Amenity benefits	Economic growth and property value uplift	Private	Nuveen Real Estate	Increased rental fees

Whilst there are some public benefits from air quality and carbon credits, the largest benefits arising from the scheme are likely to be realised by Nuveen in the form of the uplift of property values and rental increases, and by the potential changes in peak drainage flow and so site wastewater charges (though these are uncertain, due to the lack of site data and the transfer from other locations). However, whilst it is estimated that the Craigleith scheme will result in a modest uplift this is unlikely to trigger a revaluation, any future scheme will need to consider this implication.

4.2 Task 2 - Review of suitability of existing funding sources and instruments

The study next developed a long list of funding and finance options that were relevant to the concept design and assessed stakeholder's preferences of suitability for the concept design. This built on previous work undertaken for Adaptation Scotland's Adaptation Finance case studies. These spanned the public and private sector sources, and included both retail finance (i.e., at market rate), as well as concessional (i.e., below market rate). This was used to identify preferred sources of investment for a business model, including sources to bridge gaps arising from shortfalls in private sector investment appetite.

The analysis scored each funding source for its quantum, acceptability and desirability. To draw out the differing public and private sector perspectives, and to identify potential overlaps in interest, the

process was undertaken twice – once from the perspective of the public sector and once from the private sector. The overall quantum of finance was scored equally for both exercises, with acceptability and deliverability used as key differentials.

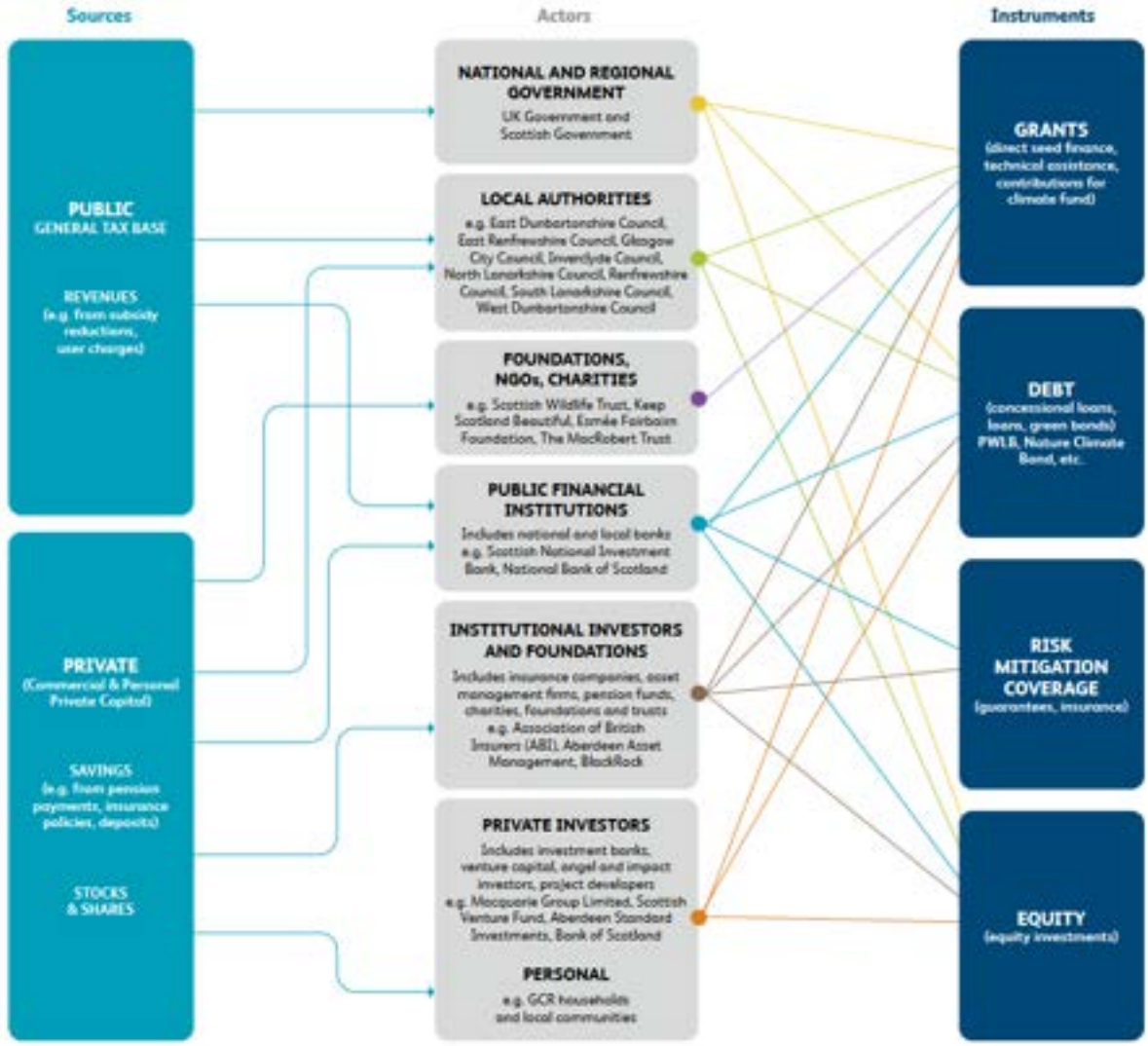


Figure 8: Funding sources, actors and instruments for adaptation. Source: Climate Ready Clyde, 2021.

In each case, the scoring was refined further based on discussions with the partnership ecosystem stakeholders. A full list of scoring is in Appendix 2, but the table below outlines the short list of highest scoring options from the public sector scoring activity:

Table 10: Preferred short list of financing options for Craigleith Retail Park (Public Sector)

Instrument	Acceptability	Deliverability	Quantum
22. Scottish National Investment Bank	4	3	5
23. Community Municipal Investments	4	3	5
19. Philanthropic Funding	4	3	4
21. UK Infrastructure Bank	4	2	5
26. Regeneration Funds	4	3	4
7. Nuveen Capital Investment contribution	4	3	4
11. Renewable Energy / Energy Efficiency revenues	4	3	3
18. Crowdfunding	4	3	3
20. Public Works Loan Board	3	2	5
24. Commercial Loans	2	3	5

Whilst the public sector highlighted a mix of public and private sector options for investment, initial assessments were dominated by public sector finance, reflecting the status quo of the adaptation finance landscape and the limited ability to reframe the scheme to access new finance sources. The scoring of public funding sources were revised downward following stakeholder feedback, to reflect the limited availability and deliverability of public funds, as well as the appetite for the public sector to support the private sector, rather than de-risk the project by providing public sector funding.

The same activity was repeated from a private sector perspective, and produced very different results, shown below. These were dominated by public sector sources, reflecting the low level of market development, the limited bankability of climate resilience investments (i.e. the ability of adaptation projects to meet the criteria for funding such as IRR or payback), the reputational impact (e.g. being associated with a climate resilience scheme funded via a tourism tax), as well as likely reception for sign off on the use of the instrument (e.g. use of crowdfunding or loans for the purposes of funding the adaptation scheme).

Table 11: Preferred longlist of financing options for Craigleith Retail Park (Private Sector)

Instrument	Acceptability	Deliverability	Quantum	Total
2. Levelling Up Fund	5	3	4	12
1. UK Shared Prosperity Fund (Capital Element)	5	3	3	11
20. Public Works Loan Board	3	3	5	11
26. Regeneration Funds	4	3	4	11
4. Scottish Water Capital Investment Programme	5	2	4	11
10. Tenant contributions / charging	4	4	2	10
19. Philanthropic Funding	4	2	4	10
23. Community Municipal Investments	3	2	5	10
25. Pension funds	4	2	4	10
3. Edinburgh and South East Scotland City Deal	5	1	4	10

However, despite these differences there was some commonality in that there was a mix of grant funding, and borrowing, a blend of public and private sources, as well as interest in innovative funding sources, such as community municipal investment and philanthropy.

Further opportunities – climate change mitigation revenue streams

Whilst the scheme design is broadly fixed, two further funding opportunities were identified as part of discussions with stakeholders. These did not relate to the current concept design but from wider improvements planned as part of net zero ambitions:

- EV charging – Nuveen have indicated that there are future plans to install rapid EV charging with a national operator, for which they are likely to receive a return for hosting the equipment.

- Solar PV – The large roof space of the buildings in the retail park are ideally suited for the installation of a Solar PV scheme. Indicative estimates generated through the JRC's PVGIS system indicate that a relatively small (50kw) Solar PV system on the roof space could potentially contribute around £100,000 of revenue over the first 20 years of the scheme.

There is the potential to explore including these measures within the business case as part of a more holistic climate roadmap for the site. In both cases, more detailed analysis would be required to confirm the costs and benefits, as well as the structural suitability of the roof space for Solar PV.

4.3 Task 3 – Private sector strategic fit - Financial risks of climate change

To inform the potential business models, an early part of the case study was to assess the strength of the case for private sector investment in adaptation. To do this, the study outlined the impacts of climate change on infrastructure and built environment assets and reviewed the publicly stated aspirations and approaches to managing climate change risks by TIAA and Nuveen. A qualitative assessment of climate-related financial risks arising from the Craigleith retail park was then completed and an outline produced setting out how the proposed concept addresses them.

This information provides important context to help better understand the enabling conditions and to support the strategic case for Nuveen to take forward the Craigleith site as a demonstrator. This approach is relevant in light of the changing regulatory context for the private sector under the frameworks of the Task Force on Climate Related Financial Disclosures (TCFD). A summary of this framework and how it is being deployed in the UK is included in Annex 2.

Financial impacts of climate change on infrastructure and built environment assets

Whilst the project is specifically looking at the Craigleith site in Edinburgh, the site is one of 14 retail parks Nuveen own in the UK as part of a real estate portfolio. In turn, Nuveen is owned by Teacher's Insurance and Annuity Association of America (TIAA), a pension fund based in the U.S. and therefore has a much larger portfolio of site assets.

When considering infrastructure and the built environment, climate impacts have a range of impacts on financial performance. These arise across the design, construction, and operation phases, and can occur due to increased construction costs, risks from asset value loss, increases in operation and maintenance costs, reductions in revenues and /or economic return and cashflow variability[xiii]. These are illustrated below:

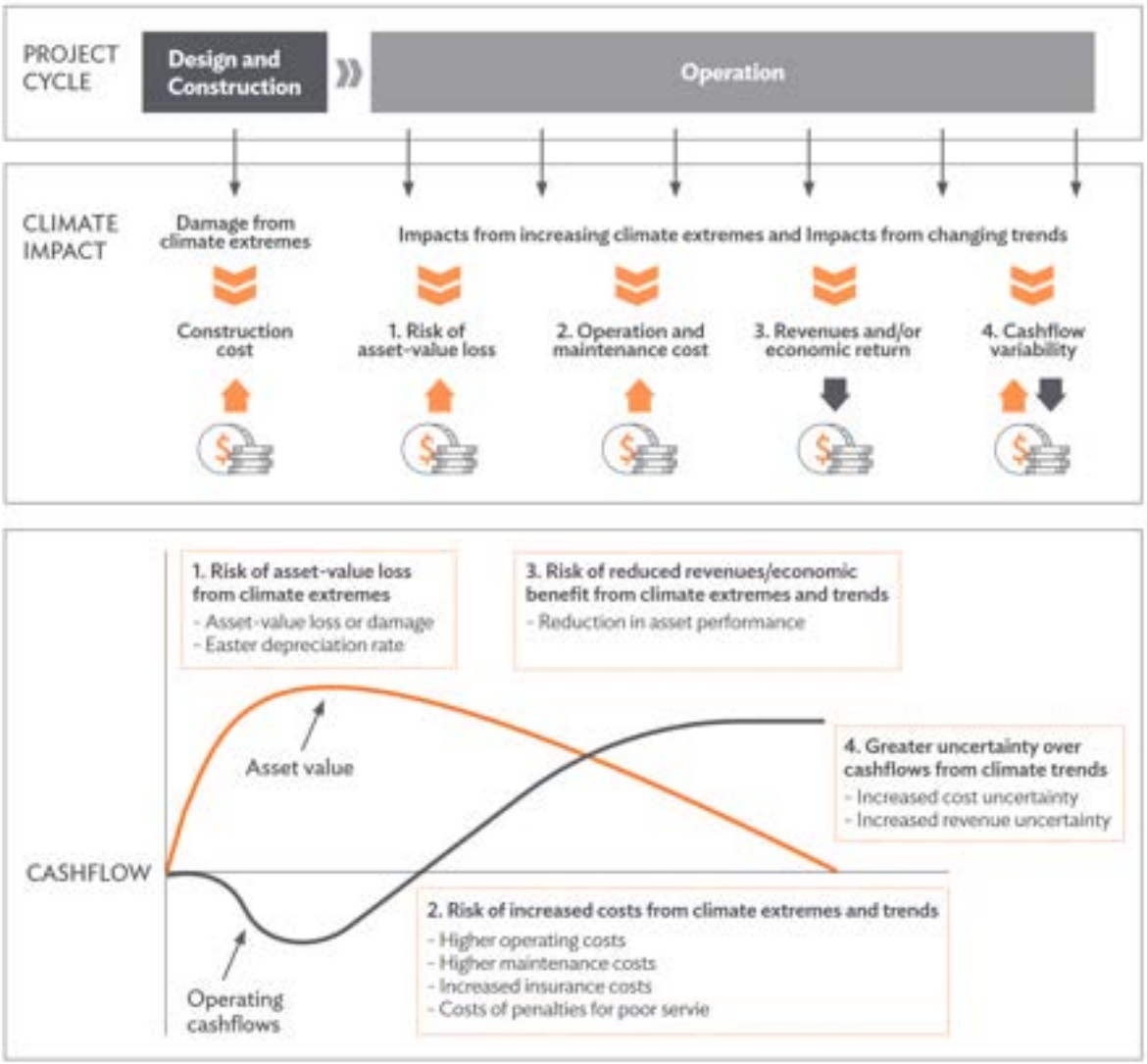


Figure 9: Impacts of climate change on infrastructure asset financial performance. Source: Global Centre on Adaptation and ADB, 2021.

Building on this, recent developments in investing in adaptation across the lifetime of the assets have shown how an optimised approach to construction which incorporates physical climate risks can optimise these cash flows over time[xiv].

The diagram below provides a stylised illustration of this. The Business as usual (BAU) curve fails to integrate climate risks, other than through risk transfer. The “Current Resilience” curve reflects current perceptions regarding resilient investing. At present significant additional costs are not optimised over the asset life cycle, and there is an inefficient or inexistant recognition of the value of in terms of the long-term financial and structural performance of the asset. By contrast, the “Optimised / CCRI Resilience” curve recognises the performance gains, based on analysis of multiple resilience options and their impact on the value and performance of the asset.

Addressing climate risks as part of how an asset is designed and operates results in incremental and more predictable future cash flows. Additional benefits include improved credit quality simulations, or/and a more efficient allocation of costs across an assert life cycle. Other upfront costs associated with improved managerial and opex solutions, as well as feasibility, due diligence and financing costs are reflected in the cash outflows.

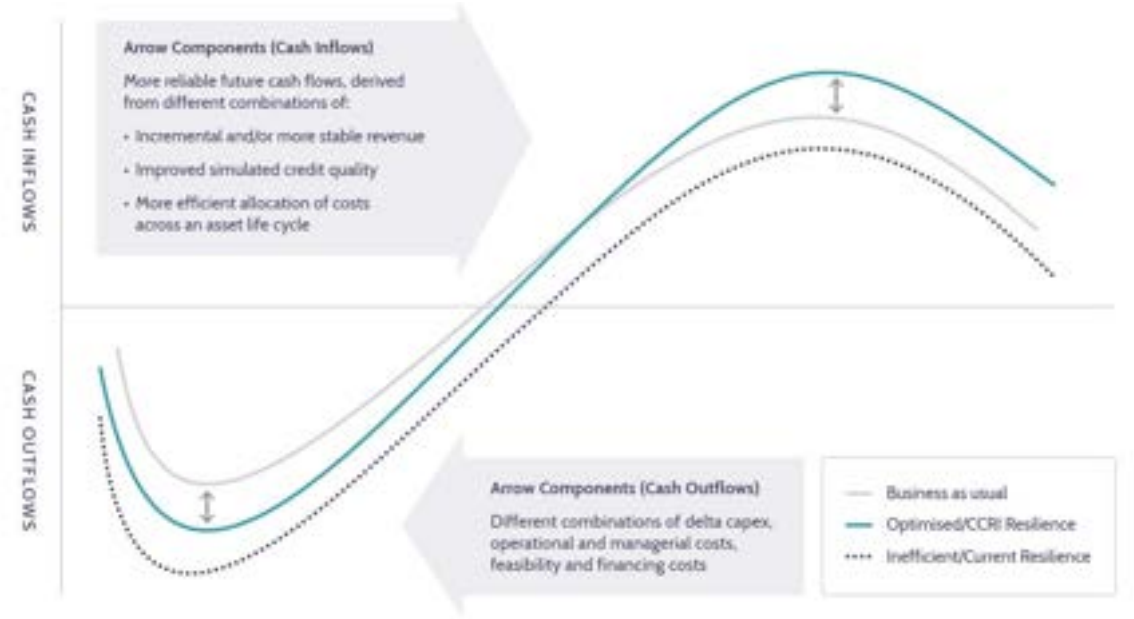


Figure 10: Stylised financial costs and benefits of integration of climate risks into infrastructure. Source: CCRI, 2021.

Nuveen's commitments to addressing physical risks of climate change

TIAA, Nuveen's parent company, committed to implementing the TCFD recommendations in 2018[xv], and has stated the aspiration to "deliver attractive long-term risk-adjusted relative returns to our clients in the face of climate change."[xvi]. It also states that "developing an understanding of how, where and when the physical effects of climate change will become financially material to an individual investment's financial performance is critical to protecting asset value and portfolio performance"[xvii]. Similarly, Nuveen have highlighted that their focus on physical risks is focused on understanding how, where and when physical risks will become financially material to an individual investment's financial performance. Whilst specific risks are not disclosed, TIAA have highlighted that climate risks relate to finance, compliance and regulatory, operations, reputation and strategy.

To take forward it's work on climate-related financial risks, TIAA has established a Climate Risk Task Force, and physical risk assessment and related data coverage across various investment types is one of the four areas of its work (TIAA, 2022).

The TIAA taskforce coordinates organisation-wide strategy on climate risks, with overall ownership by the Board of Trustees. From publicly available information, it appears TIAA and Nuveen have been adopting best practice approaches in assessing and appraising risk. This has included:

- Undertaking scenario analysis to explore how polices may impact progress on their objectives[3].
- Providing training on climate change across the organisation
- Incorporating data sources, such as Verisk Maplecroft Vulnerability data into real estate due diligence and municipal credit evaluation process.

[3] These have been aligned with the Network for Greening the Financial System scenarios, which are Integrated Assessment Models developed by academics and industry and used by central banks across the world to assess the risks to broader financial stability.

- Directly engaging with the companies comprising most of its financing emissions to disclose more information about strategies, incentive structures and risk management for the low carbon transition, as well as a set of KPIs to inform stewardship strategy on climate risk, including proxy voting decisions.

In addition to reviewing building or asset-specific risks and adaptation options, Nuveen also considers wider contextual factors for investments including the planned adaptation plans made by cities, future desirability and liveability of locations, and availability and affordability of insurance:

Figure 11: Factors included to assess financial impact from climate change. Source: Nuveen (2022).

A particular focus by Nuveen has been on integrating climate risk in the new investment process and annual business planning. New investments are screened for climate risk, with a climate risk analysis considered by the relevant Investment Committee. These seek to understand how climate risks could impact returns, and the potential adaptation options required. Dedicated discussions take place when hazards which are potentially financially material are identified. The outcomes are incorporated into annual business plans on an ongoing basis.

Sourcing	Underwriting	Due Diligence	Investment Committee	Annual Business Plans
Screen for future acute risk, chronic stressors and climate legislation in relevant market over a 30-year period.	Understand how climate risks could impact returns, investment required to mitigate risks and comply with regulations	Identify opportunities to improve efficiency and resilience	Include climate risk analysis in investment memo for committee's consideration.	Review climate-related impacts and compliance with local regulations.

Figure 12: Climate risk in Nuveen's investment process. Source: Nuveen (2022).

Whilst TIAA and Nuveen are taking forward a range of risk assessment work to help prioritise and manage climate-related financial risk, Nuveen has also committed to implementing resilience solutions to create value and prepare buildings for future climate conditions. Nuveen's responsible investment product platform commits to scaling projects that support mitigation and adaptation. The company is also working with the Shell Foundation to deploy USD 100m for climate resilience in emerging markets[xviii].

The approach to managing climate-related risks in TIAA and Nuveen suggests that there is a strong enabling environment for Craigleith, if the project satisfies the relevant internal criteria and addresses climate-related financial risks.

To support this assessment, a light-touch review of the potential climate-related financial risks identified in the current site was undertaken, and the benefits of adaptation arising from the proposed concept design, using the categories of risk identified by TIAA. The review was broadened from just flood risks, to also encompass overheating risks, as these are emerging in Scotland (O'Neill, S. and Tett, S. 2019[xix]). The results are presented below:

Table 12: Categorisation of relevant TCFD risks at Craigleith and benefits of proposed scheme.

Risk Type	Relevant climate-related financial risks	Benefits of adaptation
Finance	• Reduced revenues from tenants due to decline in attractiveness due to climate risk. • Challenges in filling vacant units • Liability risks to other parties arising from climate damages (e.g., damaged goods, inability to provide services) • Higher insurance costs	• Increased reliability of cash flow • Reduced risk of tenant relocation
Compliance and regulatory	• Future national / local climate-related regulation to address down-stream flood risks / wastewater system pressure. • Breaches of existing conditions and regulatory regimes.	• Reduced risks of unforeseen costs due to regulatory change
Operations	• Failure of planting regimes • Increased capital and revenue costs from extreme weather events • Increased cooling costs • Impacts on worker productivity	• More reliable and predictable maintenance costs • Improved productivity (and therefore profitability) of retail park.
Reputation	• Reputational damage from poor climate risk management leading to higher costs of capital / lower credit ratings	• Creation of reputational benefit contributing to lower costs of capital/ borrowing
Strategy	• Loss of first mover advantage as climate resilience becomes a mainstream marketplace requirement.	• Practical capacity building creating new capacity to implement TFCD-aligned strategy.

The proposed blue-green scheme appears strategically aligned to the aims and objectives of TIAA and Nuveen. However, the fact that the scheme responds to one climate hazard and associated impacts (Increased rainfall and surface water and sewer flooding), rather than several (e.g. heatwaves and overheating), a lack of financial data on climate risks and adaptation costs and benefits, as well as the lack of access to commercial criteria within Nuveen make it challenging to assess the potential impact on risk-adjusted returns and therefore the investment case. The focus on

flooding was driven by the interest and objectives of the current partner ecosystem and their willingness to fund a concept design. A more comprehensive climate risk and vulnerability assessment, with a quantitative financial assessment might help further strengthen the private sector rationale for investment.

Whilst the concept design for Craigleith could help alleviate climate-related financial risks for Nuveen, there are a set of broader challenges and solutions which also act as potential barriers:

- **Higher risk assets associated with a global portfolio** - The Craigleith site is part of a wider global portfolio of investments for both Nuveen and TIAA. Nuveen's interests cover USA, Europe and Asia Pacific. Given that climate risks are not evenly distributed globally, with many more likely in emerging markets and the global south, as well as the limited availability of resources, the Craigleith site is not likely to be the most pressing asset for adaptation investment.
- **Multiple investor attitudes to climate risk** - The Craigleith site is owned by a consortium of investors, not just Nuveen, who have varying degrees of ambition around the TCFD agenda. This means that investment approaches must reflect the diversity of these views, rather than solely Nuveen and TIAA's own perspectives.
- **High level private sector screening processes for climate risk analysis are insufficient to assess investment needs and potentially under/overplay climate risks –** The screening approaches being adopted through the TCFD have a number of limitations. Global datasets such as Verisk Maplecroft's data can also mask local conditions. This approach can undermine the case for investment in adaptation.
- **Pricing of climate risk and/or sustainability is not yet reflected in broader real estate valuations or ESG ratings**. - Being unable to capture the market value of climate resilience makes investment in adaptation more challenging.
- **Linking climate change and extreme weather to financial projections** - The uncertainty of climate change related extreme weather events, as well as the slow-onset or chronic climate risks, make it very challenging to turn the benefits of risk reduction into a financial cash flow which can then be used to calculate adjusted Net Present Value or IRR. There have been some attempts to do this, (Espinoza et al., 2023[xx]) but the efforts required are significant.
- **Lack of transparency on TCFD approaches and their effectiveness -** Whilst the TCFD is maturing rapidly, it is still challenging to assess whether TIAA and Nuveen's approaches are likely to be effective in addressing physical risk. As evidence is still emerging, the variety of climate models, scenarios and projections makes comparison difficult and commercial sensitivity makes business information hard to obtain and verify[xxi].

There is the potential for a more strategic partnership programme between Scottish Water and Nuveen to explore and further address some of these barriers on a portfolio basis. This is outlined in further detail in the final business case.

4.4 Task 4 - Transferrable Nature-based solutions business models

The final task focused on identifying and reviewing suitable business models for blue-green infrastructure. Due to the specific regulatory environment, the responsibility and ownership around risks and actions, the stakeholders involved and climate risks/co-benefits, projects use different business models to finance an urban NBS successfully. Whilst there are a large number of concepts and approaches being explored and developed, some common business model typologies are emerging. The NaturVation project identified eight business model typologies for urban nature-

based solutions based on 54 in-depth case studies both inside and outside of Europe (Toxopeus, H.S.2019[xxii]).

Three of these eight business model typologies are particularly relevant for Craigleith: the risk reduction model, green densification, and urban offsetting. For each of these, the analysis reviewed a series of databases and good practice examples to identify a potential business model. The sources reviewed were:

- DEFRA Natural Environment Investment Readiness Fund – A grant scheme providing between £10,000 to £100,000 to develop natural environment projects that support the UK's 25-year Environment Plan, and have a business model which has the potential to be scalable and replicable. 2 rounds have been completed, with 79 projects allocated funding[xxiii].
- EU's Urban Innovative Actions – Though now closed, the EU's UIA programme funded a range of projects to identify and test innovative solutions to sustainable urban development, with a focus on NBS.
- NatureScot Investment-Ready Nature Scotland programme.
- NaturVation own business model catalogue – the set of case studies developed as part of the wider Naturvation project.
- Other relevant grey literature – e.g., the offer documents for finance schemes.

Box 4: NaturVation Business Model typology

1. **Risk Reduction model** – In the risk reduction model, upfront investments into urban nature-based solutions are made to lower future costs from extreme weather events such as droughts, storms and floods.
2. **Green Densification** – The green densification model integrates nature-based solutions into (often large-scale) urban real estate development. The costs of creating and maintaining these nature-based solutions become an embedded part of a larger business case of 'sustainable urban living', captured through real estate value and economic growth.
3. **Local Stewardship** – local nature-based solution plots and trees are valued by citizens and businesses who are willing to protect and support nature in their neighbourhood based on the direct value and sense of identity and meaning that they derive from it.
4. **Green health** – the therapeutic, health and wellbeing value of urban nature-based solutions is recognized and used as a driver to finance urban nature-based solutions.
5. **Urban offsetting** – 'no net loss' approach incentivizes or requires offset investments into urban nature-based solutions that are lost because of real estate and infrastructure development within the city.
6. **Vacant space** – the government steps back and provides space for local initiatives and (social) entrepreneurship in (sometimes temporarily) unused urban public space.
7. **Education** – urban nature-based solutions are set up and managed to support environmental education and allow young, urban citizens to engage with food and nature.
8. **Green Heritage** – builds on cultural values and a sense of identity to sustain and develop urban nature-based solutions. The green spaces that support / are cultural heritage can lead to different types of value creation, ranging from tourism and education to cultural healing.

Source: Toxopeus, H.S. (2019).

Whilst the urban offsetting model appeared relevant for Craigleith, it was subsequently discounted as a result of the ecosystem services assessment, due the complexity of implementation and administration, compared to the benefits provided.

For the remaining two areas, the study provided an overview of the model, strengths, key barriers and solutions to implementation and some high-level examples of where the approach has been implemented (or attempted).

Area 1: Risk reduction models

In risk reduction models, actors make upfront investments in nature-based solutions to reduce current and future climate risks. These risks are assessed, and financial values are developed for damages under a business as usual scenario, and then compared to the benefits of adaptation options and residual costs after adaptation (as adaptation will not be 100% effective in removing all risks). The benefits are then captured and turned into revenue streams - for example through payments from water companies funded by avoided investment needs in more expensive adaptation, but also include potential co-benefits, for example from municipalities in increased tourism revenues.

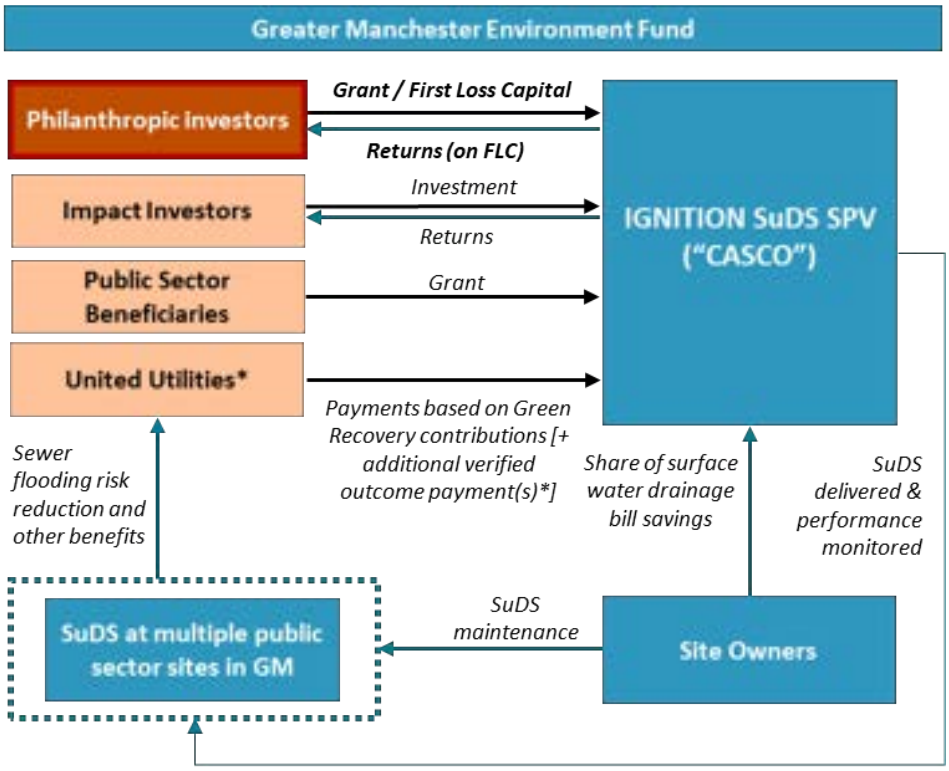
Table 13: Key barriers and solutions of risk reduction models

Barriers / Limitations	Potential Solutions
• Conflicting goals and policy objectives driving rationale for intervention	• Clarify and quantify goals and embed them in partnership agreements.
• Lack of awareness and valuation of benefits	• Initial quantification via modelling, Installation of monitoring equipment
• Issues around certainty of revenue stream for the long term, due to short charging periods.	• Use of a contractual mechanism to allow for long term, fixed price revenue stream from beneficiaries (normally water companies).
• Long term repayments of SuDS make it suitable for long-term asset owners	• Contract a managing agent as intermediary to ensure that charges remain collected regardless of change of tenants.

Best practice/ successful examples:

- **Greater Manchester -** The IGNITION project identified a package of SuDS projects across non-domestic properties in Greater Manchester. Sites were targeted based on their ability to install SuDS of a sufficient size that would lead to a benefit from the reduction in the run-off from the site, and therefore a potential revenue stream from reduced surface water drainage charges levied against that non-domestic property. These savings, aggregated across a number of sites and several years, provide a revenue stream to contribute to the up-front capital costs of SuDS installation[xxiv]. An outline of the original business model is shown below, along with a table of illustrative funders and benefits derived.

  However, the IGNITION model has not yet been implemented due to the limited performance benefits to the sewer network, as well as regulatory uncertainty associated with the issuance of an Environmental Impacts Bond. The scheme is now being progressed as a smaller scale blend of water company, DFE and long-term Local Levy funding, in partnership with impact investment from the Esmee Fairbairn Foundation.



Source of Investment	Outcome / Benefit
Regional Flood and Coastal Committee	Improved surface water management
Department for Education	Reduced flood risk at schools
Local Authority	Increased amenity and placemaking
Philanthropic Investors	Environmental benefits

Figure 13: Ignition Business Model, and potential investment sources and outcome benefits. Source: Evans et al. (2022).

- **Plymouth** – Plymouth City Council are working with Finance Earth, the Environment Agency, and Southwest Water to explore the potential for outcomes-based payments to improve water management in the public realm, with a results contract generating revenues for investors in return for fewer storm overflow events. Work is currently being funded under the NEIRF to develop an investment case, based on payments for reduced overflow events. This may be through a standard contract or an innovative instrument such as an environmental impact bond - where repayments are linked to overall performance, similar to energy performance contracting. Discussions with the team at Finance Earth highlighted similar challenges to Manchester, related to quantification of benefits from water flow reductions.
- **Washington DC, USA** – Environmental Impact Bonds have successfully been used at scale in the U.S, where Quantified Ventures placed a $15m bond to Goldman Sachs Urban Investment Group and Calvert Impact Capita for the funding of green infrastructure. (Quantified Ventures, 2018)[xxv].

Area 2: Green densification

The green densification model integrates nature-based solutions into (often large-scale) urban real estate development. The costs of creating and maintaining the project is embedded as part of a larger business case. This can be for sustainable urban living for residential development, or sustainable business, captured through real estate value and economic growth. Seeing the adaptation component as part of a wider investment programme in modernising assets also opens up the potential for blending with mitigation finance.

Table 14: Key barriers and solutions of green densification models.

Barriers / Limitations	Potential Solutions
• Limited appetite for interventionist approaches by public authorities	• Strong risk management approaches in place, and better appraisal of the value delivered by such approaches.
• Large value uplifts can trigger revaluations, increasing costs for tenants and owners.	• Implementation of scheme in phases in line with climate risk, to allow incorporation into rental values without triggering revaluation.
• Limited evidence on the value of ESG in retail park settings	• Direct monitoring of benefits on a test site, wider market development
• Many standards such as BREEAM do not adequately factor in climate resilience ratings	• Advocate for updated standards, position schemes as exemplar and leading market development.

Best practice/ successful examples:

- **Parc Marianne, Montpellier** - Parc Marianne eco-district in Montpellier is a green urban development that integrates green-blue infrastructure; As a coastal city, the design explicitly addresses flood risk by leaving space for the water to run through in case of flooding allowing for density and nature. The district also received ecolabel certification (2015) on thermal performance, quality of life, nature and biodiversity and mobility. The City bought the land in the 1980s and 90's and developed long term plans, with the City Council setting out detailed social and environmental requirements for the development of the new area. Developers then bought the land from the City, for around €110m, with the city setting the rents that the developers can ask for each flat. The scheme was successful due to a very interventionist approach, with the municipality buying a lot of land, controlling prices and planning the projects. Whilst successful, the key trade-off is the opportunity cost of the value of the land – this can make such schemes difficult to justify in the context of other near time priorities.

- **London** – The Greater London Authority pioneered the use of nature-based solutions to realise economic value through its Greening the BIDs programme. More recently, Islington has identified 1,000 potential sites for pocket parks and has been funded through the Natural Environment Investment Readiness fund to quantifying the potential ready for bundling, with an initial target of Business Improvement Districts as financiers.

4. Conceptual business model and business case

The above analysis has provided insights into an investment case that involves a mix of public and private sector actors, as well as potential models for Craigleith. These insights have been used to propose a high-level blended finance model. The business model has then been developed out into a government compliant business case (the UK Treasury five case business model[4], which assesses the strategic, economic, commercial, management and financial cases for the investment). Given the emerging need for gap filling from the public or private sector, we have then included a section on a case for gap funding from Nuveen.

Conceptual business model – Craigleith Climate Resilience Fund

The suggested business model for Craigleith is a hybrid of the three main options above – combining elements of a risk reduction partnership and blending it with outcome-seeking capital, to create repayable revenue streams from uplifts in property values and reduced pressures on the drainage system. The overall approach is outlined below and could work as follows:

1) Scottish Water and Nuveen would capitalise the fund for delivery of the capital works. The fund could be capitalised from the following sources:
    a. **Existing asset maintenance capital** - The standard capital allocated by Nuveen to the asset maintenance of the car park.
    b. **Additional investment** – an additional set of investment from Nuveen in recognition of the overall value uplift of Craigleith created by the scheme and the resilience benefits provided.
    c. **Gap finance** – Funding or finance from public or private sector to bridge the gap allowing the project to become bankable. This could be provided by Nuveen, Scottish Water, or another partner keen to enable this type of approach, such as Scottish Government or City of Edinburgh Council.
2) The fund would then be used by Savills to manage delivery of the scheme on site.
3) The project would result in peak flow savings, providing a series of cost savings to Scottish Water.
4) Scottish Water would retain a portion of savings, and repays a portion to tenants via rebates on their water bill for a set period (e.g. 30 years).
5) A dedicated levy would be added to bills alongside rental uplifts to reflect the financial benefits realised from the rebates generated by the investment as well as the wider attractiveness of the site (amenity benefits), potential increased footfall and reduced insurance premiums.
6) The dedicated levy would be paid into the climate resilience fund, whilst standard rental yields are returned to Nuveen in the normal way.
7) The climate resilience fund would provide a return to Nuveen over the 30 year period.

Each of the finance sources used in the model is explored in the funding statement below, looking at the level of repayment and the confidence in revenue generation.

[4] GUIDE TO DEVELOPING THE PROGRAMME BUSINESS CASE. HMT, 2018. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749085/Programme_Business_Case_2018.pdf

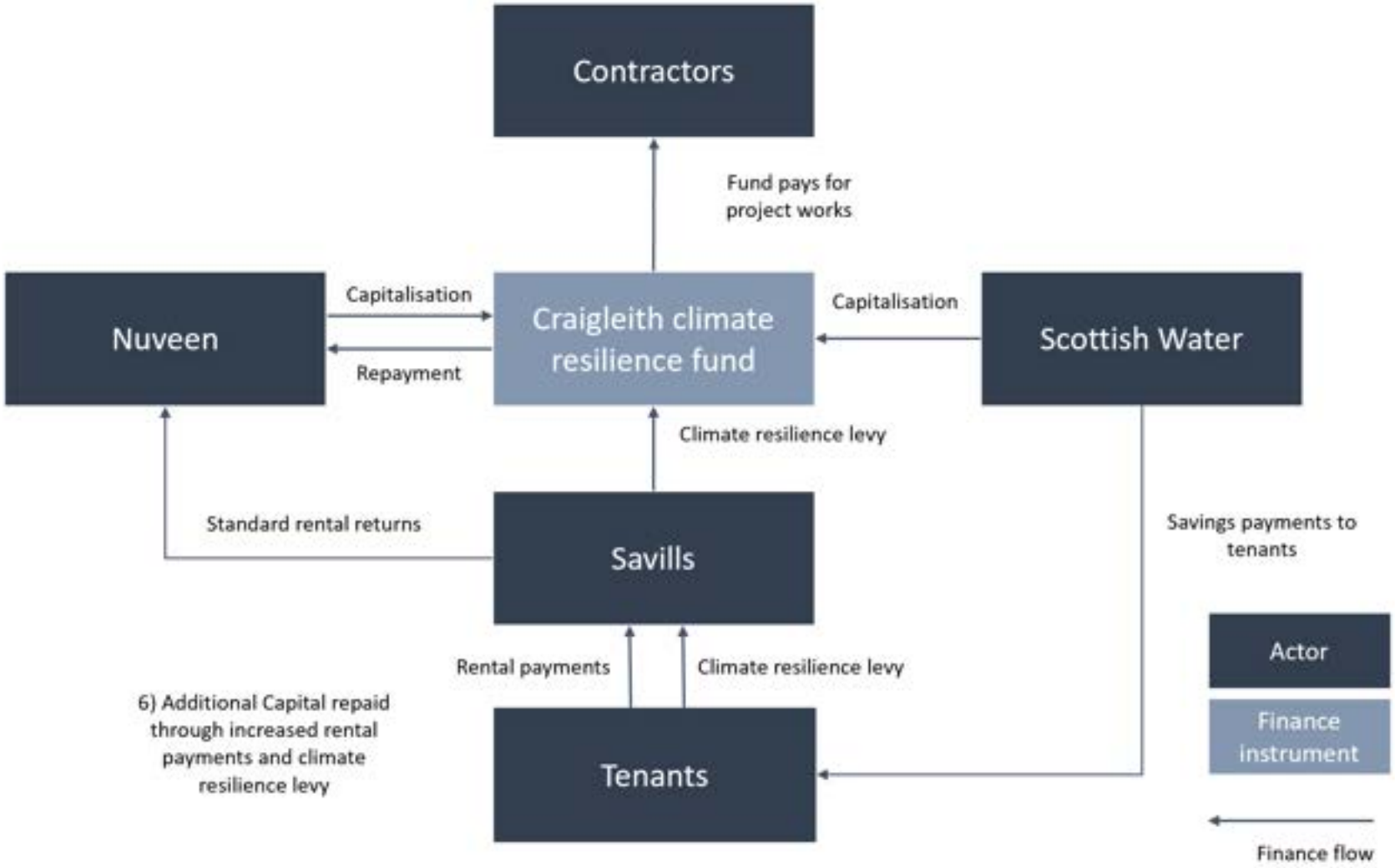


Figure 14: Illustrative business model Craigleith Climate resilience fund.

There are a number of considerations which have influenced the design of the model:

- **Legal limitations on how Scottish Water can issue rebates for cost saving**s - Current non-domestic charging regimes in Scotland for sewer drainage are paid for by occupiers, comprising a fixed non-volumetric charge as well as a fixed volumetric charge. These charges are calculated based on rateable values.[xxvi] The Scottish Government's charging principles for water services[xxvii] set the framework in which Scottish Water is expected to provide services across the country. Principle 3 on harmonised charges prevents Scottish Water from charging differentially across Scotland for similar services. Within this, there is some flexibility and innovation in two areas:

  i) Where a small number of best practice sites have done everything that is possible on site but where they must remain connected to the sewer for environmental protection. In such cases, Scottish Water can move the site onto area-based charging regimes.

  ii) Under Section 29(e) of the Water Industry (Scotland) Act 2002, Scottish Water can provide a discount on drainage costs where they are satisfied that the investment reduces the direct costs of providing services.

  Whilst using section 29(e) of the Act is the preferred route, it presents two challenges. Firstly, the benefits of such a reduction would be returned to tenants, rather than owners, meaning that any investments made by Nuveen would not be recouped directly by them but via rental increases or a direct levy.

- **Year to year variations in cost savings to Scottish Water and tenant rebates** – Variations in weather on a year to year basis will result in varying cost reductions to Scottish Water, and associated repayments to tenants. To provide certainty to tenants, the levy would be pegged to the rebate. The use of a fund structure helps manage year to year variations in extreme weather and associated NBS performance, providing a more predictable income stream to Nuveen.

Whilst the conceptual model has the potential to unlock the additional investment needed, there is still considerable work needed to establish whether this model works in practice and is financially viable. This would require more detailed costings. There would also need to be more detailed due diligence, and analysis of the partnership and legal arrangements. This will again require time and resources. This further detailed design work could also look at alternative funding arrangements, for example, the scheme could be simplified if Scottish Water was able to directly contribute the portion of savings to the fund, as compared to the tenants, but this would need further investigation.

Business Case – Strategic Outline

The business case developed for the model uses the standard government business case model (See above). This sets out the need to consider five cases: strategic, economic, commercial, financial and management. Given the need for a temporally coherent appraisal, these are scoped out below, using a thirty-year period. The identified option has been compared to a 'business as usual' scenario, which assumes the straightforward resurface of the carpark:

Table 15: Shortlist options compared in Strategic Outline Case

Business case option	Approach
1) Do nothing - Standard resurface	A standard resurface of the car park at a cost of £586,000.
2) Installation of Nature Based Solutions	Resurface of the car park in line with proposals put forward by Harrison Stevens.

Option 2 was designed and detailed iteratively to try and ensure an optimal scenario and return for the public and private sectors. The limited benefits quantification undertaken as part of the concept design for option two has meant the study has not been able to consider the full range of costs, benefits, revenues and expenditures required by all parties. Therefore there is significant uncertainty in the figures provided in the financial and economic cases. The analysis below should therefore only be considered indicative.

Strategic Case

The purpose of the strategic case is to make the case for change and to demonstrate the strategic fit. Whilst option one makes no significant additional contribution to national or local policy and development objectives on climate change adaptation, flood risk management, biodiversity and the economy, option two of the resurface has a strong strategic fit with a wide range of Scottish Government policy:

- **Blue-green Infrastructure** - The Scottish Government's 'Water Resilient Places' policy framework emphasises a 'blue-green first' approach to water management, with design being undertaken alongside consideration of financing and with inclusive governance as well as coordination of policy, standards, advice and support.
- **Climate change adaptation** - The second Scottish Climate Change Adaptation Programme[xxviii] (SCCAP2) includes an outcome dedicated to economic resilience. It highlights a range of effects of a changing climate on business including flooding and higher temperatures, and has an outcome aspiring to ensure that "Our inclusive and sustainable economy is flexible, adaptable and responsive to the changing climate". Within this, it seeks to ensure that "Scotland's manufacturing, services and wider economy are informed and adaptable to climate change" (with a particular emphasis on building premises), as well as ensuring that "Scotland's economy is innovative and harnesses the opportunities created as a result of climate change". Similarly on infrastructure, Outcome 4 of the SCCAP2 aims to ensure that 'supporting systems are resilient to climate change', with a particular focus on water. Finally, under s.44 of the Climate Change Scotland Act, public bodies have a duty to deliver their activities in a way best designed to deliver the outcomes of the Scottish Climate Change Adaptation Programme.
- **Economic policy** - The deployment of NBS for mitigation and adaptation is also recognised as a strategic market opportunity and area for competitive advantage in the National Strategy for Economic Transformation[xxix].
- **Green Finance** – the project aligns with the need for the financial sector and large corporates to identify, disclose and manage their climate-related financial risks, as set out in the UK Government's Green Finance Strategy.

At the City level, the approach aligns with the Edinburgh Climate Change Adaptation approach, including several actions in the Edinburgh Adapts action plan (BE3, BE7, BE9)[xxx] and the adaptation elements in the City Council's more recent Net Zero strategy[xxxi]. It also aligns with the joint SEPA, CEC and Scottish Water vision for water management in the City of Edinburgh[xxxii].

Similarly, as outlined in the TCFD assessment above, the scheme provides a strong strategic fit against the publicly stated ambitions by TIAA and Nuveen in managing the physical risks of climate change.

Under current arrangements, Scottish Government funds most adaptation investment through transfers to its public bodies, or to Local Authorities, even when the private sector derives a degree of adaptation benefit and wider co-benefits. However, as mentioned from the outset, there is a significant financing gap in Scotland and continuing this approach will not bridge the investment gap required to keep risk to current levels. The dominant perception that it is public sector's responsibility to manage flooding has also led to crowding out of private sector investment.

This creates challenges for schemes like Craigleith – where the costs and benefits to all are relatively modest and diffuse, meaning they are unlikely to score highly in public sector prioritisation, or as desirable investment activities for the private sector, but which have the potential to be part of a wider portfolio of solutions. Therefore, there is a need for the emphasis of the public sector to shift towards enabling private activity, and towards developing their knowledge and capabilities in this space.

There have been significant efforts by Scottish Government, SEPA and NatureScot to mobilise more private finance into adaptation and natural capital. In March 2022, Scottish Government set out a set of responsible investment principles for natural capital (Scottish Government, 2022)[xxxiii]. This has been further supported by technical assistance (TA) for seven projects from the Investment Ready Nature Scotland (IRNS) project preparation facility, and this TA has been extended into the Facility for Investment ready Nature in Scotland. Considering the need to crowd in private finance, the scheme proposed demonstrates strong policy alignment and a strong case for change.

Similarly, the case for change is based on the changing nature of the market, and future requirements to disclose and manage physical risks of climate change, and this scheme provides an early, and small scale, but real example of this work, which could be used as the foundations for future work.

Economic case

The purpose of the economic analysis in the business case is to ensure that the proposal delivers societal economic net benefits, i.e., that the benefits outweigh the costs including wider social and environmental effects, and also delivers value for money[5]. For option 1, it was assumed that no additional benefits would be delivered for the investment, providing a BCR of 0.

From a review of the concept design using the existing information provided, and the provisional economic analysis, there is only a low economic case for investment. The overall analysis of the project leads to a benefit to cost ratio of 0.95:1. This means the value of benefits (the discounted stream of benefits over the thirty years) are below the costs (capital and operational costs over the same period). Normally a project would want to show higher benefits than costs, i.e., a BCR of >1.

[5] Value for Money is not about lowest prices, it is about delivering best overall value. While different definitions exist, a common framework, and one used by UK Government, is the 3Es: economy, effectiveness, efficiency. See NAO https://www.nao.org.uk/successful-commissioning/general-principles/value-for-money/assessing-value-for-money/

The benefits mostly arise from drainage and wastewater and amenity, with a smaller set from environmental regulation. These are shown below:

Table 16: Summary of economic benefits – Costs and benefits are shown as discounted present values.

Item	Option 1: BAU	Option 2 - NBS
Costs (present values)	£586,000	£1,314,253
Benefits (present values)		
Drainage and Waste Water	£0	£116,708
Amenity	£0	£711,666
Environmental Regulation	£0	£2,039
Total	£0	£830,412
Benefit-Cost Ratio	0	0.63
Economic Net Present Value	-£586,000	-£483,841

Initial benefits were higher but revised downwards following the business rate revaluation information published in April 2023, as well as the updated drainage and wastewater savings information from Scottish Water.

Commercial case

The purpose of the commercial case is to demonstrate that the preferred option will result in a viable procurement and a well-structured Deal between the public sector and its service providers.

Delivery of the business model involves four sets of activities: Procurement of the capital works, ongoing maintenance, fund management and charging mechanisms, and realisation of the revenue streams:

- **Procurement of capital works** – Works could be procured by a number of the private or public sector partners, including Nuveen, Savills, Scottish Water and the City of Edinburgh Council. The most straightforward option would be for Savills to commission this work, given their role as the managing agent, as well as in administering the fund. However, it would be important that the scheme meets public sector partners requirements to unlock a portion of the capital and the charging mechanism. Alternatively works could be procured via Scottish Water framework, or directly by Nuveen. These may have some benefits in reducing cost, depending on whether they could be purchased as part of a wider programme of activities.

- **Ongoing maintenance** – This would be provided by Savills, although would need to be subject to confirmation they have the relevant skills and knowledge for the maintenance of the nature-based solutions being delivered.

- **Fund management and charging mechanism** – Savills could manage and administer the fund, handling the capitalisation from Scottish Water and Nuveen for the initial capital works, and to recoup the climate resilience levy paid by tenants. The increase in rentals would be collected by Savills in line with existing arrangements.

- **Realisation of revenue streams –** This would be handled under existing arrangements with Scottish Water and other entities with which it makes repayments based on agreed savings.

Financial case

The purpose of the financial dimension of the business case is to demonstrate the affordability and funding of the preferred option, including the support of stakeholders and customers, as required. This is identified through three supporting pieces of information:

- A budget statement based on accounting principles as per the Consolidated Budgeting Guidance. This shows the resource and capital costs over the lifetime of the proposal. For strategic initiatives, the budget will often include forecast financial statements of a whole organisation over a number of years;
- A funding statement showing the sources of funds and other resources required i.e. which internal departments, partners and external organisations would provide the resources and funding required; and
- A cashflow statement showing the costs that will be spent on the preferred option if it goes ahead.

Budget statement

The total costs for the two options for the project are estimated as follows:

Table 17: Budget statement

Item	Costs		Notes
	Option 1 - BAU	Option 2 - NBS	
Capital Works	£586,000	£1,219,000	Option 2 based on quote from Thomson Gray.
Implementation staffing costs	£0	£58,500	Option 2 based on 1 member of staff for 1 year to manage, @£45k P.A. with 30% uplift for Tax and NI.
Monitoring and evaluation costs	£0	£36,753	Estimates provided by Royal Botanic Gardens Edinburgh of £1,200 over 30 years.
Total	**£586,000**	**£1,277,500**	

All costs are nominal and do not account for inflation. It has been assumed that the ongoing maintenance costs can be subsumed into the indicative maintenance charge currently in place via Savills on the site as early discussions with the partnership ecosystem and Savills highlighted that they would be able to accommodate these as part of business as usual. Similarly, ongoing staff costs to all partners have been excluded as they are assumed to be able to be covered by business as usual. Planning fees and preparatory works (including detailed design) have been excluded as they are assumed to have been completed by the partnership ecosystem before the implementation.

Funding Statement

The funding statement for option 1 was assumed to purely originate from Nuveen, for the total costs of £586,000. The funding statement which sets out an indicative set of capital contributions for option two is included below.

Table 18: Funding statement for Option 2- Craigleith Climate Resilience Fund

Source	Repayable / non repayable	Organisation	Indicative contribution
Existing asset maintenance	Non-repayable	Nuveen	£586,000
Additional investment (value uplift and climate resilience)	Repayable	Nuveen	£600,000
Gap finance	Non-repayable	Scottish Water	£250,000
Total			£1,436,000

The gap finance is included as a contribution to the fund to cover not just the capital costs, but also the ongoing project expenses of depreciation, capital repayments to Nuveen and the asset and monitoring costs.

However, who provides the gap finance, as well as the total amounts of capital repaid to Nuveen and when this happens could be varied based upon stakeholder discussions and preferences – for example no discussions have been held with Nuveen about their willingness to invest based on value uplift. There is also a dependency based on the amount of repayment that will be generated from the savings and the proportion that Scottish Water are prepared to reinvest into the project.

Cashflow Statement

The cashflow identifies all relevant income and expenditure over time. For ease and simplicity, the cashflow has been undertaken in real terms (I.e., today's prices), rather than nominal (accounting for inflation). This was due to the large initial outlay and relatively small flows in future years.

Discussion with Nuveen indicated they have a wide range of differing criteria and consider hurdle rates (the minimum rate of return on a project required by a manager or investor) on a case by case basis. As a result, it was agreed to generate the cashflow on a public sector basis. The full cashflow is attached as Annex 4.

For the public sector, the cash flow has been prepared over the project lifetime (30 years), to provide a coherent appraisal scenario, using HMT's discount rate (3.5%) on the final cashflow. This should provide insights for the public sector on whether there is a strong case for investment (i.e. a shorter payback period, and a high internal rate of return).

The preparation of the cashflow included a number of key assumptions:

- **Depreciation** – the residual value of the asset is assumed to be zero at the end of the thirty year period and so depreciation has been spread over the useful life of the asset – i.e. thirty years. This is a general requirement of accounting rules (see Schedule 1, Part 1 Section B (18) of the Small Companies and Groups (Accounts and Directors' Report) Regulations 2008)
- **Gap funding from Scottish Water** – this funding would be phased over 5 years to offset the initial costs of depreciation and monitoring.
- **Effects of climate change** – these savings included a 1% increase year on year to account for the increased frequency and severity of rainfall events due to climate change.

- **Fund repayment** – Nuveen's initial additional capital would be repaid evenly over the 30 year period.
- **Savings retention** - Scottish Water would return 100% of the financial savings from drainage reductions into the project.
- **Future rental yields** – The cashflow assumed a 1% uplift in rental across the 30 year period - The team modelled three values of rental uplift – 0.5%, 1% and 3%, but felt the 1% value struck the balance between realising value and avoiding risks of losing tenants. In reality, rental increases are stepped over time and may not be introduced in Year 1, but in future years.
- **Cost of borrowing and interest** – Neither the cost of borrowing nor earned interest from re-investing was included – a more robust cashflow should include the costs of borrowing once agreed who was supplying the capital.
- **Maintenance -** All maintenance was assumed to be undertaken under current arrangements.
- **Fund management arrangements –** all fund management arrangements were concluded using current approaches.
- **Discount rates** – Use of Green Book discount rates for public sector analysis – i.e. 3.5% a year

Table 19: Key variables used in the cashflow scenarios

Criteria	Value
Project lifetime	30 years
Discount rate	3.5%
Climate change uplift	1% year on year
Rental value uplifts	1%

Outcome of analysis and financial profile.

Over the thirty year period, the IRR of the project is projected to be 91.84%, and a low, but positive NPV of £34,099. The overall cashflow increases in the first five years with the gap funding from Scottish Water, alongside rental incomes, savings, helping address the issues of depreciation in the early years, before the overall fund starts to run down over the 30 years as capital is repaid to Nuveen, depreciation increases.

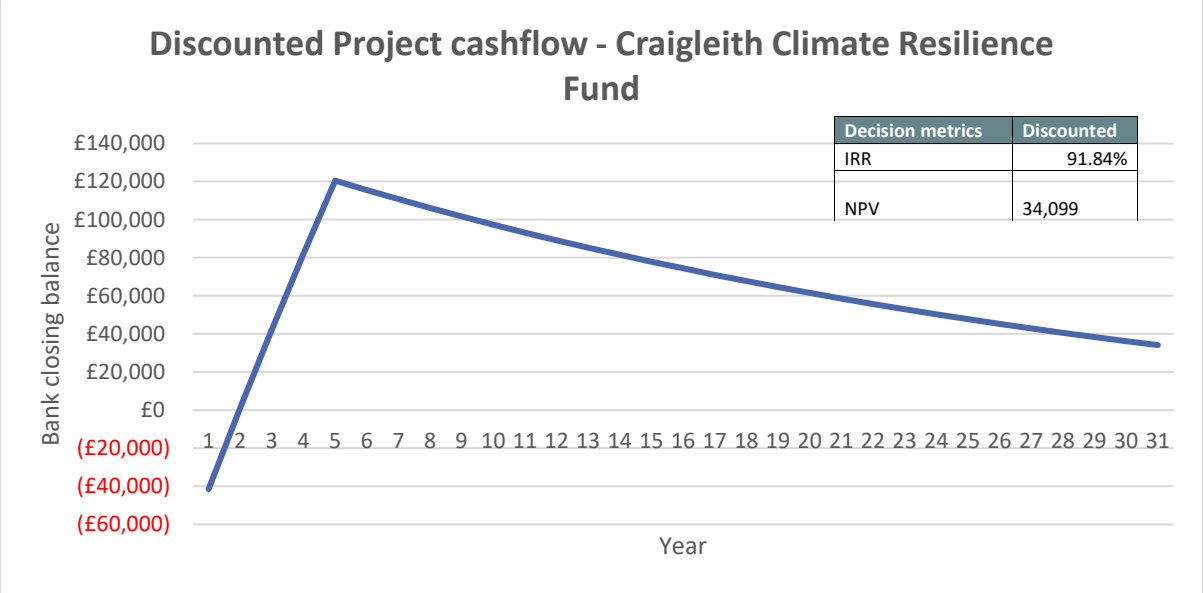


Figure 15: Discounted project cashflow – Craigleith Climate Resilience Fund.

Whilst positive, if the project were to undertake the same analysis from a private sector, there are a range of additional factors that will need to be accounted for. These are explained in Box 3. below. A key next step will be adjusting the assumptions in the cashflow to account for both public and private sector preferences.

Box 3: private sector financial analysis for investment.

A financial analysis only uses market prices – it excludes environmental or social benefits. The financial attractiveness of a project is usually expressed in terms of an Internal Rate of Return. An IRR is the annual return that makes the net present value equal to zero, or a payback period. This generally takes a short-term perspective, which relate to a required rate of return or the opportunity cost of capital, noting commercial / private investors typically expect much higher returns than public investments. Key differences include:

Discount rates – Whilst public discount rates tend to be low, those used in private sector analysis tend to higher to account for the higher costs of capital. Commercial standards are generally based on the Bank of England's Sterling Overnight Index Average Rate (Sonia), plus a certain percentage.

Payback periods – Whilst the project has been calculated to repay Nuveen's investment over thirty years, in general terms the private sector requires much faster payback periods (3-5 years in the Real Estate Sector

Costs of capital - Without a discussion on financing sources internally within Nuveen, it was not possible to include a weighted average cost of capital. This number is the average cost of capital, weighted to reflect difference sources (like bonds or loans), carry different return expectations. This is important as it express the return that lenders demand to provide the finance for a project, and is often used as a 'hurdle rate' – the minimum rate of return on a project required by a manager or investor.

Management Case

The purpose of the management dimension of the business case is to demonstrate that robust arrangements are in place for the delivery, monitoring and evaluation of the scheme, including feedback into the organisation's strategic planning cycle.

To ensure the successful delivery of the scheme, the governance of the project is recommended as an extension of the existing partnership ecosystem, to put the partnership on a formal footing. This would include:

- Developing and signing an MoU or partnership agreement to establish Craigleith as a blue-green exemplar. This should set out the overall ambitions, objectives and ways of working. Although collaborative approaches tend to deliver better outcomes they can increase the amount of time required to implement a project due to the need to understand and agree shared aspirations, objectives and ways of working.
- The parties could co-fund a dedicated officer to drive forward the scheme, managing project development and implementation and associated risks. They would be hosted by one organisation, but designed to serve all parties' interests.
- Royal Botanic Gardens Edinburgh could be appointed to independently assess and verify the benefits being provided by the scheme both to underpin the revenue stream and also ESG benefits.

Conclusions

Whilst the assessment above shows relatively low benefits of the NBS option, and presents a range of implementation challenges, the options appraisal highlights that the NBS approach has a greater strategic fit and economic benefits compared to the do nothing option, based on additional gap funding for the public sector. On this basis, the appraisal suggests it should be considered the preferred public sector option from the two.

Case for gap funding

From the business case and experience of similar schemes there is not a strong enough case to justify investment on a purely commercial basis, suggesting that some degree of gap funding will be required to unlock the investment. There is a case for this to be either purely public capital, purely private capital or a blend of both. The rationale for each of these is outlined below.

Private sector gap funding

Whilst Environmental, Social and Governance (ESG) impacts of investment have become an increasing priority for investors, the sector has faced a range of challenges, including the structure of the retail sector and the impacts of the COVID-19 pandemic, as well as the cost of living crisis. This has led to limited liquidity in the sector. With fewer commercial real-estate transactions, there is more limited evidence to quantify the divergence of property values based on sustainability projects alone. However, given the wider changing regulatory model, there is a modest positive case for investment in the proposed business model, over and above the direct project-related benefits, based on the following near (2-3 year) and longer term (5- 10 year) benefits:

Table 20: Investment rationales for Nuveen to invest in funding gap.

Time period	Investment case
Short - medium term (2-5 years)	• **Public sector appetite to de-risking** – The presence of public sector partners willing (in principle) to provide a degree of financial contribution brings down both the overall risks and costs for taking on an ambitious project. • **First mover advantage and future investor and regulatory environment** - The increasing investor attention and government regulation on disclosing and managing climate-related risk will mean an increasing need to demonstrate solutions. The Craigleith Climate Resilience Fund will help

	Nuveen continue to be ahead of competitors and emerging regulatory requirements. • **Providing a market-leading ESG demonstration project** – Whilst current ESG metrics do not account well for physical risk, positioning Craigleith as an exemplar project will provide valuable case studies for future ESG reports, with a differential emphasis to competitors.
Longer term (5-10 years)	• **Innovation and Capacity Building** - Significant innovation is required to deliver private sector adaptation given the strength of barriers. The development of a Climate Resilience Fund represents an innovative form of finance and serves as a step on a broader journey that the organisation will need to embark upon to build internal capacity and capabilities to successfully climate proof its assets and revenues. Given the model's potential for replication and scaling, it may also offer the potential for wider rollout across Nuveen's portfolio. • **Incorporation of climate resilience into new ESG metrics and taxonomies -** Whilst metrics are not currently measuring climate resilience to any specific degree this is likely to change as the market matures, with the emergence of adaptation as a category in the forthcoming UK Green Taxonomy. Early understanding of what such projects entail will help address future compliance issues. • **Implications of emissions trajectories** - Many real estate companies and investors are focusing on mitigation. The increasing awareness that the Paris Agreement targets are likely to be temporarily passed or missed entirely (overshoot) warrants a renewed focus on adaptation as part of a balanced approach to addressing climate change in real estate portfolios.

Case for gap funding by the public sector

Whilst adaptation and nature-based solutions mainly have the characteristics of public goods, the recognition of the need for private finance and action to close the gap is driving significant innovation to help overcome barriers (A summary of the barriers to financing adaptation and NBS projects is included in Annex 1). At the same time, the challenging situation of public finances increases the need to maximise value for money from public spend and incentivise and crowd in private sector action.

In this context, there are multiple roles that the public sector can play, based on the maturity of markets and views of relevant stakeholders. This ranges from championing early successes, through to de-risking. In cases where private sector investment is unviable, purely public financing is used as a last resort. A decision tree for the approach, outlining the range of different stances the public sector can take is shown below:

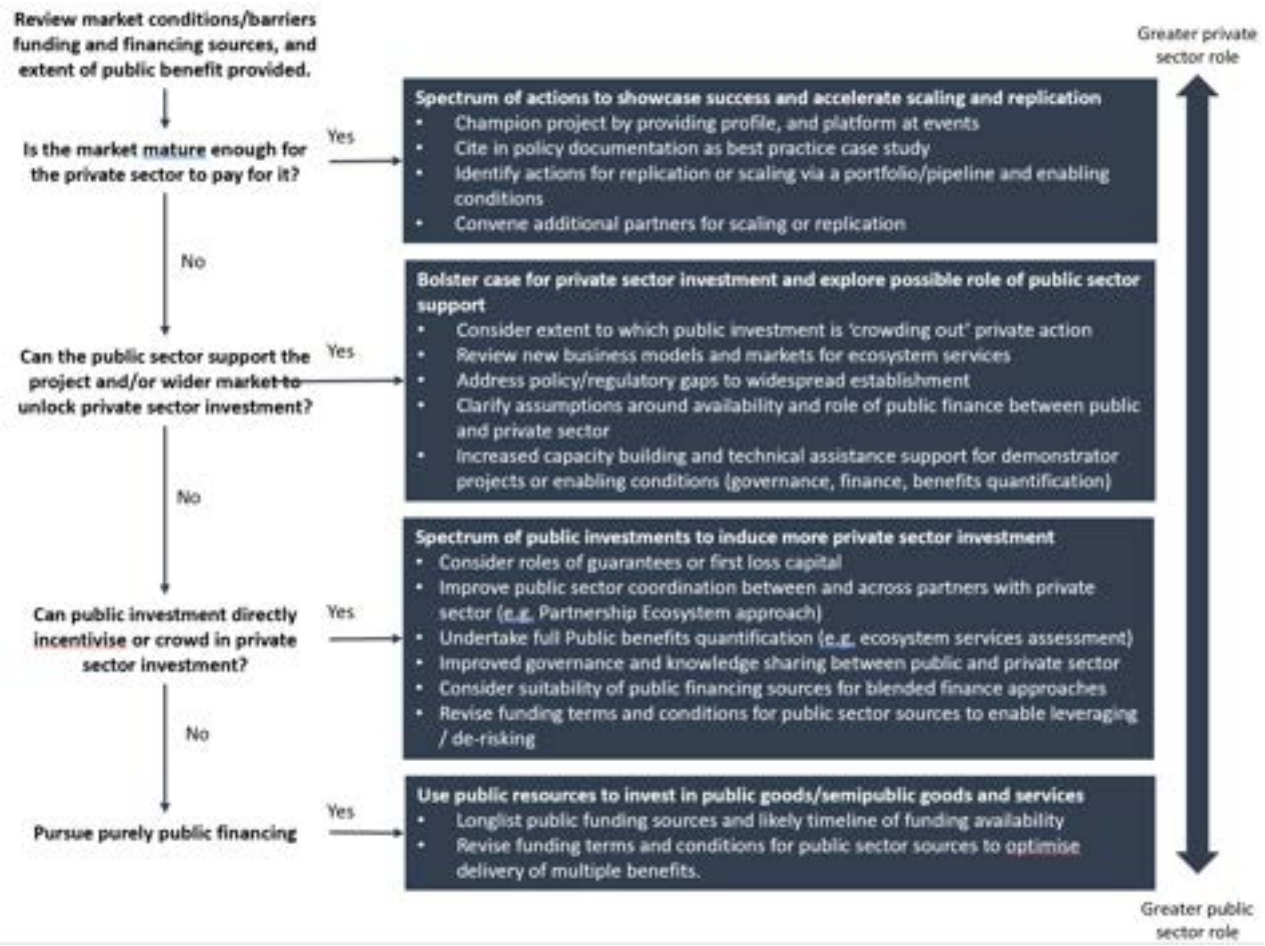


Figure 16: Decision tree for public sector to maximise private sector funding of nature-based solutions in Scotland in the changing private sector context. Source: Authors, adapted from World Bank, 2019.

In this specific case, a relatively small investment by the public sector could unlock a relatively large private sector investment.

Limitations

Whilst the project appears a promising adaptation solution, it is important to highlight that other traditional 'grey' investments may offer better public value for money. Many studies find high benefit to cost ratios for both hard and soft protection measures and for grey and green infrastructure (Kovats and Brisley, 2021[xxxiv]). In normal economic appraisal, project teams generate a long list of potential solutions to address objectives and then shortlist these and appraise and rank them based on their relative value for money. This project only explored one scheme meaning it has not been possible to undertake such a ranking, and it is recommended that in future phases a light touch appraisal of other solutions be undertaken to allow for comparative analysis.

Next steps

To support the further development of the business case and to move towards implementation, The Partnership Ecosystem could work to develop the shared value proposition arising from the site, including the beneficiaries, the revenue streams preferred etc. As part of the development, the following should be taken forward:

- **Model the reductions on drainage pressure** – given this factor underpins the overall viability of the business model, it is important that this is quantified as quickly as possible. This could include more detailed modelling under particular design events and extremes, and uplifts to account for future climate change, for example using the Environment Agency climate allowances, and also attempt to quantify the associated monetary benefits.
- **Conduct a full climate risk and vulnerability assessment of the site to identify the range of future hazards** – such as from higher temperature and heat – and full benefits provided. This should include the full range of climate-related financial risks over the lifetime of the asset in line with its wider physical risk guidelines.
- **Consider the potential to include a wider range of possible funding and financing sources from mitigation** – During the project, stakeholders at Nuveen mentioned the potential investments in a range of mitigation actions, such as EV charging or solar PV. These investments have the potential to create new revenue streams which could be used to contribute towards the adaptation solutions.
- **Fund management** - Confirm whether Savills would be willing to manage the Craigleith Climate Resilience Fund and any associated charges
- **Developing and incorporating the remote monitoring, sensing and survey arrangements** - to underpin the benefits realisation for both the public and private sector.
- **Better understanding willingness to pay** - Scottish Water and Savills could examine recent water meter and billing data to better understand the relative savings that may arise to tenants, the likely attitude of tenants to rental uplift values, to better inform an appropriate rental value uplift/dedicated levy rate that will be passed back to a climate resilience fund as a revenue stream.
- **Gap funding** - Scottish Water and Nuveen could review the respective cases for gap funding and discuss their own respective appetites to provide the gap funding.
- **Further appraisal of costs and benefits** – the costs and benefits of the approach should be revised and extended to encompass the additional elements above, to strengthen the case and contribute to a more robust business case.
- **Project champions** - Nuveen should seek to secure a corporate champion from its sustainability team to position the case study as an exemplar/demonstrator. This could also include undertaking potential for 'seeing is believing' visits – visiting existing schemes to discuss the benefits provided.
- **Repayment mechanisms** - Explore whether any future business model could be simplified by allowing the repayments from SW to be made to investors rather than billpayers directly. This would be likely to reduce the complexity of the scheme and potential transaction costs.
- **Data sharing** - Establish a data sharing and management agreement to allow the sharing of the relevant data and evidence needed to underpin the business model.

To address the issues above, partners could consider applying to NatureScot's new Facility for Investment-ready Nature in Scotland. FIRNS provides grants of up to £240,000 to help develop viable business cases and financial models to attract investment. In addition to the specific project, the Facility could be used to explore the potential replicating and aggregating the model. This could evaluate a number of options – including across the portfolio of Nuveen in Scotland, similar typologies of sites etc. Partners should consider whether there is appetite to develop and submit an application.

Potential for replicating and scaling the model

The project team were also asked to assess the potential to use the project as the basis of wider replication or aggregation across Scotland, and its implications of such an approach for the individual project dynamics and business model.

A project portfolio is where individual projects are bundled together for the purpose of raising additional funds or achieving greater impact. Such approaches depend on having a series of projects that can be developed together, or a replicable business model that can be applied in multiple contexts.

Project portfolios are consistently cited as a way of overcoming many of the barriers to climate finance, by reducing project preparation costs, reducing ticket sizes and attracting larger scale investors. However, there are also a number of drawbacks. The advantages and disadvantages are outlined below:

Table 21: Advantages and drawbacks of 'portfolio' approaches for financing adaptation projects.

Advantages	Disadvantages
• Can reduce the overall cost of capital (for large transactions - £500m+) • Increased attractiveness and impact • Reduced project development costs • Increased range of investors (e.g. pension funds, institutional investors)	• Can increase overall project development times • Increased risk from larger concentration of projects • Increased complexity of management and coordination (depending on partners involved) • Enhanced monitoring and reporting requirements • Can require additional certifications and verifications (e.g. Local Authority credit ratings).

There are a number of possible options for building on the project to develop a replicable, or aggregated approach:

1. **National 'public sector led' aggregators -** Consider the potential to include NBS in 'national' aggregation schemes seeking institutional investors – such as 3Ci's Local Authority pipeline, or institutions, or SDI's Green Investment Portfolio. Notably both the Scottish National Investment Bank and the UK Infrastructure Bank has also identified a role for Nature Based Solutions in their lending portfolio.
2. **Replicable projects across Nuveen's Real Estate Portfolio** – Nuveen could seek to replicate the model across a range of other sites as part of a broader strategy to mitigate physical risks of climate change.
3. **A City-scale project pipeline** – The City of Edinburgh Council could consider the preparation of a City-scale pipeline. This would have the advantages of leveraging existing City connections and local knowledge and data to reduce project development costs. This could be informed by an analysis of organisations in the City in scope of TCFD regulations.

Whilst there is the potential for the model to be used as the basis for replication / aggregation, there are likely to be some specific challenges for any of the models outlined above – particularly in relation to identifying and managing the range of sites and associated stakeholders required for a

pipeline of projects, in quantifying the benefits now and under climate change. In addition, the fund approach used for the site would need to be extended to hold the inflows and outflows from multiple streams, potentially creating a new series of risks or benefits.

To take forward the development of a potential aggregation / portfolio approach, several activities would need to be undertaken:

- **Discuss the appetite for aggregators amongst stakeholders** – discuss the potential appetite for embarking on this process with all project stakeholders.
- **Explore the suitability of patient lenders and/or aggregators** – If there is appetite to use the project as part of an aggregation approach, partners should begin to engage with 3Ci and SDI on the potential to participate and the associated requirements for doing so. Whilst the project is too small for direct lending by either the Scottish National Investment Bank or UK Infrastructure Bank, both have indicated interest to lead the market development of ecosystem services, better understanding their aspirations in this space (for example to aggregate to a pipeline) would broaden the range of financing options in this space.
- **Commission a TCFD analysis of Edinburgh to identify further partners and sites could underpin a wider programme approach with Nuveen and/or Savills** – The partnership ecosystem could commission an analysis of those companies in scope of the TCFD regulations to identify a cohort of additional partners for engagement. Their footprints could be compared to areas of significant pressure on drainage network or sewer/surface water flooding risk for prioritisation.

5. Case study lessons and recommendations for project development processes

Alongside developing a high-level business case, the project was also asked to consider the learning arising from the exploration of this case study concept, and the potential lessons for future project developers in Scotland. The key lessons and learnings are summarised as follows:

From the current project:

The work on the project identified a number of learnings, and particular challenges:

- Adaptation revenues are quite hard to monetise, requiring significant effort and evidence to generate credible numbers, and many benefit streams are quite low.
- Despite being a strategic driver for large real estate companies, work under the TCFD framework has not progressed significantly enough to be a large driver for investment in adaptation options at the present time.
- Developing and implementing projects which realise multiple benefits for a wide range of partners are complex and face several barriers, including coordination and different perceptions about who should pay (public or private).
- Value transfer methods for drainage savings as a result of implementing NBS are challenging, and likely to overestimate the savings – Scottish Water's own estimates were considerably lower over the project lifetime.
- The requirements to depreciate assets on a cashflow can represent a significant challenge to positive cashflow of NBS projects where the revenue streams are relatively low.

Despite this, it is positive that a bankable solution looks like it may be possible – in many contexts, it is not possible to identify and fund bankable projects. Finally the ability to design and deliver

complex projects in this manner is likely to become more important issue as climate impacts increase.

For future projects:

- **Concept designs should include the metrics required to underpin the appraisal of economic costs and benefits, revenue streams and financial models**. The failure to model reduced water pressure on the drainage system under current conditions and with climate change, as well as the associated cost savings, was a key limitation as it creates a significant barrier to development and implementation of new business models.
- **Early development of project options should long-list solutions and identify a short list of options for economic appraisal**. This case study has only appraised one solution, which has a relatively low cost-benefit ratio. Future projects should explore the range of solutions (Both grey and green) to identify alternative ways to achieve the similar policy objectives and evaluate a shortlist in line with Green Book guidance.
- **The real estate sector's approach to physical risk is relatively limited, but maturing rapidly** - early work tends to focus on portfolio-level risk, and only looks around 30 years into the future. This means that real estate companies may be simultaneously under-estimating and over-estimating risks. For example some risks may only materialise past the 2050s, whilst the global climate models use can fail to represent local conditions such as urban heat islands or the presence of existing flood defences.
- **Future projects should begin business model development earlier in the project, where there is still scope to modify the concept design** – A number of public and/or private revenue streams were closed off early in the project, before there was time for an investigation of the potential funding streams and revenue benefits.
- **Holistic assessments of mitigation, climate risk and adaptation options will maximise economic value, and unlock a broader range of investors and revenue streams** - Understandably, the focus of Craigleith has been on waste water reduction. However, there are also possible or planned mitigation activities which could be combined into the project. Similarly, it is likely the retail park is exposed to a wider range of climate risks, such as heatwaves and higher temperatures. A fuller appraisal of the risks and adaptation options, including the costs and benefits would likely identify a broader range of interested parties and potential revenue streams, though this should be undertaken carefully to ensure that governance remains manageable.
- **The private sector should be encouraged to use climate change mitigation revenue streams and savings to de-risk adaptation** – Given the limited near-term financial benefits of adaptation, and the barriers, more consideration should be given to the use of the savings and revenues generated by mitigation. For example, the installation of new EV charging facilities will provide Nuveen a new revenue stream, whilst other options such as Solar PV, or energy efficiency improvements could generate new income streams, and free up the balance sheet to invest in resilience which will help protect future revenue streams. For example landscaping and land reclamation are not currently eligible within allowances for structures and buildings[xxxv].
- **There is the potential for TCFD frameworks to underpin engagement with the real estate sector** – There may be the potential to scale engagement with the private sector, depending on the range of companies covered by TCFD or Sustainability Disclosure Requirements, and therefore with early incentives to invest in adaptation. The partnership ecosystem could undertake an 'Assets at risk TCFD report' to identify these companies and their location of assets across Scotland. This could help prioritise engagement with key private sector

partners, and develop an engagement offer, framed around TCFD risk, to further unlock private sector investment and maximise the use of public funds.

- **The partnership ecosystem approach has the potential to strengthen public-private collaboration** - The partnership ecosystem approach developed and employed in Edinburgh has been helpful in shaping early private sector engagement since it reduces the barriers and complexity. This should be developed and expanded, to include support on financing, to ensure that concept designs are developed alongside financing plans, and that potential revenue streams are not closed off early.
- **The Scottish Government's water charging principles for 2027 onwards need to enable financial innovation** – to address situations where customers take steps to significantly reduce their demands on Scottish Water's drainage infrastructure, the Scottish Government committed to undertaking a cost analysis of sewerage services, capturing monetary costs and non-monetary benefits including the use of innovative drainage approaches, by 31 March 2025. The aim was to inform the approach to period beyond 31 March 2027. It is recommended that this should consider the extent to which the approaches enable innovative financing mechanisms, including whether Section 29(e) of the Water Industry (Scotland) Act 2002 needs amending to include asset owners, as well as customers, to unlock private sector investment. These should be carefully managed to ensure they don't create unintended or distortionary effects such as displacing development or investment.
- **Scottish Government must do more to develop the wider market for ecosystem services** – whilst the benefits were relatively minimal for this project, realising a range of investment streams, such as carbon credits, would have been more challenging due to a lack of wider enabling conditions and barriers outlined above, such as trading or brokering platforms for projects to be able to bank their benefits. It is beyond the scope of this work to develop detailed recommendations but continued market making is needed to broaden the number of bankable projects.
- **Scottish Government and Adaptation Scotland should consider the case for a technical assistance facility and/or finance innovation lab as part of the third Scottish Climate Change Adaptation Programme -** Around 2.5-10% of project costs are development costs (OECD, 2018)[xxxvi]. Whilst FIRNS is providing such assistance to nature-focused projects which deliver adaptation benefits, there are a range of wider adaptation projects will need project support and development. Whilst Adaptation Scotland's case studies have provided useful insight and expertise, significant additional technical assistance capacity will be needed to shift from innovative pilots to mainstream development. Such facilities are not available in Scotland but are available in other jurisdictions. Examples include the EIB's Technical Assistance Facility and the Global Innovation Lab for Climate Finance.
- **There may be climate justice implications of seeking to advance adaptation by global real estate firms** - Given the limited capacity, and global footprint of large real estate firms, working to crowd in private sector investment in Scotland from global real estate firms may undermine global climate justice efforts. Where companies such as Nuveen have a portfolio which includes developing countries, these are arguably a higher priority given their larger exposure and higher vulnerability. However, this needs further research to understand the current capacity of real estate firms to adapt. In the interim it is important to ensure that work in Scotland feeds into international learning and dissemination, for example through Scottish Government's Climate Justice Fund.

Annex 1 - Barriers to financing adaptation and nature-based solutions

The project at Craigleith encapsulates a microcosm of the wider global challenges associated with financing climate adaptation and nature. Globally, there are significant gaps in the amount of investment flowing into adaptation (United Nations, 2022[xxxvii]) and nature (United Nations, 2021)[xxxviii]. Whilst there are not detailed estimates of the adaptation gap for Edinburgh, initial estimates for Glasgow City Region have estimating a gap of at least £184m a year (e.g. Climate Ready Clyde, 2021[xxxix]). There is also a similar nature finance gap, estimated in Scotland to be between £15bn and £27bn between 2022 and 2032[xl]. In this context, significant effort is going into addressing the key barriers to financing and investment in adaptation and nature based solution. This annex examines both in turn.

For adaptation, the main barriers to finance fall into five key categories – markets and revenue, information, bankability, policy and regulation and behavioural[xli]:

- **Information and lack of support available**: There are barriers to investing in adaptation because of the information gaps (information failures) around future climate risks, but also information gaps about the costs, effectiveness and benefits of adaptation measures. Future investment is dependent on this willingness to pay, which is affected strongly by the level of awareness, understanding and engagement with adaptation issues. There also exists uncertainty about the exact costs and benefits of each project, often caused by a lack of precedent. Most adaptation projects are context and site specific, and costs and benefits from one project can not necessarily be translated to another.
- **Markets and revenue:** Many adaptation measures do not create revenue streams (either positive revenues or cost savings), or a financial rate of return. Finding revenue to repay finance is challenging. Adaptation projects can take time to develop and establish benefit or revenue streams, which makes financing difficult even when the adaptation is reactive. Furthermore, investments designed to prevent costs in the future (anticipatory adaptation) are hard to fund publicly (e.g., due to uncertainty, discounting and coordination required in public projects) or privately (given the expected rate of return for private sector projects).
- **Bankability (project structuring preparation and risk, including co-ordination failures):** A general barrier is that adaptation projects currently tend to take more time and resources to develop than other projects, such as mitigation projects. This is because of the site and context specific nature of adaptation projects, and the greater complexity in assessing benefits. Similarly, adaptation often involves numerous stakeholders, or many diffuse actors, which complicates financial structuring (co-ordination failures). It is more difficult to develop investment ready adaptation projects, as well as more difficult to subsequently get them financed, compared to other investment projects. There is also a lack of skills to undertake the development of projects, and among financiers of potential projects.
- **Regulation**: Investing in adaptation, especially in innovative areas, sometimes requires changes in regulatory frameworks or permissions. These regulatory issues can be a significant incentive to project developers, but also act as a barrier to investors until they are resolved.
- **Behavioural** – Scaling up adaptation finance involves convincing householders and businesses to invest in risk reduction or realise savings associated with climate change. At present, many are used to this being an area of Government expenditure and their willingness to pay will depend on their levels of awareness, understanding and engagement with climate change risk and adaptation issues.

The types of adaptation barriers can be project specific, or pertain to the wider enabling environment for projects, and are not evenly distributed, as shown below:

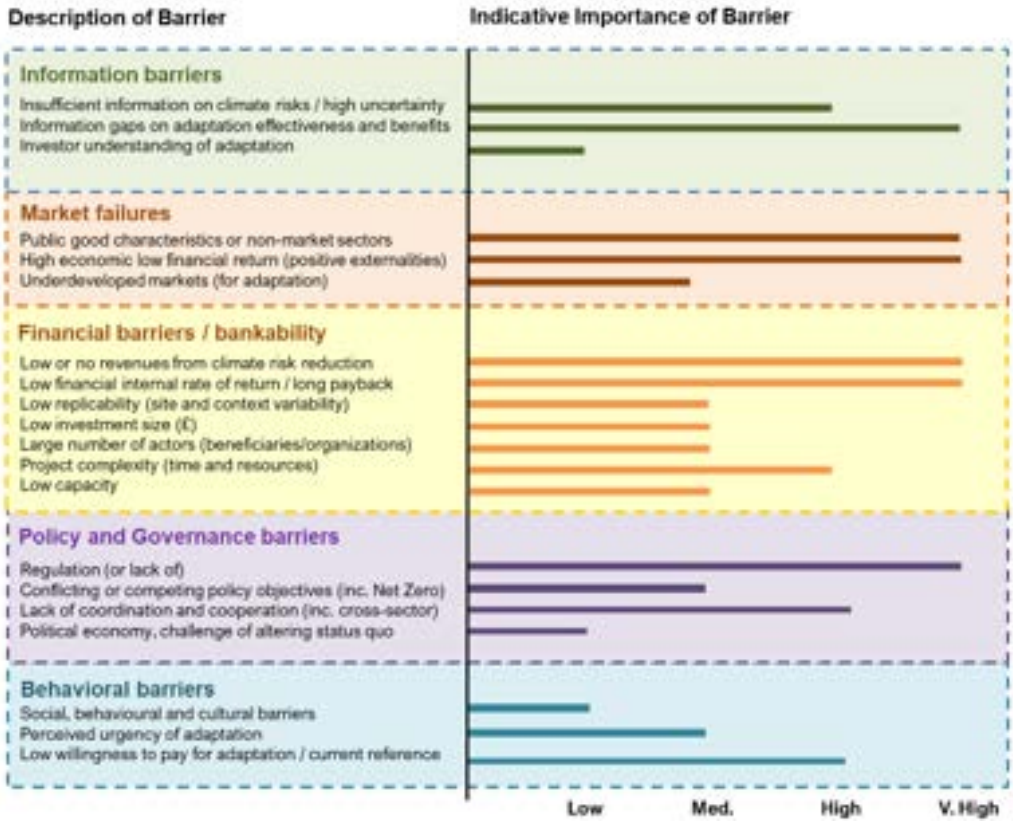


Figure 17: Barriers to adaptation finance and indicative importance. Source: Watkiss, P. and Frontier Economics (2022).

These barriers are also project and context specific, and the type of adaptation strongly influences the potential to attract finance. They vary by the types of adaptation, the nature of adaptation, the type of benefits, discounting, uncertainty and complexity of analysis as highlighted below. In general, financing those towards the left of the diagram will be more straightforward than those on the right.

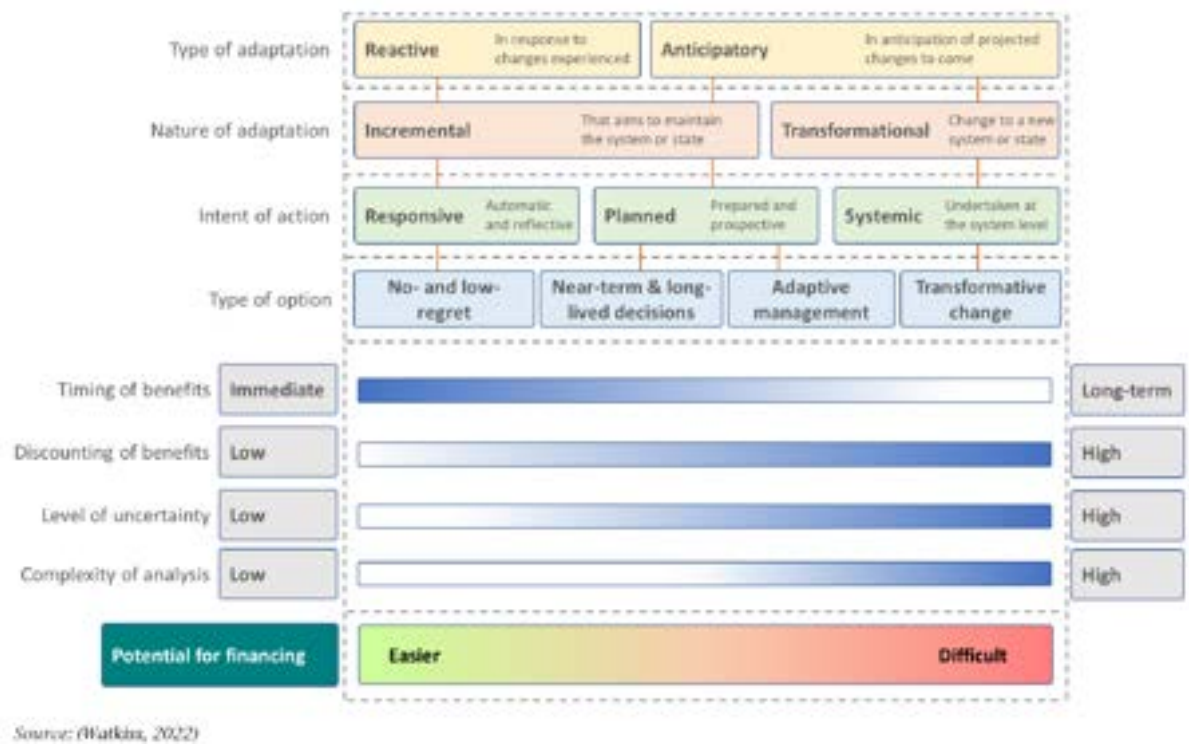


Figure 18: Adaptation characteristics and the impact on relative financing potential. Source: Watkiss, 2022.

Finally, financing of projects are also related to their enabling environments – i.e. the conditions in which projects are developed and implemented. Many project development roadmaps focus on developing the project and then retrofitting the project based on available funding sources, or willing actors. Instead, projects which have collaborative processes, innovative accounting practices, intentional processes and an Enabling regulatory framework and policy are more likely to be more successful (ASAP, 2022)[xlii]. Whilst more effective, this also increases the effort required in the project development process over and above more traditional projects, including for mitigation.

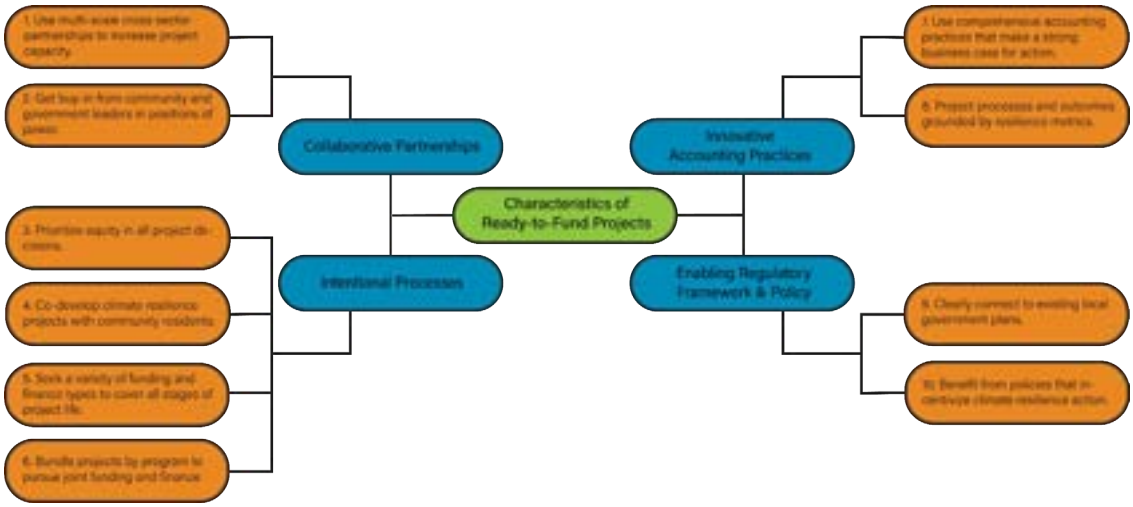


Figure 19: Characteristics of Ready to Fund projects. Source: American Society of Adaptation Professionals, 2022.

Early work by PWA from the literature review of the EU's Pathways2Resilience programme is highlighting that three domains of factors which influence these – system factors beyond the control of local government or individual public institutions, regional enabling factors, and project specific factors.

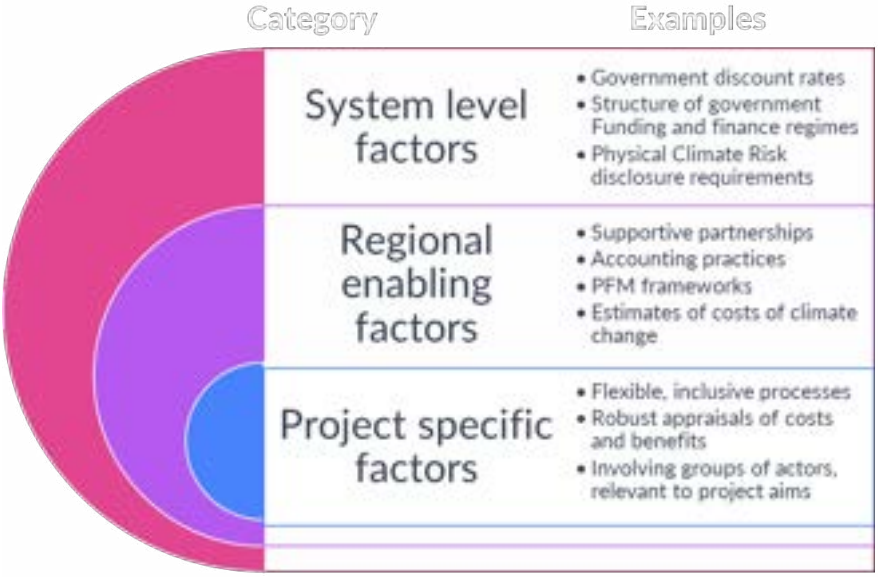


Figure 20: Stylised illustration of factors emerging from adaptation literature. Source: Author.

Barriers to Nature-based solutions

Many of the barriers to investing in nature-based solutions are similar to those of adaptation more broadly, with much of the literature identifying and characterising challenges around governance, finance and markets, technologies, institutional barriers, social and cultural, knowledge, and policy and regulation (e.g. Arbau, L. 2021, Young et al., 2022[xliii], Polzin and Toxopeus, 2017[xliv]). These barriers can often be overcome individually, but for many projects they combine, making the risks of investment greater than potential returns (Young et al, 2022). There are also challenges around issues of scale, where particularly in urban environments the fragmented land ownership, and need to engage multiple actors can be particularly challenging to manage or navigate, increasing project development costs.

In a UK context, many of the leading actors in the space of trying to scale up and accelerate delivery of nature-based solutions have identified four specific additional barriers:

1. **Limited sources of revenue from nature to fund investment** - the systemic undervaluation of nature (for example payment for creation of ecosystems but not funding for the services they provide) and the absence of drivers for the private sector to invest in its conservation, restoration, and management, means that there are limited sources of revenue from nature to fund investment. In addition, low carbon prices and a UK market limited to woodland creation and peatland restoration also limit its application. In addition, such payments don't support nature recovery but merely limit the ongoing impacts of the degradation of the natural environment.
2. **Significant disincentives for investment in nature-based projects** - the uncertainty and complexity created by the lack of coherence between the approach to environmental regulation (including a focus on specifying how and where projects should happen, rather than outcomes to drive private sector action), existing public funding mechanisms, and incentives, results in

very high transaction costs that create significant disincentives for investment in nature-based projects.

3. **Certainty to price and manage risk** - the lack of an institutional architecture, including a market regulator, and robust market governance, as well as the lack of approved standards for measuring and accrediting nature-based projects, means that investors do not have sufficient certainty to price and manage risk over the long term; and
4. **Inability to aggregate** - the limited capacity of the current supply chain to deliver a robust and reliable pipeline of nature-based projects means that projects cannot be readily aggregated to investment scale.

An additional challenge at the project level for adaptation and NBS projects involves successfully identifying, and developing a viable business model. Whilst traditional business models focus on the value proposition, its creation and delivery, and how much it will cost to deliver and how to pay for the product or service delivered, NBS value propositions are often extended to consider not just the benefits for end-users but also the broader environmental, economic and social value propositions [xlv].

The business model innovation literature distinguishes three main components of a business model: the value proposition (to customers in a form of a marketed product or service), the value delivery architecture (notably resources, partners, network) and the value capture component (revenues and costs). Key features of a NBS business model for blended or private sector financing involve:

- **A value proposition** – a clear articulation on the economic, social and environmental value this NBS offers to the different groups of beneficiaries
- **Value creation and delivery** - Identification of activities and resources required to create the value (e.g. monitoring arrangements), as well as a clear set of partners and beneficiaries supported by appropriate governance arrangements.
- **Value capture -** development of revenue streams which allows repayment of borrowing or investments and/or profits. These revenues can take many forms, including the generation of savings (e.g. reduced drainage charges or energy costs), avoided damages (e.g. from flooding or heatwaves), or additional benefits (e.g. increased footfall and dwell time, or competitive advantage).

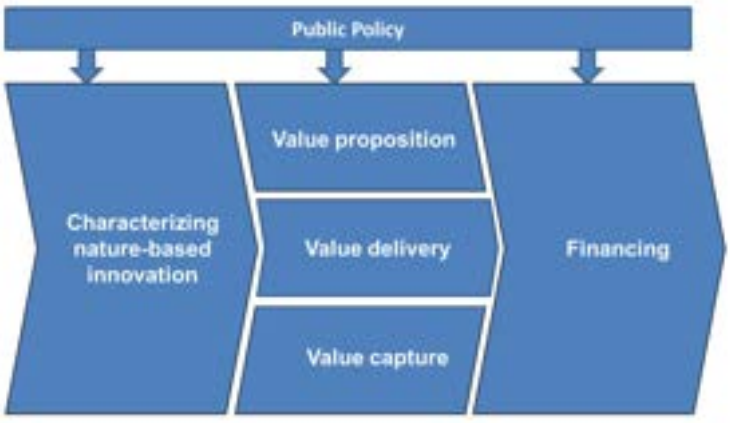


Figure 21: Approach to business model development and NBS financing. Source: Toxopeus and Polzin, 2017.

The choice of business model and finance options are linked - all three aspects affect the type and structure of finance that can be obtained and fit the characteristics. In addition, there are a number

of specific barriers which prevent business model innovation and development (McQuaid and Nua, 2019):

1. **Focus on securing capital investment for the NBS without due consideration of the sustainability of the NBS business model.** This leads to a lack of planning related to the financing of ongoing operational costs and/or consideration of the optimal governance model for the NBS.
2. **Path dependency on the same sources of capital financing for NBS.** Today NBS are mostly funded from public sources (city, regional, national, European). The pressure to meet a variety of public funding requirements has led to the emergence of 'Frankenstein' projects which try to satisfy multiple funding objectives but ultimately compromise on the original NBS objectives.
3. **'Silo' gaps:** Internally there is often a lack of communication and strategic alignment between different public sector departments in relation to NBS. The priorities of the environmental and planning departments of local government who are often responsible for the implementation of NBS are not always well aligned with the priorities of the departments responsible for finance or maintenance. There is a lack of common language in relation to the value of NBS.
4. **Knowledge gaps:** Internally there is often a lack of financial, governance and business model expertise in the environmental and planning departments of local government responsible for NBS. This can contribute to path dependency on conventional sources of financing and 'silo' gaps between departments.
5. **Complexity of governance hindering innovation in business models:** NBS often involve multiple public agencies, NGOs, residents in planning and implementation. It is challenging to align different stakeholders to a common vision and engage stakeholders in ongoing governance and business model arrangements.

Annex 2 - Overview of Taskforce on Climate Related Financial Disclosures and UK implementation

Over the past two or three years, there has been increased focus on mobilising the entire economy to invest in both mitigation and adaptation, stemming from the financial sector's realisation that climate change presents a material risk to global financial stability, as well as to the revenues and profits of individual companies. It was recently estimated that 92% of the world's largest companies have at least one asset highly exposed to a climate hazard by the 2050s [xlvi].

An overriding challenge is that climate risks are not systematically reflected in the values of financial assets, hindering the incentive to invest in managing climate risks. To address this risk, the Taskforce on Climate-Related Financial Disclosures produced the first global framework for those in the financial sector to measure and report on their progress on tackling the financial risks of climate change (FSB, 2017)[xlvii]. For the purposes of the framework, it categorises risks from climate change into two categories: *transition* risks which are those associated with the move to a low carbon economy, and *physical risks* – the risks associated with the physical impacts of climate change. An overview of this framework, and how they translate into financial impact is shown below:

Figure 22: Climate-related risks, opportunities and financial impact. Source: FSB, 2017.

The TCFD recommendations focus on identifying, disclosing and managing these risks and opportunities through four key areas: Governance, Strategy, Risk Management and Metrics and Targets.

As part of efforts to harmonise market and industry initiatives, and in recognition that many users of disclosures were seeking useful information on organisations' plans and progress to move to a low carbon economy, the TCFD extended its guidance in 2021 to include recommendations that organisations develop transition plans[xlviii].

The guidance defines a transition plan as "an aspect of an organization's overall business strategy that lays out a set of targets and actions supporting its transition toward a low-carbon economy, including actions such as reducing its GHG emissions". Whilst adaptation is explicitly excluded from the TCFD definition of a transition plan, the guidance also acknowledges the need for companies to develop adaptation plans as responses to the financial related risks and opportunities and that both may be part of an organisation's overall business strategy.

In light of the UK's importance as a global financial centre, the UK Government has sought to be a leader in this space, and the recently updated Green Finance Strategy 2023[xlix] outlines the progress and ambitions to transpose the TCFD framework into UK law, both as an approach to regulating the financial services sector, but also to drive action in the real economy. This approach was known as the 'Sustainability Disclosure Requirements'.

The key elements are outlined in Box 4, but in effect the requirements focus on providing information on whether a company has a credible approach to managing its climate-related risks. These regulations do not extend to transition plans, but the UK Government has also committed to requiring this disclosure through the broader Sustainability Disclosure Requirements.

Box 4: Elements of disclosure required under the UK Government's non-binding guidance.

A. A description of the governance arrangements of the company or LLP in relation to assessing and managing climate-related risks and opportunities.

B. A description of how the company or LLP identifies, assesses, and manages climate-related risks and opportunities.

C. A description of how processes for identifying, assessing, and managing climate-related risks are integrated into the overall risk management process in the company or LLP.

D. A description of—

   i. the principal climate-related risks and opportunities arising in connection with the operations of the company or LLP, and

   ii. the time periods by reference to which those risks and opportunities are assessed.

E. A description of the actual and potential impacts of the principal climate-related risks and opportunities on the business model and strategy of the company or LLP.

F. An analysis of the resilience of the business model and strategy of the company or LLP, taking into consideration of different climate-related scenarios.

G. A description of the targets used by the company or LLPs to manage climate-related risks and to realise climate-related opportunities and of performance against those targets; and

H. The key performance indicators used to assess progress against targets used to manage climate-related risks and realise climate-related opportunities and a description of the calculations on which those key performance indicators are based.

To support the introduction of Transition Plans, the UK Government recently created the Transition Plan Taskforce to create a gold standard. Whilst its draft guidance[l] contained little on adaptation, the Climate Change Committee recommended its inclusion[li] and the Taskforce recently announced a working group on adaptation to best consider how to include consideration of adaptation. This is over and above the UK Government's planned work programme on green finance and adaptation being developed for 2024.

Whilst the approach is new and evolving rapidly, there are indications that strengthening the ecosystem and transparency of plans and processes will be a powerful approach. A number of large corporates are beginning to estimate the impact climate change may have on their profits and revenues. For example, it was recently estimated that the physical impacts of climate risk at Pepsico hast a potential financial impact of USD 217 million or 2.1% of the company's three-year average annual operating profit and will be realised in the next five to ten years (Planet Tracker, 2023).[lii].

Similarly, Aviva recently pushed companies within its investment portfolio to publish 'robust and viable' climate transition plans. Whilst the approach is currently limited to the largest companies, this is likely to cascade down the supply chains to either companies in an investment portfolio, or to smaller suppliers or customers as companies seek to get a handle on emissions and physical risks.

Finally, at the same time as developing disclosure frameworks and transition plans, there have also been efforts to develop Green or sustainable finance taxonomies to guide the investment activities of investors and project proposers in companies and the financial sector. A taxonomy is a formal classification of what constitutes a sustainable economic activity. Early efforts have been in Europe[liii], and with the UK's departure from the European Union, the UK is currently leading development of its own taxonomy[liv] - with adaptation as an area of focus.

Taxonomies could eventually form the basis of legal claims against companies for failing to adapt to physical risks. The EU Taxonomy regulations and guidance highlight that to claim an economic activity as sustainable, companies need to assess the climate risks of the economic activity and systems to a range of hazards and where they are material, develop an adaptation action plan.[lv] This will then be independently audited, and could be the basis for foreseeability.

Whilst this top-down approach is likely to be a significant driver of change, it is important to recognise that these approaches are nascent, and there are significant limitations and drawbacks to methods, which will likely need to be complemented by stakeholder engagement, and detailed modelling and analysis at the asset level. For example:

- The global nature of many of the companies in scope mean that initial analysis will be high level, and will likely need to be complemented by bottom up, site specific analysis for meaningful assessments of risks.
- Limited availability of resources can result in trade-offs between mitigation and adaptation efforts. This means organisations often have to make choices between pursuing efforts to reduce emissions or adapt to impacts, affecting their overall efforts on one or both.
- Many of the 'Value at Risk' metrics employed at the portfolio level to help quantify physical risks rely on global climate models. These fail to reflect real world implications, such as the presence of flood defences, or local topography, or the presence of urban heat island effects, meaning risks can be over or underrepresented.
- The introduction of new frameworks and requirements will require training and capacity building to ensure they are effectively understood and serviced. Within this, many smaller businesses and SMEs will need additional support to assess their climate risks and comply with reporting given their more limited ability to implement change, and to assess, disclose and manage climate risks.

Annex 3 – Prioritisation of funding sources and financing sources – full results

The full list of funding and financing sources identified and appraised as part of the finance task are listed below:

Subcategory	Instrument	Description	Examples of use
Grants	1. UK Shared Prosperity Fund (Capital Element)	UK Successor to European Regional Development Fund	
	2. Levelling Up Fund	Capital fund investing in infrastructure, including regeneration, upgrading local transport, and investing in cultural and heritage assets.	Granton Gas Holder
	3. Edinburgh and Southeast Scotland City Deal	£751m allocated to Research, Development and Innovation.	Fife Industrial Innovation Investment Programme
	4. Scottish Water Capital Investment Programme	Scottish Water have a rolling investment programme from 2021 – 2027. £4.5bn financed from customer charges and borrowing by Scottish Government	
	5. Grants from wider scheme beneficiaries	Funding from Royal Botanic Gardens Edinburgh / NHS Lothian in recognition of reduced future flood risk	Partnership Funding scheme, England
	6. Scottish Government General Capital Support Grant	Funding to Local Authorities to take forward flood defence schemes. £42m allocated each year.	Hawick, Scottish Borders
	7. Nuveen Capital Investment contribution	Direct investment by Nuveen as asset owner.	Flood defence Grant in Aid, England
	8. Nuveen Sustainability / CSR team	Private sector contribution based on CSR / reputational benefit / pathfinder approach/	
	9. Schools / Education benefits	Payments from schools' budgets based on educational benefits provided.	Greater Manchester

Subcategory	Instrument	Description	Examples of use
Taxes / User Charges / Credits	10. Tenant contributions / charging	Contributions of tenants to capital or maintenance of scheme	Greening the BIDS, London
	11. Renewable Energy / Energy Efficiency revenues	Ringfencing of future savings or blended approach to mitigation and adaptation investment	
	12. User charging – Car park / EV charging	Introduction of a small tariff for charging EVs.	
	13. Property Sale Tax	Tax on the sale of individual units or if the asset changes hands.	
	14. Tourism Tax	Payment of a nightly levy for tourism to the city.	Edinburgh City Council, subject to Local Visitor Levy bill, Algarve
	15. Carbon Credits	Payments made for every metric tonne of CO2e produced.	UK Emissions Trading Scheme – UK-ETS, large corporations with internal pricing
	16. Biodiversity credits	Payments for an improvement in habitats for relevant ecosystems around the world.	Biodiversity Net Gain, England
	17. Payment for Ecosystem services	Payment for other residual ecosystem services, such as provisioning	
Philanthropy / Impact Grants	18. Crowdfunding	Fundraising from public with no expectation of a return. 20 EV charge bays included in the proposal.	Crowdfunder, Spacehive, Ethex
	19. Philanthropic Funding	Grants from organisations for impact.	Built by Nature Foundation, Laudes Foundation
Loans	20. Public Works Loan Board	Default source of lending to Local Authorities. Issued by Debt Management Office.	

Subcategory	Instrument	Description	Examples of use
	21. UK Infrastructure Bank	UK Government bank, with lending below PWLB borrowing rates.	Limited examples but NBS in the Strategic Plan as an area to develop over time.
	22. Scottish National Investment Bank	Scottish Government backed Bank, with missions around net zero and place, capitalised with long-term, patient capital. Lends to private sector. Focus to date on NBS	Lost Shore –£26m investment to transform disused quarry in the west of Edinburgh into multi-purpose country park and leisure facility
	23. Community Municipal Investments	Citizen lending, either to a project directly, or to Local Authority	Abundance in partnership with West Berkshire funded trees and flood defences.
	24. Commercial Loans	Loans provided by private banks on a commercial basis.	Triodos in Lancashire.
	25. Pension funds	Pension funds which seek environmental and social returns alongside financial ones	Strathclyde Pension Fund Direct Investment Portfolio, Lothian Pension Fund
	26. Regeneration Funds	Blended finance instrument between public and private sector for regeneration projects	E.g., SURF
Equity	27. Angel Investors	Raising of financing through the sale of shares /ownership stake in a company / SPV.	Green Angel Syndicate
Bonds	28. Green Gilts / UK Green Financing Framework	Debt financing via UK government, with spend hypothecated and reported on.	
	29. Green Bonds / Resilience Bonds	Large scale debt instrument issued to achieve specific outcomes, with performance tracked over time.	

Subcategory	Instrument	Description	Examples of use
Land Value	30. Tax Increment Financing	Borrowing linked to projected growth or sustained future tax revenues.	
	31. Planning gains / levy	Levy paid per tonne of carbon on new developments in City of Edinburgh boundary	Milton Keynes, GLA, Kensington and Chelsea

Table X. Funding (White) and Financing (blue) options for Craigleith Retail Park.

Grading	Rating
5	Highly likely
4	Likely
3	Average
2	Unlikely
1	Highly unlikely

The results of the scoring exercise are shown below:

Public Sector

Instrument	Acceptability	Deliverability	Quantum	Total
1. UK Shared Prosperity Fund (Capital Element)	3	3	3	9
2. Levelling Up Fund	3	2	4	9
3. Edinburgh and Southeast Scotland City Deal	2	1	4	7
4. Scottish Water Capital Investment Programme	2	4	4	10
5. Grants from wider scheme beneficiaries	4	2	2	8
6. Scottish Government General Capital Support Grant	3	4	2	9
7. Nuveen Capital Investment contribution	4	3	4	11
8. Nuveen Sustainability / CSR team	4	2	3	9
9. Schools / Education benefits	2	2	2	6
10. Tenant contributions / charging	4	3	2	9
11. Renewable Energy / Energy Efficiency revenues	4	3	3	10
12. User charging – Car park / EV charging	4	2	2	8
13. Property Sale Tax	2	1	2	5
14. Tourism Tax	2	2	4	8
15. Carbon Credits	3	1	1	5
16. Biodiversity credits	2	1	1	4
17. Payment for Ecosystem services	3	1	1	5
18. Crowdfunding	4	3	3	10
19. Philanthropic Funding	4	3	4	11
20. Public Works Loan Board	3	2	5	10
21. UK Infrastructure Bank	4	2	5	11

22. Scottish National Investment Bank	4	3	5	12
23. Community Municipal Investments	4	3	5	12
24. Commercial Loans	2	3	5	10
25. Pension funds	3	3	4	10
26. Regeneration Funds	4	3	4	11
27. Angel Investors	3	2	3	8
28. Green Gilts / UK Green Financing Framework	3	1	5	9
29. Green Bonds / Resilience Bonds	3	1	5	9
30. Tax Increment Financing	3	1	4	8
31. Planning gains / levy	3	2	4	9

Private Finance

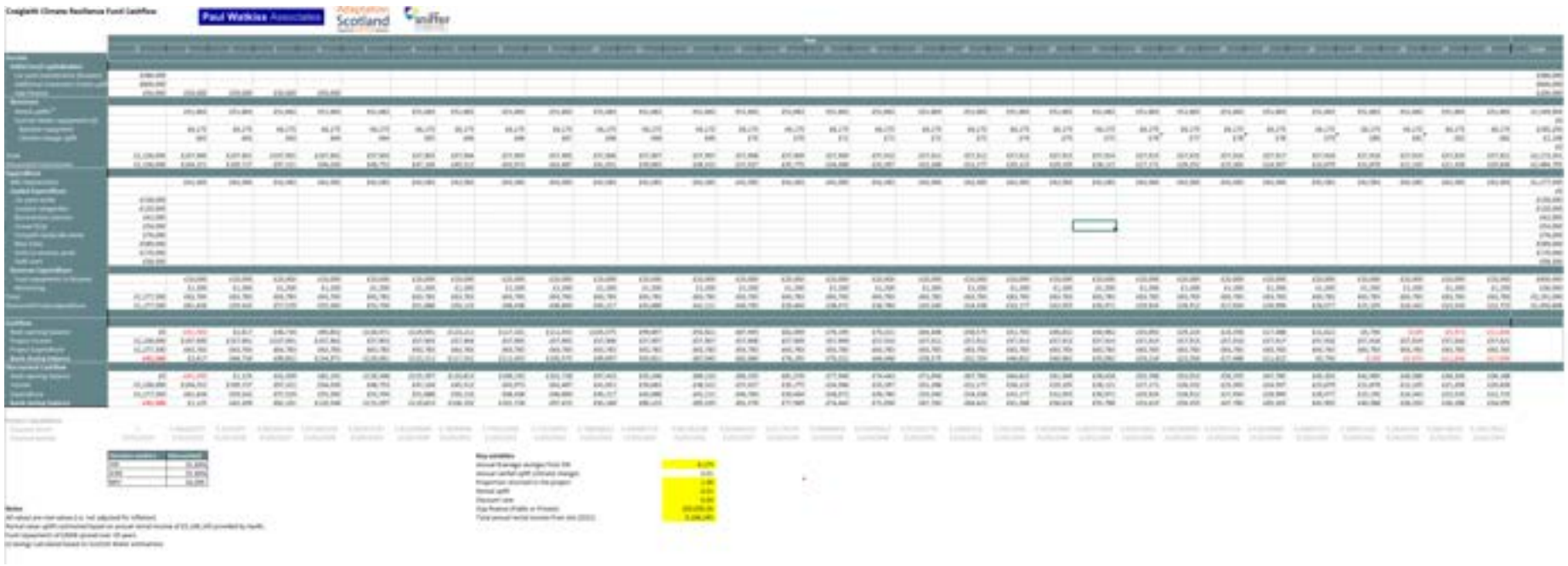
Instrument	Acceptability	Deliverability	Quantum	Total
1. UK Shared Prosperity Fund (Capital Element)	5	3	3	11
2. Levelling Up Fund	5	3	4	12
3. Edinburgh and Southeast Scotland City Deal	5	1	4	10
4. Scottish Water Capital Investment Programme	5	2	4	11
5. Grants from wider scheme beneficiaries	4	2	2	8
6. Scottish Government General Capital Support Grant	4	2	2	8
7. Nuveen Capital Investment contribution	2	2	4	8
8. Nuveen Sustainability / CSR team	4	1	3	8
9. Schools / Education benefits	4	2	2	8
10. Tenant contributions / charging	4	4	2	10
11. Renewable Energy / Energy Efficiency revenues	2	4	3	9
12. User charging – Car park / EV charging	2	4	2	8
13. Property Sale Tax	1	1	2	4
14. Tourism Tax	1	1	4	6

15. Carbon Credits	4	2	1	7
16. Biodiversity credits	2	2	1	5
17. Payment for Ecosystem services	4	2	1	7
18. Crowdfunding	3	2	3	8
19. Philanthropic Funding	4	2	4	10
20. Public Works Loan Board	3	3	5	11
21. UK Infrastructure Bank	3	1	5	9
22. Scottish National Investment Bank	3	1	5	9
23. Community Municipal Investments	3	2	5	10
24. Commercial Loans	2	1	5	8
25. Pension funds	4	2	4	10
26. Regeneration Funds	4	3	4	11
27. Angel Investors	1	1	3	5
28. Green Gilts / UK Green Financing Framework	2	1	5	8
29. Green Bonds / Resilience Bonds	2	1	5	8
30. Tax Increment Financing	3	2	4	9
31. Planning gains / levy	3	2	4	9

Annex 4 – Supporting information for economic analysis

Available as a separate download.

Annex 5 – Indicative project cashflow



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