Pembrokeshire Green Infrastructure Assessment

Pembrokeshire County Council

Final report

Prepared by LUC

February 2023

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Introduction

1.1 Welcome to the Green Infrastructure (GI) Assessment for Pembrokeshire.

1.2 Prepared by Pembrokeshire County Council (PCC) and Pembrokeshire Coast National Park Authority (PCNPA), the GI Assessment provides a suite of ambitious and deliverable management interventions with the aim of creating healthier, more resilient environments across the county. An emphasis is placed on both the strategic scale and settlement based opportunities.

1.3 This report may be used to explore the work, understand its purpose and gather more information about the proposed projects and proposals across Pembrokeshire.

Overview of the Green Infrastructure Assessment

What is Green Infrastructure?

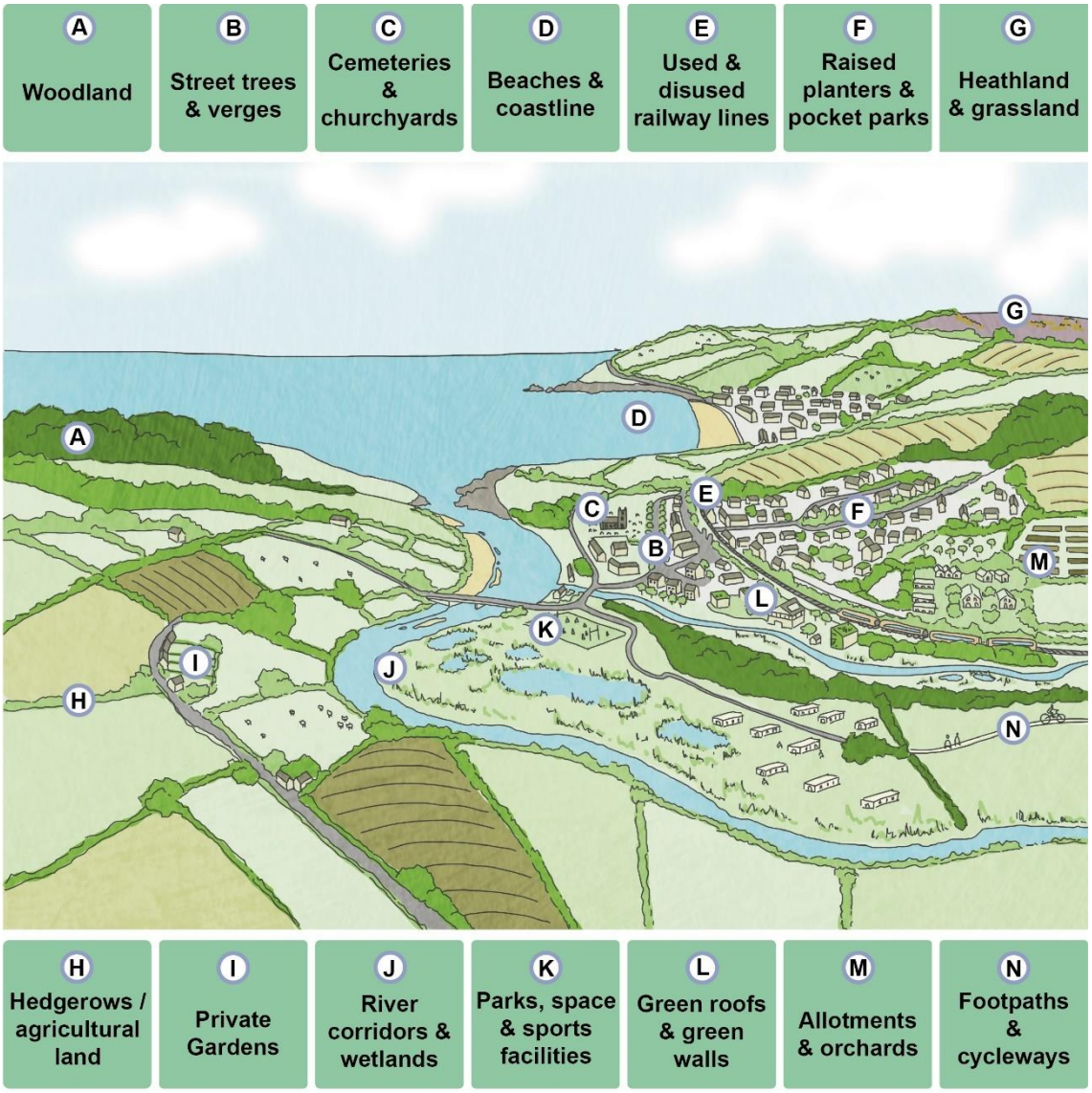
1.4 As defined within Planning Policy Wales (Edition 11) **[See reference 1]**, Green Infrastructure (GI) refers to “the network of natural and semi-natural features, green spaces, rivers and lakes that intersperse and connect places”.

1.5 Just as a transport network connects people across and area through a network of roads, rail or pavements, GI helps to connect people, wildlife and nature. GI can therefore include strategic scale assets such as river corridors as well as parks, woodlands, private gardens, allotments, hedges, street trees, roadside green verges, or footpaths.

1.6 The figure below depicts the multifunctional nature of green infrastructure, which can include:

- Woodland
- Street trees and verges
- Cemeteries and churchyards
- Beaches and coastline
- Used and disused railway lines
- Raised planters and pocket parks
- Heathland and grassland
- Hedgerows/agricultural land
- Private gardens
- River corridors and wetlands
- Parks, spaces and sports facilities
- Green roofs and green walls
- Allotments and orchards
- Footpaths and cycleways

Figure 1.1: Multi-functional nature of Green Infrastructure



1.7 Recognition of the multi-functional nature of GI is also of particular importance. When considering any given GI asset, it is likely that several functions will be identified, and several benefits derived. For instance, a high-quality urban park will likely provide opportunities for informal recreation, support active travel, provide education opportunities, space for wildlife, reduce surface water run-off and mitigate air pollution.

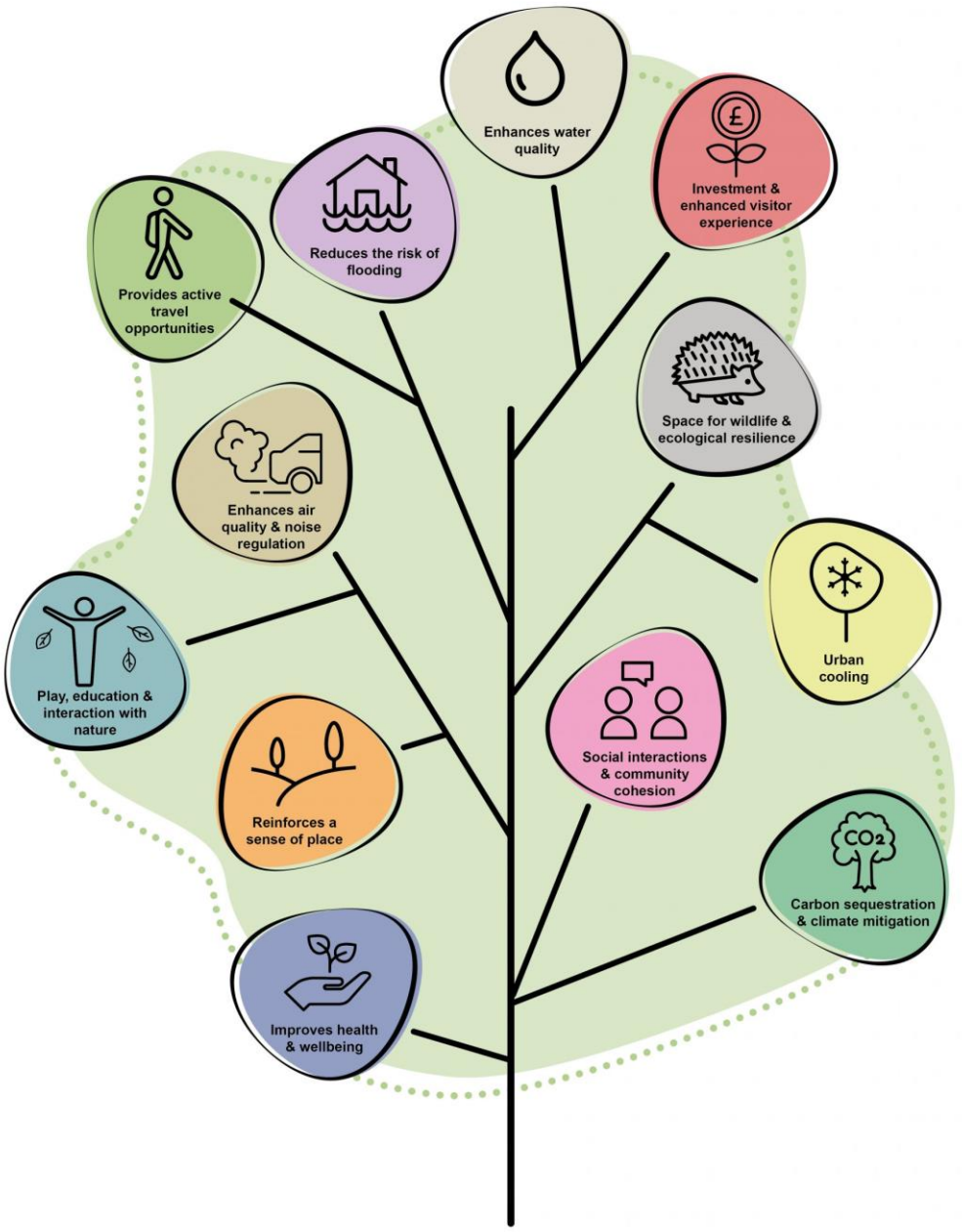
1.8 GI should form a strategic network of high-quality green spaces and other natural features, which offer quality of life benefits for communities. It should

thread through the built environment and connect the urban area to wider rural areas. Recognised as an essential component of resilient and healthy communities, the concept of GI, therefore, forms a cornerstone of sustainable development.

1.9 The figure below depicts some of the benefits of green infrastructure, which include:

- Reduction of the risk of flooding
- Enhancement of water quality
- investment and enhanced visitor experience
- Spaces for wildlife and ecological resilience
- Urban cooling
- Social interactions and community cohesion
- Carbon sequestration and climate mitigation
- Improvement of health and wellbeing
- Reinforcement of a sense of place
- Play, education and interaction with nature
- Enhancement of air quality and noise regulation
- Provision of active travel opportunities

Figure 1.2: Benefits of Green Infrastructure



Why do we need this GI Assessment?

1.10 At a national scale, the evolving policy context in Wales ensures that GI is receiving greater attention than ever before. Future Wales **[See reference** 2**]** is the Welsh Government's National Development Framework and is the highest tier of the Development Plan in Wales. As the most recent expression of national planning policy, Future Wales is considered to have primacy in the planning policy hierarchy. The Local Development Plan is therefore required to ensure conformity. The purpose of Future Wales is to ensure the planning system at all levels is consistent with, and supports the delivery of, Welsh Government strategic aims and policies. The key policies of relevance to GI are Policies 2, 8 and 9. Policy 2 states that *"the growth and regeneration of towns and cities should positively contribute towards building sustainable places that support active and healthy lives, with urban neighbourhoods that are compact and walkable, organised around mixed-use centres and public transport, and integrated with green infrastructure".*

1.11 Policy 8 notes that flood risk management that enables and supports sustainable strategic growth will be supported, including the promotion of nature-based solutions as a priority. Furthermore, -the requirement for biodiversity enhancements, increased ecosystem resilience and provision of GI is outlined in Policy 9. This includes the identification of GI opportunities with the aim of delivering sustainable growth, ecological connectivity, social equality and well-being. The Preseli Hills and the woodlands of northern Pembrokeshire are specifically highlighted as an ecosystem service hotspot, offering multifunctional benefits at the strategic scale.

1.12 In 2015, the Welsh government passed the Well-being of Future Generations (Wales) Act 2015 **[See reference** 3**]**. This Act gives national and local government a legally binding common objective to work together to improve health and well-being in Wales, via seven well-being goals. Delivery of GI at a settlement scale therefore requires alignment with this existing policy and strategy base. This ensures that proposed GI interventions are based on the taxonomy of the Well-being of Future Generations Goals and rooted in other national, regional and local policies.

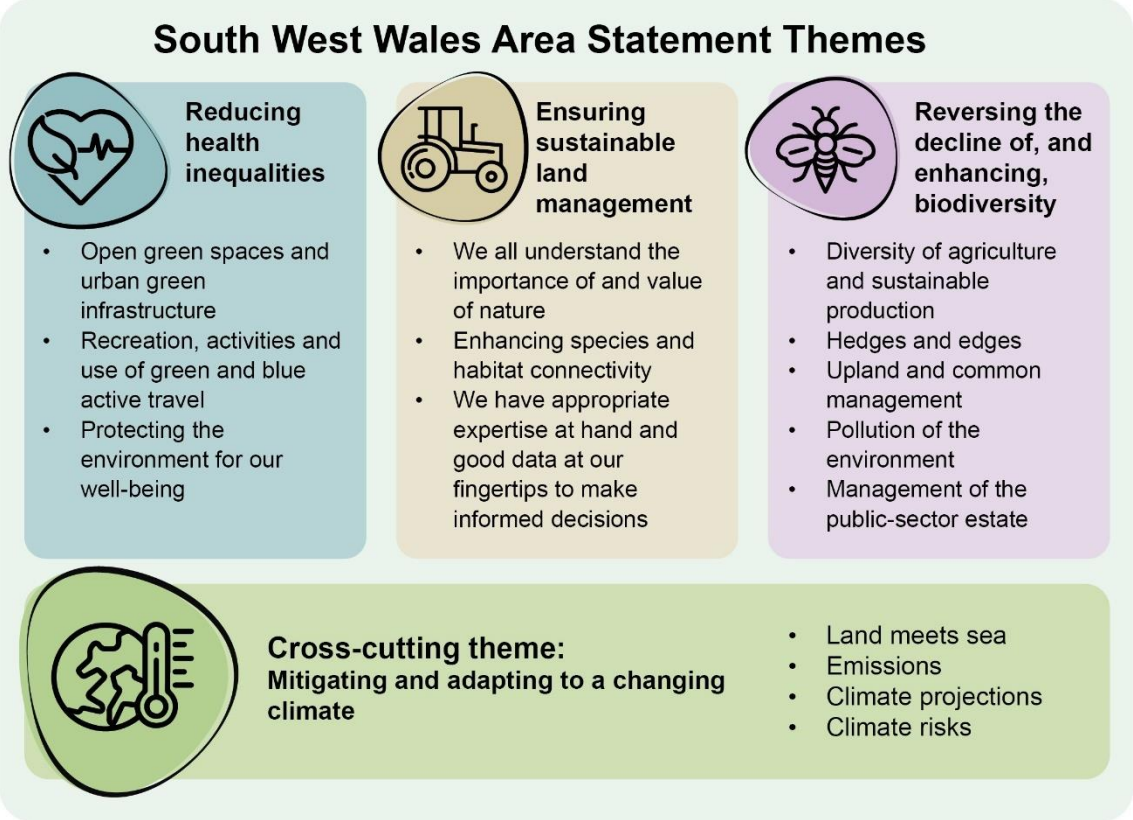
1.13 Delivery of nature-based solutions and proposals to increase GI in and around urban areas are highlighted as national priorities within Natural Resources Policy **[See reference** 4**]**. Other key legal frameworks and national planning policy documents in Wales (including the Active Travel (Wales) Act 2013 **[See reference** 5**]** and legislation such as Wales' pioneering SuDS regulations **[See reference** 6**]** and the State of Natural Resources Report for Wales **[See reference** 7**]**) provide a framework for future investment in GI.

1.14 The Environment (Wales) Act 2016 **[See reference** 8**]** also includes a new biodiversity duty with the aim to help reverse the decline and secure long-term resilience of biodiversity in Wales. This highlights the key issue of biodiversity pressures and the need to enhance ecosystem resilience in Wales, supporting the delivery of the Local Biodiversity Action Plan at the local level. The Act forms a core consideration in decision making and provides a framework that ensures Wales' natural resources are managed sustainably.

1.15 At the national level, the State of Natural Resources Report for Wales **[See reference** 9**]** identified the nature and climate emergencies as the two key strategic environmental challenges for Wales to address. Climate change and flooding are also key issues impacting the urban context of Pembrokeshire, and one of the Strategic Objectives to delivering the Vision of the PCC Local Development Plan **[See reference** 10**]** is to mitigate and respond to climate change. The PCNPA Local Development Plan **[See reference** 11**]** also highlights climate change, sustainable design, flooding and sustainable energy as priority issues within the county.

1.16 The key factors influencing the need for the GI Assessment are based on the 'themes' identified within the South West Wales Area Statement **[See reference** 12**]** published by Natural Resources Wales (NRW), as defined below in Figure 1.3 and described in the paragraphs that follow after the figure.

Figure 1.3: South West Wales Area Statement Themes



Mitigating and adapting to a changing climate

1.17 Climate change and its associated risks are a significant consideration for the county, particularly following the declaration of a climate emergency by both PCC and PCNPA in 2019. The requirement also exists to respond to the county's wider commitment to achieving net zero by 2030. Investment in GI offers the potential to reduce Pembrokeshire's vulnerability to climate change and other environmental threats, such as flooding. This is supported by a strong evidence base, including the Natural Resources Wales (NRW) State of the Natural Resources Report.

1.18 Published in 2022, the Pembrokeshire Well-being Assessment **[See reference** 13**]** describes climate change and the nature emergency as the defining issues of our time. The effects of climate change will increase the

significant number of properties, communities, infrastructure and key services at risk of flooding within the county. A number of settlements in Pembrokeshire are already facing adverse problems relating to climate change, hence a holistic approach is required to address these issues. GI interventions therefore have a key role to play in responding to climatic variability and change.

Reversing the decline of, and enhancing, biodiversity

1.19 Climate change and its associated risks are a significant consideration for the county, particularly following the declaration of a climate emergency by both PCC and PCNPA in 2019. The requirement also exists to respond to the county's wider commitment to achieving net zero by 2030. Investment in GI offers the potential to reduce Pembrokeshire's vulnerability to climate change and other environmental threats, such as flooding. This is supported by a strong evidence base, including the State of Natural Resources Report for Wales **[See reference** 14**]**.

1.20 Published in 2022, the Pembrokeshire Well-being Assessment **[See reference** 15**]** describes climate change and the nature emergency as the defining issues of our time. The effects of climate change will increase the significant number of properties, communities, infrastructure and key services at risk of flooding within the county. A number of settlements in Pembrokeshire are already facing adverse problems relating to climate change, hence a holistic approach is required to address these issues. GI interventions therefore have a key role to play in responding to climatic variability and change.

Reducing health inequalities

1.21 The Well-being Plan for Pembrokeshire **[See reference** 16**]** promotes the environment as a key resource to improve health and well-being, address social isolation, enhance mental health and deliver projects such as social and green prescribing. In addition to improving general health outcomes, the report states

that enhancing the public's relationship with nature offers the opportunity to directly enhance their attitudes and behaviours concerning environmental sustainability.

1.22 The expansion and improvement of GI provides a mechanism to tackle health and economic inequalities as well as support community cohesion. All of Pembrokeshire's settlements offer a wide range of GI assets that provide health and well-being benefits which could be further enhanced through appropriate GI interventions.

Ensuring sustainable land management

1.23 Whilst the focus of the GI Assessment is on the identification of GI interventions at the settlement scale, the way in which land is managed has wider implications on the county. Diversity of agriculture and sustainable production forms a key issue, with sustainable approaches to forestry and farming potentially offering huge benefits to the environment. These include a reversal in the decline of biodiversity, reduced flood risks and improvements to the quality of water resources. The opportunity also exists to increase the potential for carbon sequestration within soils and biomass, through the protection and enhancement of existing assets.

How has the GI Assessment been developed?

1.24 The development of the GI Assessment has involved the evaluation of the existing baseline and identification of opportunities for improvement. The approach has included five steps, as outlined within the GI Assessments Guidance Note 42 published by NRW. This process was used to compile the evidence base to help develop and identify GI interventions.

Setting the baseline

1.25 The first step in the development of the GI Assessment was the identification of existing GI assets, ecological corridors and strategic networks within Pembrokeshire. Baseline spatial data was gathered from a wide range of sources, including NRW, and collated using Geographical Information Systems (GIS).

Identifying priorities

1.26 This stage involved the analysis of the spatial distribution of the existing GI network, as well as the socio-economic and environmental context which contributes to the 'need' for GI within Pembrokeshire. Datasets were analysed to identify risks and challenges within the county, providing the starting point for the identification of opportunities to improve the GI network. This information was supplemented with local priorities, risks and opportunities identified within South West Wales Area Statement **[See reference** 17**]**, providing the drivers and strategic context for the Studies.

1.27 Consultation and engagement formed a critical component in the development of the GI Assessment. This was used to supplement the data analysis and involved engagement with key stakeholders via a series of virtual workshops, targeted consultation and site visits. These responses were used to inform the preparation of the emerging GI Assessment. Public consultation was also undertaken using an online survey and interactive map as a tool for gaining an insight into perceptions, opportunities and local expectations.

Site assessment

1.28 Field work was undertaken in order to identify site specific threats and challenges to project delivery. The 11 settlements were visited with the aim of identifying opportunities for maintaining and improving the GI network at a site level, complementing analysis at the strategic scale.

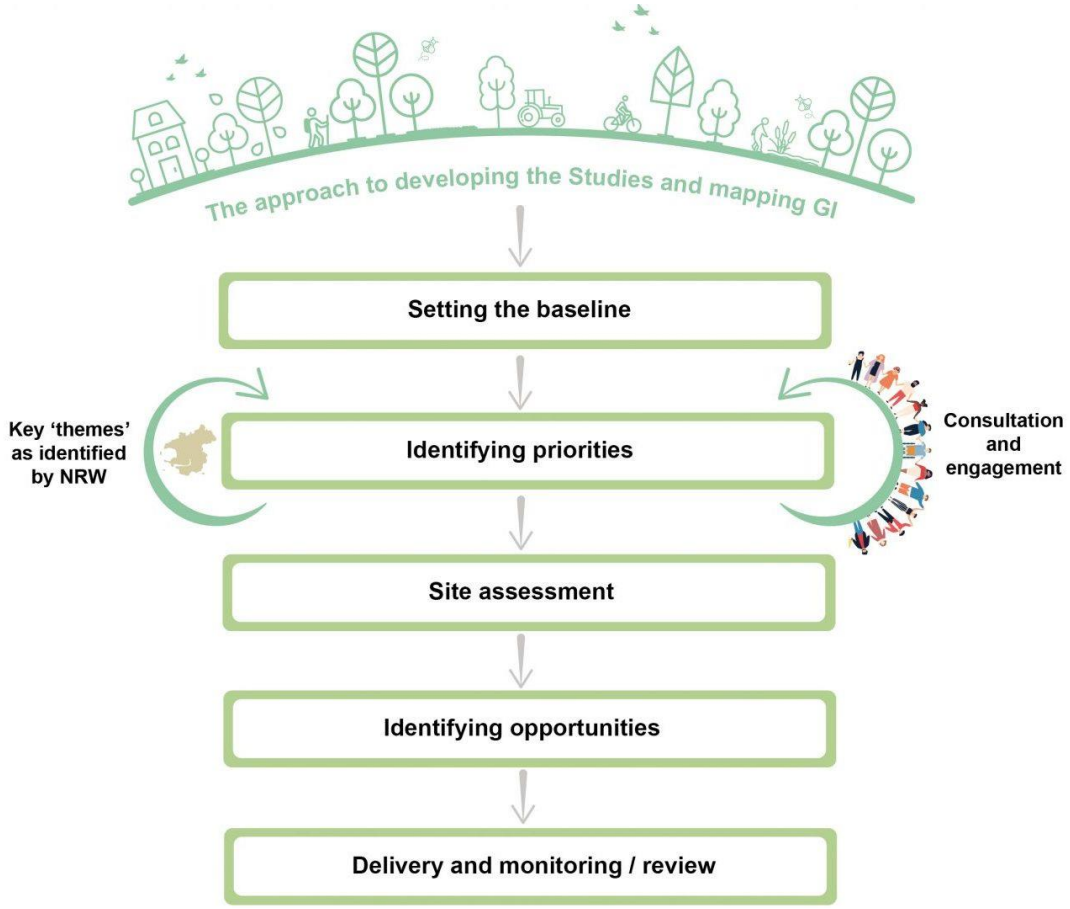
Identifying opportunities

1.29 Starting at the strategic scale, analysis was completed to address priorities relating to both biodiversity and people within Pembrokeshire. The findings were used to inform the identification of GI projects for the protection, enhancement, and expansion of the GI network. Specific emphasis was placed on the identification of opportunities to improve ecological resilience, the provision of ecosystem services and water management. Each of the GI projects were mapped and the functions of each action / project highlighted.

Delivery and monitoring / review

1.30 The development of the GI Assessment focussed on ensuring the delivery of GI interventions, including mechanisms to monitor future successes through performance indicators.

Figure 1.4: Approach to developing the Studies and mapping GI



Why was a settlement based approach adopted?

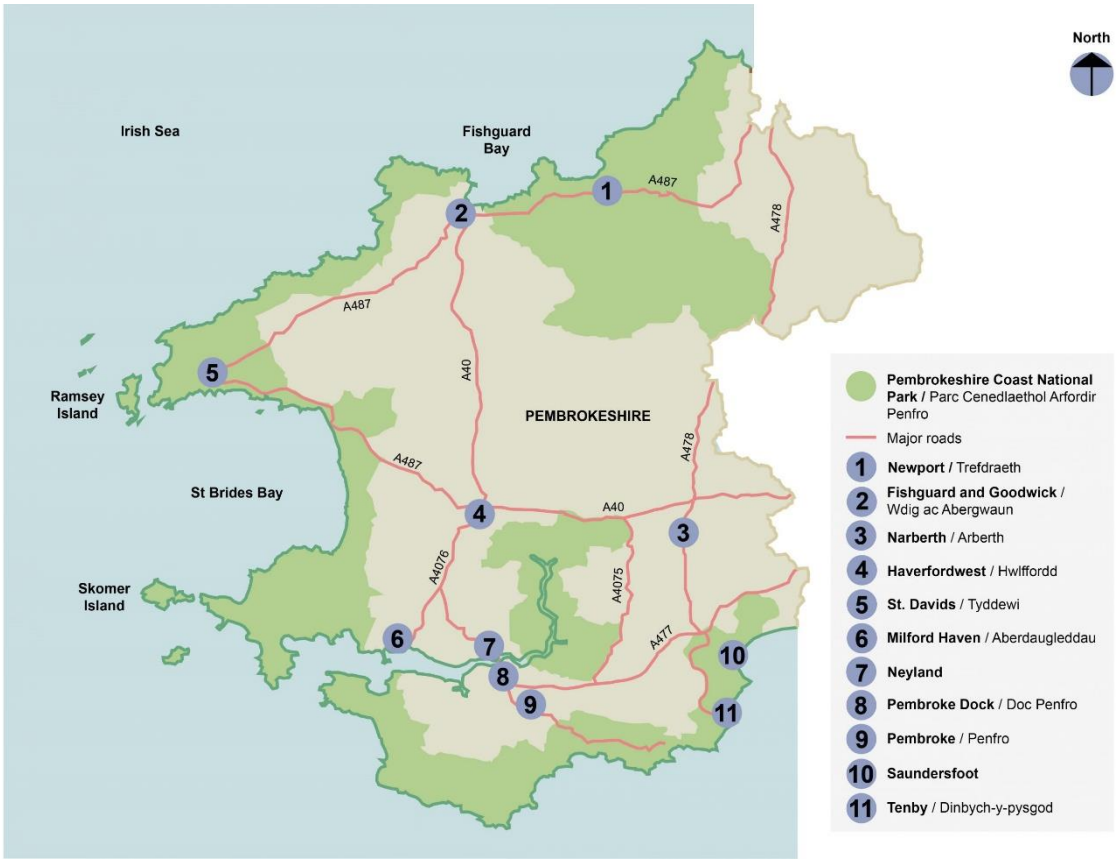
1.31 This approach was used as it offered the greatest opportunity for delivering needs for people and the community. By outlining opportunities within the urban environment, the GI Assessment aims to assess the potential to enhance GI in Pembrokeshire's key settlements and thereby encourage healthy and active living, boost local economic regeneration and increase the resilience of the natural environment. These ambitions also support the national challenges and opportunities identified within Natural Resources Policy **[See reference** 18**]**. These include helping to tackle health and economic inequalities, aiding community cohesion and delivering climate change mitigation and adaptation.

1.32 The State of Natural Resources Report for Wales **[See reference** 19**]** indicates that increasing GI in and around urban areas delivers a wide range of benefits in terms of both ecosystem resilience and community well-being. The provision of increased canopy cover close to settlements is also recognised as offering greatest recreational and ecosystem service value. In addition, well planned GI within urban areas can provide relief from climatic extremes through shelter and shading as well as connectivity for biodiversity to adapt to climate change. Furthermore, the provision of urban focussed GI interventions helps to ensure communities benefit from healthy environments, supporting preventative approaches to health outcomes. This includes ensuring a particular focus is placed on key public health issues of transport related air and noise pollution as well as tackling physical inactivity and mental health through the provision of increased green space.

1.33 The 11 settlements included in the GI Assessment are listed below and displayed on the following map:

- Fishguard and Goodwick
- Haverfordwest
- Milford Haven
- Narberth
- Newport
- Neyland
- Pembroke
- Pembroke Dock
- Saundersfoot
- St Davids
- Tenby

Figure 1.5: 11 setlements included in the GI Assessment

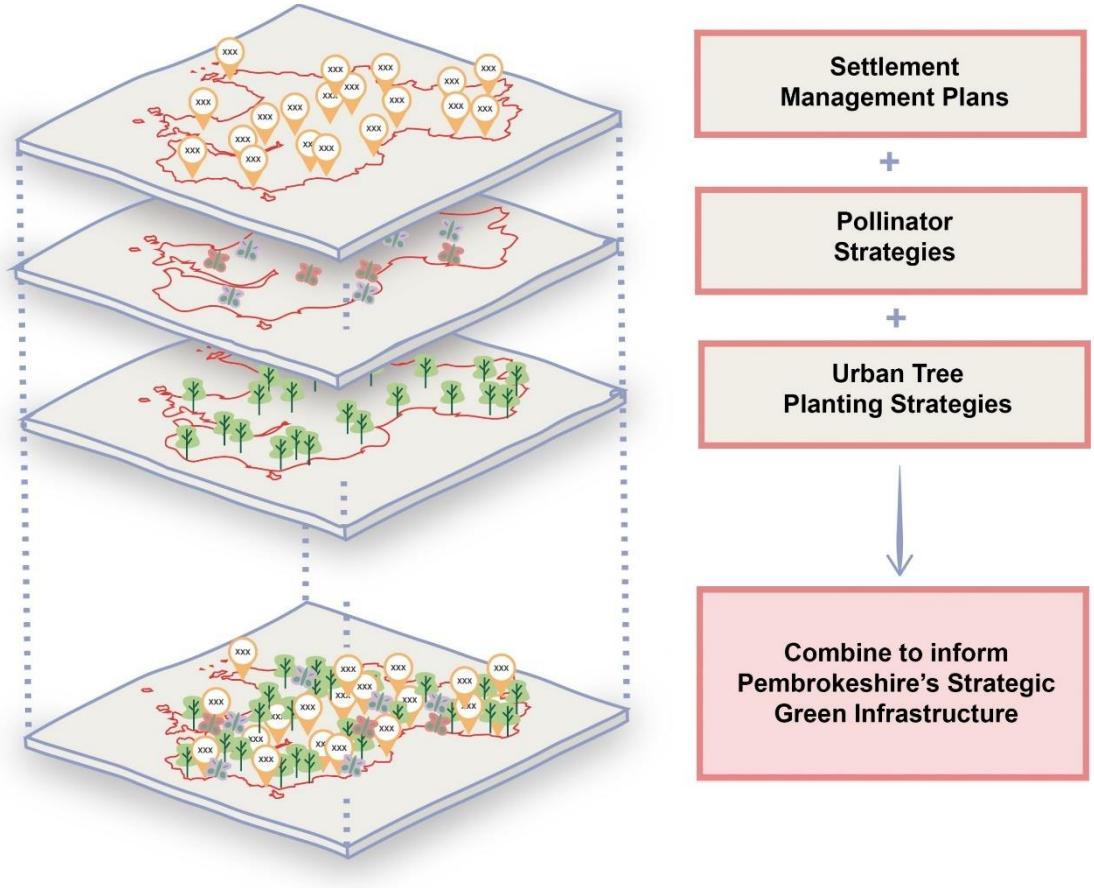


1.34 The GI Assessment builds on the work achieved to date as part of the Green Infrastructure Action Plan for Pembrokeshire (now superseded), with an increased emphasis on future management and delivery. The projects and opportunities outlined provide a road map for future investment and aim to guide the future delivery of GI ambitions across the county in the short, medium and long term.

1.35 The GI Assessment comprises three distinct elements (as listed below) which combine to inform GI at the strategic scale in Pembrokeshire:

- Settlement Management Plans
- Urban Tree Planting Strategies
- Pollinator Strategies

Figure 1.6: Three distinct eleements of the GI Assessment



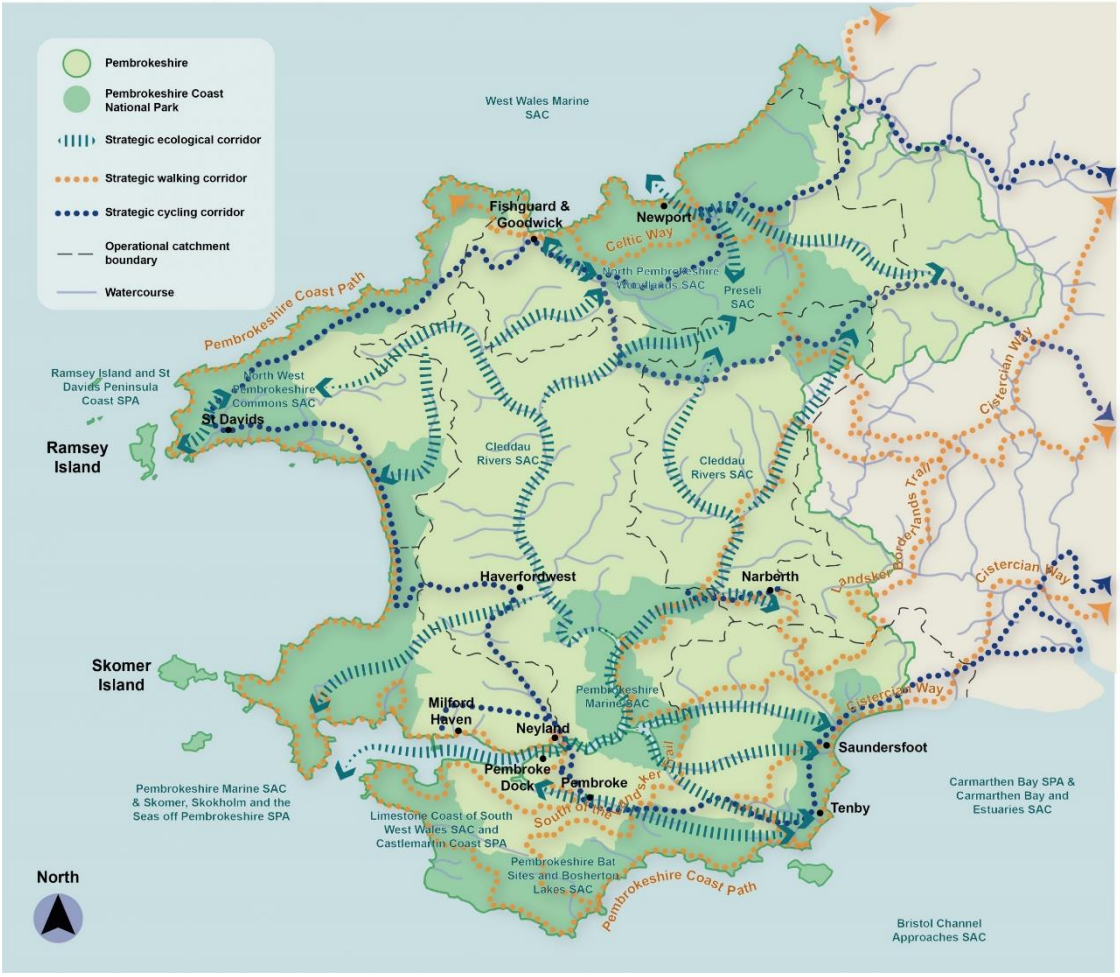
Chapter 2

Vision and Aims

The overarching vision of the GI Assessment is to strategically plan for Pembrokeshire's GI network through the identification and management of interventions across the county.

2.1 The focus of the proposals is on delivery and future management, providing a roadmap for future investment in GI. By focussing interventions within Pembrokeshire's 11 key settlements, the strategic network of GI will be reinforced, as shown on the figure below.

Figure 2.1: Pembrokeshire's Strategic Green Infrastructure Network



2.2 The vision of the GI Assessment is supported by a series of six aims, as outlined below:

- Aim 1 – Create a setting for urban and rural prosperity
- Aim 2 – Enhance the visitor experience and economy
- Aim 3 – Build healthier communities
- Aim 4 – Maintain and enhance quality of place
- Aim 5 – Ensure urban and rural areas are resilient to climate change

- Aim 6 – Protect and enhance biodiversity & natural networks

2.3 These six aims closely align with the South West Wales Area Statement Themes **[See reference** 20**]** (see below) and will help to deliver the GI network and form the basis for monitoring its success. Their achievement will depend on distributed leadership across a wide range of PCC / PCNPA departments and external partners through a collaborative GI-led process. Through the delivery of an integrated approach to GI across the county, it will enable a greater variety of multifunctional benefits to be achieved for a wider range of receptors. Furthermore, the aims will promote a strategic, yet holistic, approach to the planning, design and management of GI.

Reducing Healthy inequalities aligns with the following aims:

- Aim 1 – Create a setting for urban and rural prosperity
- Aim 3 – Build healthier communities

Ensuring sustainable land management aligns with the following aims:

- Aim 1 – Create a setting for urban and rural prosperity
- Aim 2 – Enhance the visitor experience and economy
- Aim 4 – Maintain and enhance quality of place

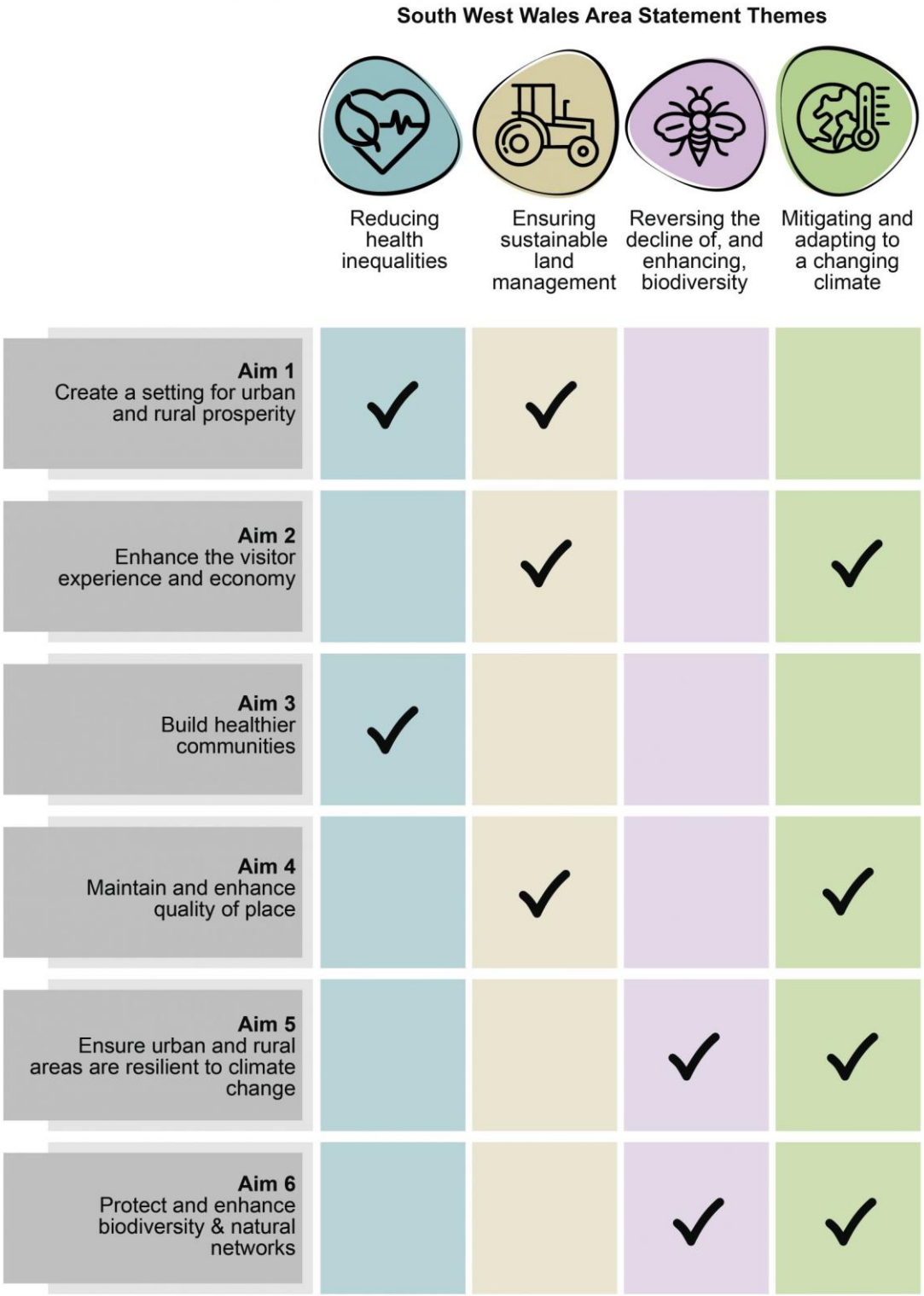
Reversing the decline of, and enhancing, biodiversity aligns with the following aims:

- Aim 5 – Ensure urban and rural areas are resilient to climate change
- Aim 6 – Protect and enhance biodiversity and natural networks

Mitigating and adapting to a changing climate aligns with the following aims:

- Aim 2 – Enhance the visitor experience and economy
- Aim 4 – Maintain and enhance quality of place
- Aim 5 – Ensure urban and rural areas are resilient to climate change
- Aim 6 – Protect and enhance biodiversity & natural networks

Figure 2.2: South West Wales Area Statement Themes



Chapter 3

How to use the Green Infrastructure Assessment

3.1 A ‘how-to’ guide has been developed to promote the successful delivery of GI across Pembrokeshire and demonstrate how the GI Assessment should be used by various audiences. This will provide a framework to assist in the effective delivery of GI, supporting the planning process and achieving its successful implementation and management.

3.2 Unlike other reports, this work is not designed to be read from start to finish. Instead, the different sections of the website link together to allow users to explore the key components of GI at the strategic scale and across the three individual workstreams. The format of the website also allows users to focus on GI opportunities and projects within specific areas of interest.

Local Community

- I want to find out about the existing GI network in Pembrokeshire
- I want to find about opportunities for tree planting and how to get involved
- I want to find out about how to encourage pollinators into my garden
- I want to find out about GI Projects where I live and how these ay be delivered

Developers

- I want to find out about how to support the delivery of GI across Pembrokeshire.
- I want to find out about how to identify existing GI to protect and enhance through development proposals.

- I want to find out about how to develop proposals which provide enhancements to the local GI network and align with the identified GI projects and navigate to the relevant settlement; and navigate to the developer checklist.

Local Planning Authority (development and local planning policy)

- I want to find out about opportunities for protecting and enhancing the GI network at the strategic scale.
- I want to find out about how to appraise development proposals to ensure a 'GI-led' design approach.
- I want to find out about the options to fund and implement GI through mechanisms such as developer contributions (click here) and navigate to the relevant settlement.
- I want to find out about the identified GI projects and how these can inform the creation of strategies, masterplans and design codes.
- I have funding to plant some street trees, where should they go?
- I need guidance on how to ensure the successful establishment of urban trees.
- I want to improve management practices to better deliver for pollinators.

External Partners / Community Groups

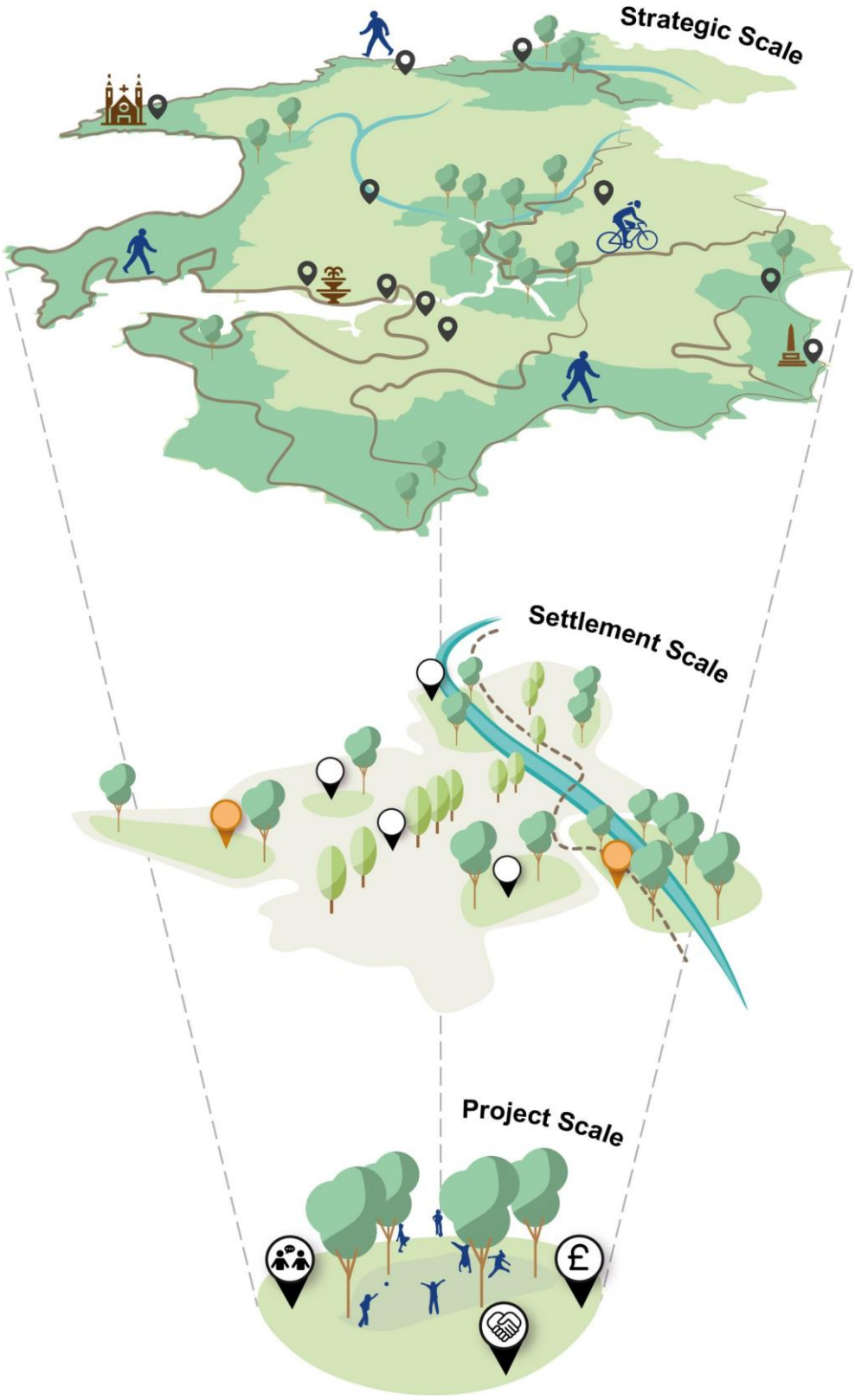
- I want to find out about how to contribute towards the shared vision for GI across Pembrokeshire.
- I want to find out about identified GI projects and how to help in the delivery of improvements across the strategic GI network.
- I want to establish a pollinator trail where I live.

Pembrokeshire's Strategic Green Infrastructure

3.3 Pembrokeshire is internationally important for many of its coastal, marine and lowland heathland habitats. The strong influence of the coast and the mild oceanic climate within the county are reflected in its pattern of land use, habitat and species distribution. The Eastern and Western Cleddau combine to form a significant catchment within the county. Inlets and estuaries range in size from the large and ecologically-rich Milford Haven Waterway and Daugleddau Estuary, to small inlets such as Solva. The southern shores of the Teifi Estuary also form a section of the county's northern boundary.

3.4 Pembrokeshire is largely rural, with 56% of the land cover comprised of 'enclosed farmland' and a further 17% woodland, as described by the South West Wales Area Statement **[See reference** 21**]**.Traditional agricultural field boundaries, small copses and streams provide vital movement corridors for plants and animals, linking larger areas of woodland and scrub with fen and marsh on poorly drained valley bottoms. The county is also considered to be of national importance for ancient semi-natural oak woodland. Tracts of tree cover are predominantly confined to marginal agricultural land, reflecting the pattern of intensive farming within Pembrokeshire.

Figure 3.1: Stragic GI context- landscape down to project scale



3.5 The strategic GI context of the county was explored as part of this work, prior to focussing in at the settlement and project scale. This included a review of landscape character, strategic active travel links, ecological corridors, river catchments and ecological sites of national and international importance. By understanding Pembrokeshire at the landscape scale and the relationship of urban environments to strategic corridors, links and sites, it has ensured that the settlement-based projects tie into Pembrokeshire's strategic GI network.

3.6 This method aligns with the suggested approach to Green Infrastructure Assessment by Natural Resources Wales (NRW) in their Guidance Note 042. The interchangeable order of steps, shown below, ensures the appropriate scope and detail of evidence and data is used to inform interventions. This process is not intended to be linear and the revisiting of steps at different scales was undertaken to ensure appropriate priorities and opportunities were identified at the strategic, settlement and project scale.

Figure 3.2: Approach to GI Assessment by NRW

3.7 Approach to GI Assessment by Natural Resource Wales (as depicted in the figure directly above) includes:

- Setting the baseline
- Identifying priorities
- Site assessment
- Identifying opportunities
- Delivering & monitoring/review

Setting the Baseline

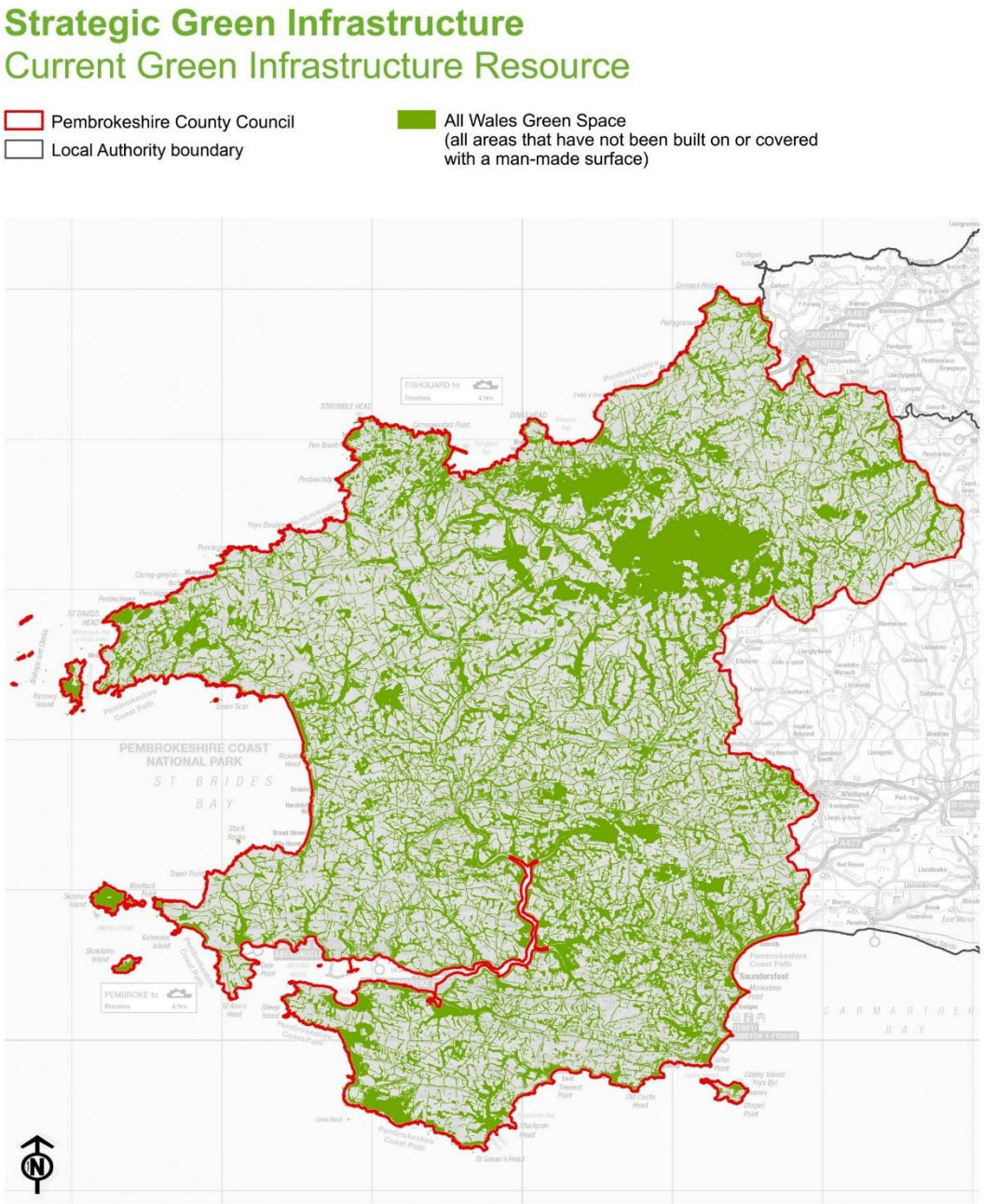
3.8 The identification of existing GI assets and networks formed an essential step in the GI assessment. Datasets were divided into the four categories, as defined by NRW (the 'Current GI Resource', 'Climate Change Mitigation', 'Ecological Assets and Networks' and 'Landscape Context'). An overview of potential strategic GI opportunities and policy recommendations, informed by the strategic data analysis are outlined below.

Current GI Resource

Relevant datasets

- The All Wales Green Space dataset – identifies all areas that have not been built on or covered with a man-made surface, providing an indication of current green space resource in Pembrokeshire.
- Urban tree canopy cover – shows the distribution of trees and indicative canopy spreads. This dataset encompasses key Pembrokeshire settlements only.

Figure 3.3: Strategic GI- Current GI Resource



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Needs and opportunities

Address deficiencies in green space provision

3.9 Using the Fields in Trust standards of provision for Pembrokeshire, address local needs by identifying any shortfalls in recreational open space provision across the county. Opportunities should aim to deliver multifunctional value, including health, well-being benefits and biodiversity value. Accessibility deficiency mapping should also be examined to explore the need for improved access to open spaces for local communities.

3.10 Policy recommendation: Utilise the planning system and developer contributions to maximise the delivery of open space provision and enhancements across the county. This should include the establishment of principles for the provision of GI within new development e.g. open space standards and targets for biodiversity. Opportunities to enhance the biodiversity value of existing green space should also be explored through the requirement for management plans as part of the planning process.

Increase native woodland coverage

3.11 The potential exists to increase the resilience to pests and diseases and adapt to the long-term effects of climate change by promoting the diversity of native woodland in the county. A specific focus should be placed on opportunities to increase native tree cover within river valleys and restore coniferous plantations on ancient woodland sites. Proposals should be developed to ensure alignment with existing tree planting guidance, including the adoption of the principle of the 'right tree, right place' approach to woodland management.

3.12 Policy recommendation: Promote the protection and enhancement of native tree planting in river valleys by designating the NRW flood zone and ancient woodland sites on the Development Plan Proposals Map. Appropriate

buffers should also be applied around woodland and development sites to reduce the potential for detrimental impacts on areas of priority habitat or ancient woodland.

Increase urban tree canopy coverage

3.13 Deliver wide ranging ecosystems services by increasing tree canopy coverage within urban settings across Pembrokeshire. All proposals should be in adherence to the Overarching Principles of the Urban Tree Planting Strategy to promote successful long-term establishment.

3.14 Policy recommendation: Utilise the planning system and developer contributions to maximise the delivery of tree planting opportunities within urban settings, as outlined in the 'delivery' section of the Urban Tree Planting Strategy.

Promote habitat connectivity

3.15 Utilise tree and hedgerow planting proposals as a mechanism to promote habitat connectivity. The adoption of wildlife-friendly management practices should be used as an approach to increase the foraging potential of existing habitats.

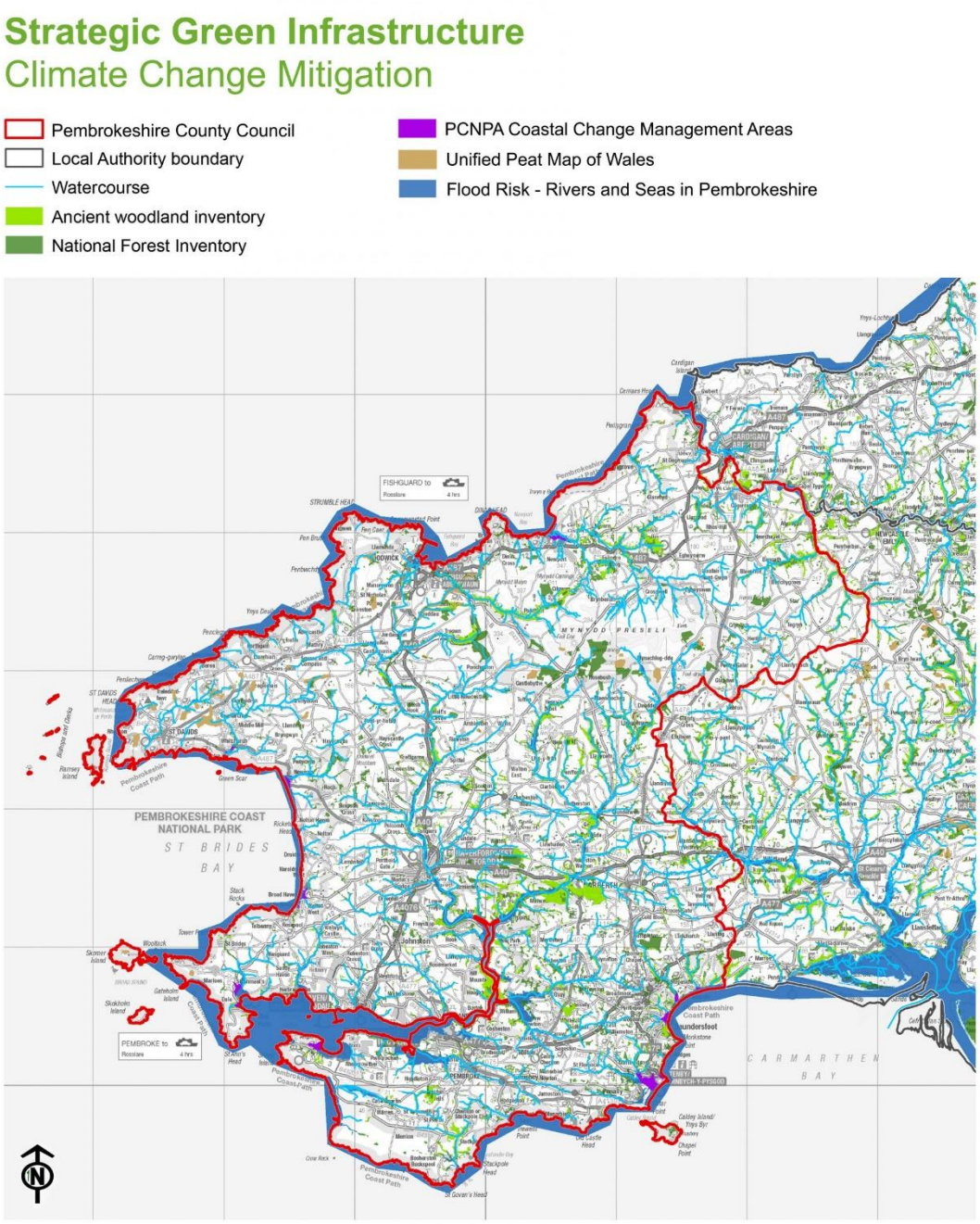
3.16 Policy recommendation: Protect habitat networks, including existing tree and hedgerows, from disturbance, deterioration or loss through the development management system. This should include the promotion of biodiversity enhancement interventions within development planning.

Climate Change Mitigation

Relevant datasets

- The Unified Peat Map of Wales – indicates the geographical extent of peatlands in Pembrokeshire, offering the potential to identify sites for peatland restoration (in conjunction with the NRW Welsh Information for Nature Based Solutions (WINS) Project).
- National Forest Inventory Woodland Wales – provides a breakdown of woodland types and distribution to inform future woodland planting proposals.
- Detailed flood risk maps – recognises areas at risk of surface water flooding, providing the starting point for the identification of areas that may benefit from GI interventions.

Figure 3.4: Strategic GI - Climate Change Mitagation



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Needs and opportunities

Promote the sustainable management of peat resources

3.17 Opportunities to restore and maintain bog, fen and heathland habitat across the county should be explored, whilst acknowledging that the best option for peat on a development site is to design the development so that it is preserved in situ, wherever possible.

3.18 Policy recommendation: The Unified Peat Map of Wales should be designated as part of the Strategic GI on the Development Plan Proposals Map. Development proposals should be assessed to ensure adherence to Appendix 11 of the Authorities' Supplementary Planning Guidance on Biodiversity, which provides detailed advice on peatland management. Appropriate grazing management approaches (including scrub clearance) on upland heath should also be promoted as a mechanism to achieve increased biodiversity.

Promote the protection and enhancement of the coastal zone or areas prone to flooding

3.19 A sustainable long-term approach to coastal erosion and flood risk management within Pembrokeshire is required to deliver a range of multi-functional benefits, including ecological enhancement within areas of flood risk. The opportunity also exists to support the introduction of nature-based solutions and Sustainable Drainage Systems (SuDS) as principles which maximise the benefits for water quality, biodiversity and amenity (whilst also reducing diffuse pollution and soil erosion).

3.20 Policy recommendation: The results of NRW's flood zone mapping for land use planning purposes should be utilised to ensure that development is directed away from the coastal zone or areas prone to flooding. An appropriate buffer should be applied around defined NRW flood zone locations as a mechanism to promote the protection of these areas from development, as well as explore

potential opportunities to enhance the habitat network. Climate Change Management Areas should also be included on the Development Plan Proposals Map to promote the opportunity for biodiversity enhancement and climate change adaptation in populated coastal areas. Feasibility studies and ground truthing will be required to assess the appropriateness of this recommendation.

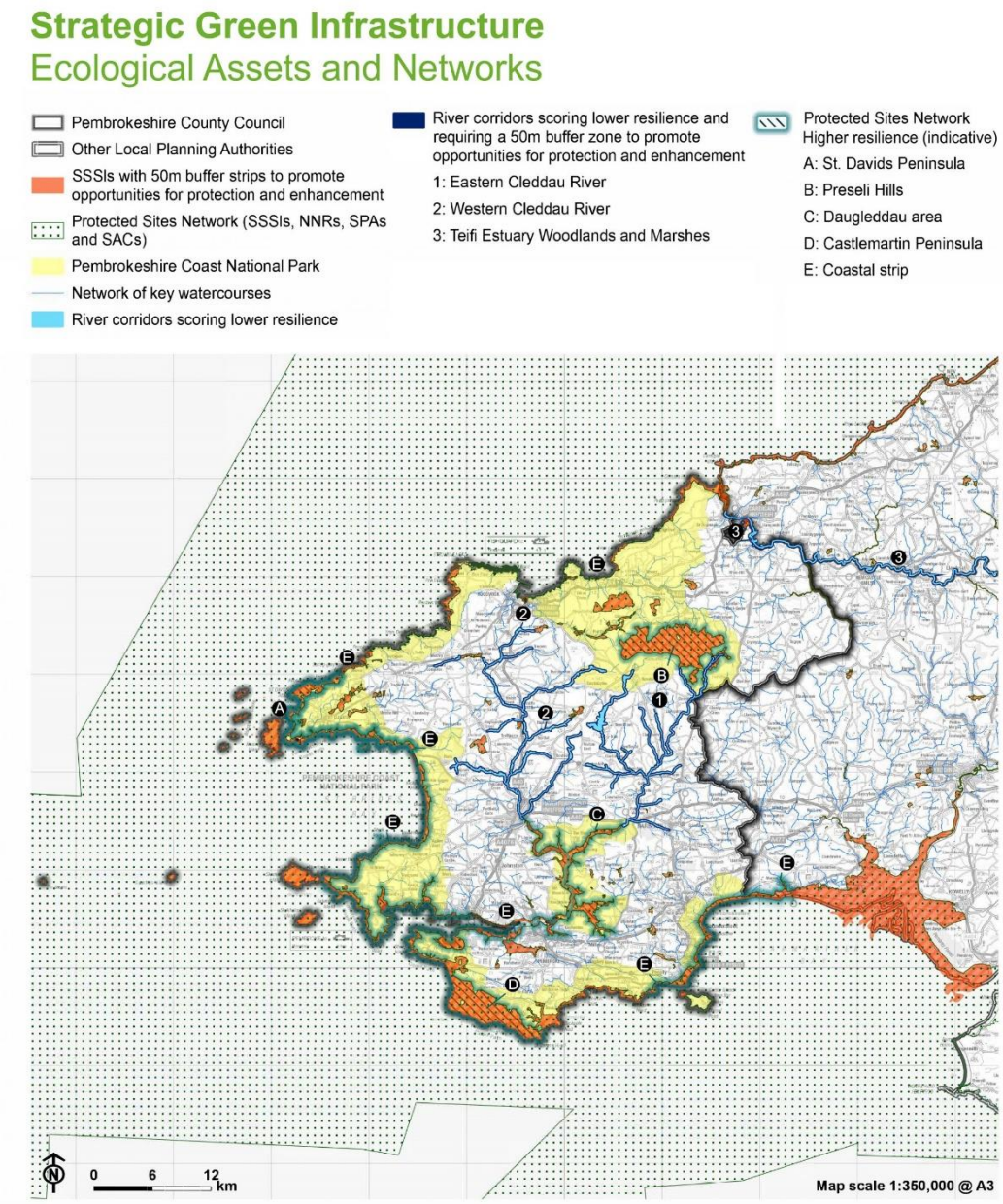
3.21 Local policy should also make reference to the Welsh Government's SuDS Statutory Guidance, which describes the mandatory use of SuDS for surface water on new developments. This also includes the requirement for approval and adoption by the local authority acting in its SuDS Approving Body (SAB) role.

Ecological Assets and Networks

Relevant datasets

- The Protected Sites Network – combines Special Areas of Conservation (SAC), Special Protection Areas (SPA), Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (which are also Sites of Special Scientific Interest).
- Phase I Habitat Survey – outlines comprehensive habitat data coverage.
- The Habitat Network – conveys general patterns of ecological connectivity across the landscape.
- CuRVe dataset – provides an overview of the relative ecological resilience of areas.

Figure 3.5: Stragetic GI- Ecological Assets and Networks



Needs and opportunities

Working in conjunction with NRW, identify interventions to improve the condition of protected sites.

3.22 The opportunity exists to improve the ecosystem resilience of specific habitats, including the adoption of site-specific interventions where a species or habitat is considered locally important or at high risk. This includes the identification of sites where ecosystem resilience levels lie between 41 and 95 as per the CuRVe dataset – these locations include the Preseli Hills, St Davids Peninsula, Castlemartin Peninsula, Daugleddau and the wider coastal zone. Increased education and awareness regarding the management of protected sites should also be promoted, with the aim of striking a balance between recreational and ecological functions.

3.23 Policy recommendation: The Protected Sites Network should be designated as Strategic GI on the Development Plan Proposals Map and defined as an area to be protected. A buffer zone around SSSIs should also be applied to explore the potential of this network of sites for protection and enhancement. GI policies should be designed to protect and enhance onsite biodiversity and habitat networks within and adjacent to development sites. A 'GI-led' design approach should also be promoted within local planning policy, recognising the importance of the strategic GI network to establish opportunities for enhancement and mitigation. This includes the need to consider multi-functional GI design from the pre-application stage onwards, including through engagement with relevant stakeholders.

Promote the protection and enhancement of river corridors

3.24 A catchment-based approach is required to deliver enhancements to river corridors within the county. Key to this principle is the promotion of collaborative working, including as part of the Nutrient Management Plan Boards established for the Cleddau, Teifi and Tywi to deliver actions and achieve conservation

targets. Opportunities to restore the riparian zone, utilise tree planting and improve the management of agricultural land should be explored as mechanisms to reduce diffuse pollution. Improvements to land management practices and riparian habitat restoration also offer the potential to reduce phosphorus concentrations in watercourses.

3.25 Policy recommendation: A buffer should also be applied around the watercourses on the Development Plan Proposals Map which currently exhibit low levels of ecosystem resilience as an approach to promote the protection and enhancement of these corridors. The locations that require particular focus are the Eastern and Western Cleddau, the Milford Haven Waterway, the Teifi Estuary and Carmarthen Bay. The proposed extent of these buffers should be explored through appropriate feasibility studies and ground truthing.

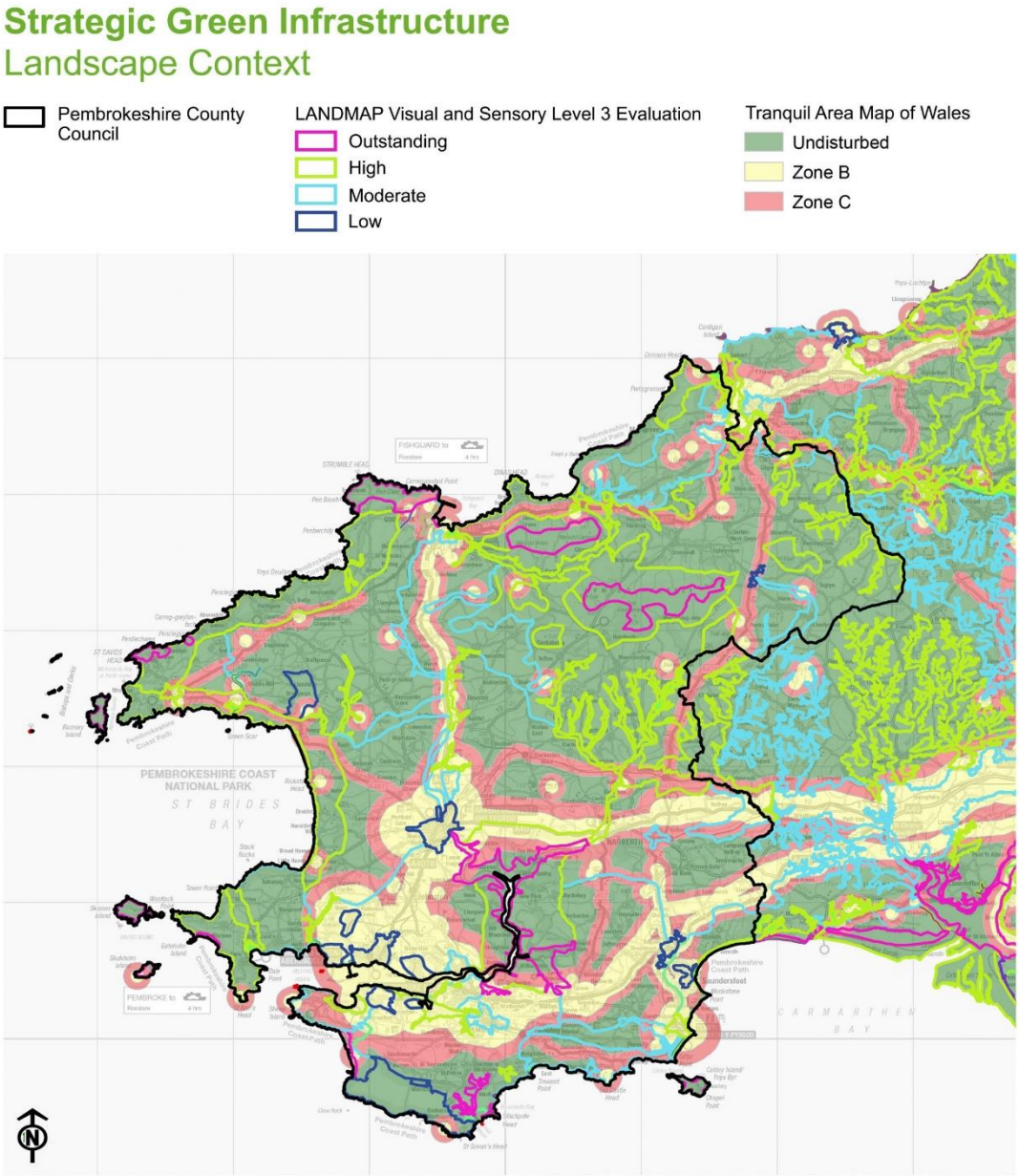
Landscape Context

Relevant datasets

3.26 LANDMAP – provides an overview of the GI assets that exist in an area and outlines how these contribute towards landscape character and sense of place. The Visual and Sensory aspect area can be used specifically to identify opportunities for improving characteristic landscape elements and enhancing lower quality landscapes in the county

3.27 Tranquil Area Map of Wales – indicates zones of existing tranquillity to inform where GI interventions could be used to improve perceived soundscape and relative tranquillity.

Figure 3.6: Strategic GI- Landscape Context



Needs and opportunities

Enhance landscape character and local distinctiveness

3.28 Informed by site context appraisal and spatial analysis, explore proposals which enhance landscape character, local distinctiveness and sense of place within the county.

3.29 Policy recommendation: Utilise LANDMAP data, specifically the evaluation data within the Visual and Sensory aspect area, to explore opportunities to reinstate lost features or enhance existing features through improvement, conservation and future change. Those areas assessed as 'outstanding' or 'high' should be included on the Development Plan Proposals Map. The dataset also offers the potential to enhance habitat connectivity and ecosystem resilience at a local level through the provision of finer grained detail regarding habitat mosaics, available as part of the Landscape Habitats aspect area. Furthermore, local policy offers the opportunity to set out and provide design principles for specific areas which exhibit local distinctiveness or sense of place. Consideration should therefore be given to long-term management and maintenance requirements in any planning consent or associated planning obligation.

Enhance the tranquillity and rural character of the county by reducing the effects of light pollution

3.30 The impact of artificial light pollution on local amenity and nature conservation should form a key consideration in the development of future proposals. This includes the identification of areas where lowering artificial light levels may improve the provision of habitat corridors for night foraging.

3.31 Policy recommendation: Utilise Tranquil Areas Map of Wales data on the Development Plan Proposals Map to identify existing tranquil areas as well as

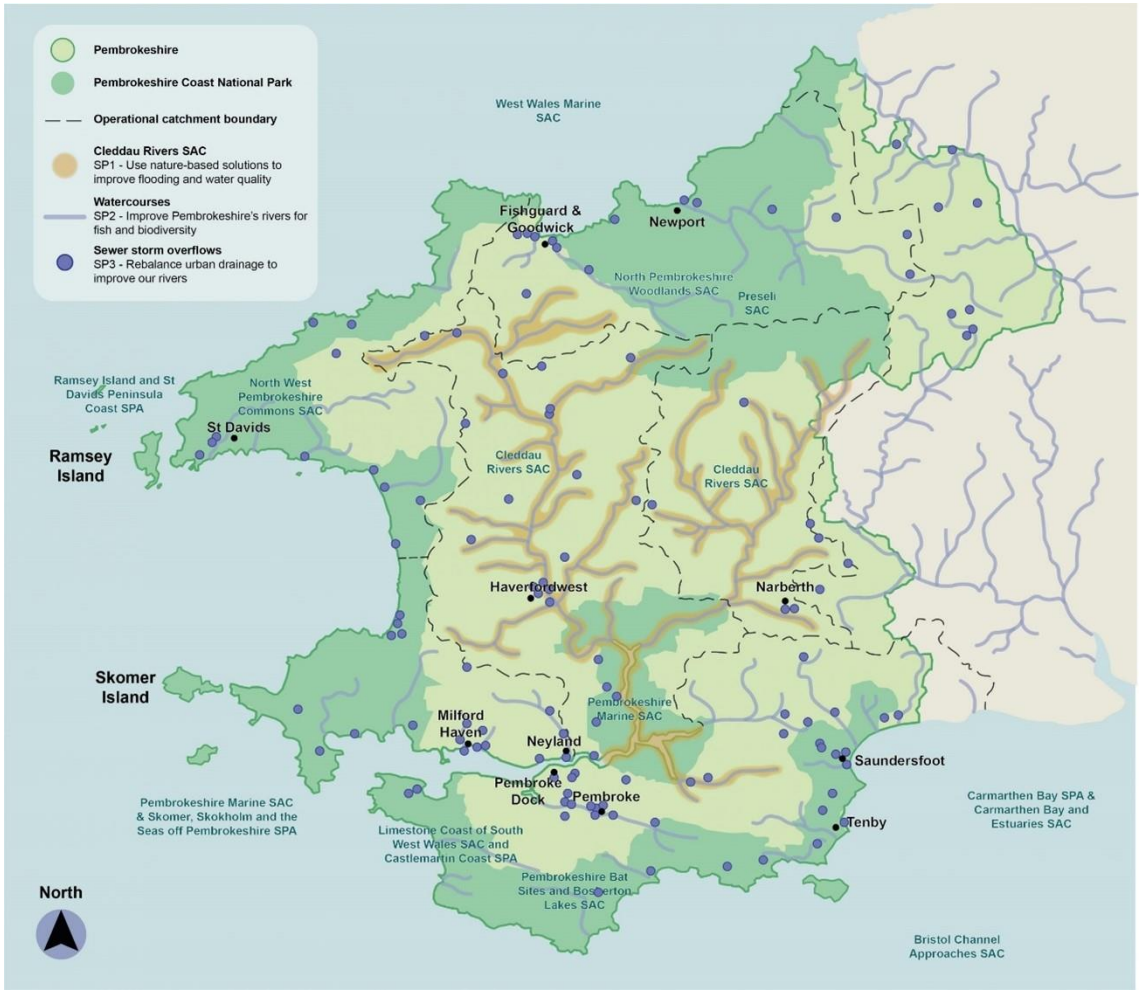
areas where GI interventions could improve relative tranquillity and perceived soundscape.

Chapter 4

Pembrokeshire's Strategic Scale Projects

4.1 Three high-level strategic projects have been identified across Pembrokeshire. These are not location-specific but apply across the landscape and catchment scale. These three projects aim to address key pressures facing Pembrokeshire today, including flooding, water quality and biodiversity decline, particularly within Pembrokeshire's rivers.

Figure 4.1: Overview of strategic GI projects in Prembrokeshire



SP1- Use nature-based solutions to improve flooding and water quality

4.2 Due to historical human interventions, much of the landscape in Pembrokeshire has been altered to aid land drainage. This has involved the use of land drains, field ditches as well as physical alterations to rivers and streams. Land-use practices can adversely impact flood risk, water quality and aquatic environments. As a result, some of Pembrokeshire's rivers are under threat from water nutrient levels – of particular concern are the Cleddau Rivers, which are protected as Special Areas for Conservation (SAC) and Sites of Special Scientific Interest (SSSI). In order to avoid exacerbating the situation, all new development within the catchments of SAC rivers must demonstrate that they do not increase nutrient loads in the rivers in order to obtain planning permission. This is leading to a crisis in the development industry.

4.3 Simple interventions and alterations to agricultural practices and land-use can make significant improvements to flood risk, resilience and water quality. The following examples are all synergistic with respect to delivering improvements on both fronts – the retention of water within the landscape has the benefit of both reducing nutrient-laden run-off and improving flood resilience.

4.4 Examples of possible interventions include:

- Creating riparian buffer strips, reducing grazing in proximity to watercourses
- Formalising areas of livestock watering, so enabling the erection of fences along watercourse to protect them from bank erosion, bank poaching and manure impact
- Planting of field margins and shelter belts with trees / shrubs to increase water retention within tree and shrub planting
- Use of regenerative farming techniques to minimise ploughing and thus reduce the area and time during which there is bare earth in the landscape

- Creating natural dams within small watercourses, slowing flow and increasing diversity of habitats within the landscape
- Taking land out of intensive agriculture, either through rewilding initiatives, or through amendments to agricultural practices to lessen the nutrient input to the land

4.5 'Ecosystem Enterprise Partnership – Building Natural Solutions' is an existing project, led by the Pembrokeshire Coastal Forum, specifically aimed at unlocking the current impasse in the development industry associated with nutrient loading in rivers. The results of this project have been combined into the Pembrokeshire Nature Partnership Land Use Planning Tool. This maps areas of risk and opportunities in the landscape with respect to nutrient run-off to watercourses. It also enables mapping of areas of opportunity to improve natural management of flooding. These mapping resources should be used to seed a process of identification, prioritisation and delivery of interventions to deliver benefits in the landscape that would improve both flooding resilience and water quality.

4.6 Benefits of the project, as depicted in Figure 5.2 below, include:

- Reduction of the risk of flooding
- Enhancement of water quality
- Space for wildlife and ecological resilience
- Carbon sequestration and climate mitigation

Figure 4.2: Benefits of the project

Delivery of nature-based solutions and ecosystem services

4.7 Land use management since the Second World War has involved increased drainage of the land, in a drive to maximise the efficiency of farmland. This has led to a reduction in diversity of habitats, and the loss of wetlands, wet-grassland and associated wet terrestrial habitats. It has also increased flood risk, as it increases the speed and volume of water flow down catchments, reducing the buffering effect of the landscape during heavy and prolonged rainfall events. Increased drainage of wet soils also has a detrimental effect on the ability of that soil to sequester carbon. Increased run-off from intensively farmed agricultural land also increases the nutrient loading on rivers and streams.

4.8 Through the use of techniques such as riparian buffer strips, reducing bank erosion and poaching, planting of shelter belts and field margins and the creation of natural dams within small watercourses, the ability of the landscape to absorb and buffer rainfall can be significantly increased. The introduction of regenerative farming practices or low-intensity systems can increase the water retention and carbon sequestration capacity of soils and ecosystems. This would have a concomitant beneficial impact on flood risk, water quality and on tackling climate change.

Delivery mechanisms

4.9 Significant work has already been undertaken by the Pembrokeshire Coastal Forum and Pembrokeshire Nature Partnership to assimilate data held within the Land Use Planning Tool. The first step for this project would therefore be to forge a relationship with these organisations in order that the next steps can be collaboratively taken forward.

4.10 With project partners in place, it is proposed that the first steps of the project would be twofold:

- To take the existing dataset and use it to cross-correlate against land ownership of project partners and stakeholders, thus providing areas of the county for early-stage intervention projects for which landowner or riparian owner negotiations may be less onerous.
- To undertake a funding scoping exercise, to identify means of funding the project's expansion from the initial, projects based on stakeholder-owned land to a wider, catchment or county-scale delivery. One option for ongoing funding is a nutrients trading scheme, whereby developers make contributions to a fund that can then be used to fund changes to land-use and agricultural practice that reduce nutrient inputs in the same catchment within which the development is to occur.

4.11 Once areas of key opportunity have been ground-truthed and defined, it would be necessary to engage with landowners and land occupiers / graziers in order to present these opportunities and discuss their impacts on current land-use. This may lead to the loss of some opportunities for reasons of commercial and physical agricultural constraints.

4.12 The proposed physical interventions and amendments to land management could be delivered by the landowners themselves, or by external agricultural contractors.

Potential partners

- Pembrokeshire Coastal Forum
- West Wales Rivers Trust
- Afonydd Cymru
- Natural Resources Wales (NRW)
- Angling clubs and organisations
- Dwr Cymru Welsh Water
- Amber International
- Landowners

Outline cost

£: <£250k

4.13 An initial feasibility and prioritisation study as well as delivery of early-stage quick-win small-scale intervention projects would involve limited capital investment. The feasibility of developing a nutrients trading scheme should also be investigated.

£££: £1m – £5m

4.14 Subsequent expansion to form a county-wide project with multiple projects would increase costs.

Potential funding opportunities

- UK Community Renewal Fund

- UK Shared Prosperity Fund
- Bespoke scheme to utilise developer contributions to deliver nutrient management projects (nutrient trading scheme)
- Nature Networks Fund (funded by the Welsh Government and administered by the National Lottery Heritage Fund in Wales)
- National Lottery Community Fund
- Local Places for Nature Fund
- NRW grants
- Welsh Water Community Fund
- Ofwat Innovation Fund
- Emerging Welsh Government Sustainable Farming Scheme
- National Forest for Wales – The Woodland Investment Grant (National Lottery Heritage Fund – Round 1)

Timescale

Quick win (<1 year)

4.15 An initial feasibility and prioritisation study, as well as delivery of small scale intervention projects would be relatively straightforward to deliver.

Medium-term (1-5 years)

4.16 Subsequent expansion to county-wide projects would require comprehensive planning, design and consultation.

Potential constraints

4.17 A key constraint for the project would be landowner / occupier / grazier agreements, as there may be a perceived risk to farm viability associated with some loss of land to riparian margins / shelter belts / field margin planting etc. There may also be resistance to alteration of watercourses with respect to land drainage and riparian-owner concerns. These concerns should be countered with the availability of agricultural payments for environmental goods and services, and hence the delayed launch of the Welsh Government's Sustainable Farming Scheme is a potential constraint in this regard. Initiating a nutrients trading scheme may ameliorate this risk by providing a sustainable, ongoing source of funding.

Maintenance and stewardship

4.18 There may be some initial maintenance required of newly planted river margins, or of newly re-exposed river banks or channels.

4.19 Maintenance of the softworks would be required as part of the 60 month establishment phase, including the replacement of failed trees. If fencing is installed to keep livestock out of watercourses, ongoing maintenance would be required. Changes to farming practices would need to be sustained into the long term, hence financial sustainability of this farming model is key.

Monitoring for success

4.20 Subject to availability of funding, monitoring of the success of the project should be undertaken through simple citizen science, using the existing body of citizen scientists, angling clubs and other stakeholders to help monitor the effect of interventions. Techniques could include monitoring of water quality using simple hand-held equipment, or installation of a simple stream-gauge to monitor streamflow, for example.

4.21 Existing NRW monitoring stations could also provide information on the effects on watercourse flow, river water quality and the response of the watercourse to rainfall events.

Next steps

4.22 Establish a working group with those already undertaking this work in the county – including Pembrokeshire Nature Partnership and Pembrokeshire Coastal Forum.

4.23 Review the state of knowledge in Pembrokeshire catchments and identify areas for further survey in order to inform feasibility and prioritisation work for quick-win projects. This should also for the first stage of a funding scoping exercise.

Figure 4.3: Prembrokeshire

SP2 – Improve Pembrokeshire's rivers for fish and biodiversity

4.24 Human activity has resulted in alterations to the rivers and streams of Pembrokeshire in the past, largely associated with power generation, navigation and flood protection. As a result, many reaches of the county's rivers and streams are characterised by artificial structures such as weirs, dams, sluices or constrained within hard structures such as culverts and river walls. These structures can provide a barrier to the movement of aquatic species, and specifically fish migration. This affects species such as salmon and sewin, eel and lamprey. They can also be detrimental to other species and habitats, including otter. Many structures that were intended to improve the environment,

have inadvertently had an adverse effect on these habitats and resulted in increased flood risk.

4.25 Afonydd Cymru and Swansea University have embarked on a project, Reconnecting the Salmon Rivers Of Wales, aimed at removing 17 barriers to fish migration across Wales, including some in Pembrokeshire on the Western and Eastern Cleddau. The opportunity exists to build on this project to explore the potential for further improvements to rivers and streams across Pembrokeshire. Through their Barrier Atlas and Barrier App, Amber International has mobilised citizen scientists to map barriers on rivers across Europe. Their focus is primarily in the Balkans and Eastern Europe, however, their work also extends across Wales. The Barrier Atlas lists at least 30 barriers (weirs, dams or sluices) on watercourses in the county, and there are many stretches of culverted and walled sections of rivers and streams that could benefit from the use of soft engineering and other nature-based solutions to improve habitat, reduce barriers to fish migration and potentially improve downstream flood risk.

4.26 This project would build on the body of evidence already collected and held by the West Wales Rivers Trust, Afonydd Cymru, Natural Resources Wales (NRW) and others to compile a county atlas of barriers and structures within and along watercourses. It would then utilise this historical work, plus new assessments where necessary, to provide the basis for prioritisation of interventions based on need, deliverability and cost. Proposals should then be taken forward for practical delivery of improvements in high priority, or quick-win areas and / or to compile bids for funding for more significant channel improvements.

4.27 Benefits of the project, as depicted in Figure 5.4 below, include:

- Reduction of the risk of flooding
- Provision of active travel opportunities
- Enhancement of water quality
- Space for wildlife and ecological resilience

- Carbon sequestration and climate mitigation

Figure 4.4: Benefits of the project

Delivery of nature-based solutions and ecosystem services

4.28 At present, migratory fish species are under pressure from a number of factors. Barriers to migration are a significant issue within the county, which can be addressed through their removal or alternatively by retrofitting these barriers with suitable alternative routes for aquatic life. Replacement of hard engineered structures with planted margins and natural banks – reconnecting the watercourse with its surrounds – would provide an increased variety of habitats both within the watercourse and on the banks. More resilient ecosystems can in turn deliver increased ecosystem services, in terms of climate resilience and increased value for leisure and amenity (for example through improved fish stocks).

4.29 Whilst hard engineering would remain part of the toolbox to manage human interaction within our rivers and streams, there is increasing recognition that aims of protecting and enhancing biodiversity, and of reducing flood risk require approaches that work with, rather than seek to constrain, natural processes. Many of the structures within Pembrokeshire's rivers and streams have a detrimental effect on flood risk downstream, particularly where stretches

are culverted, straightened and canalised. Reconnecting river stretches with their banks and floodplains would help deliver a nature-based approach to flood management.

Delivery mechanisms

4.30 Work already undertaken by West Wales Rivers Trust, Afonydd Cymru and NRW has provided some of the feasibility and prioritisation work, but it is envisaged that further desk based work and ground truthing would be required in order to inform a study that can be used to prioritise areas for intervention and identify areas where the combination of scale of project and stakeholder cooperation can enable quick-wins.

4.31 Possible interventions may include relatively simple works to remove small scale barriers such as debris dams and sluices or river wall sections. However, more complex engineering works would involve the removal of larger weirs or fish passage retrofitting. Smaller projects may be achievable within the scope of initial funding, with larger projects anticipated to require seed funding through this project in order to gain momentum and form separate, standalone projects.

Potential partners

- West Wales Rivers Trust
- Afonydd Cymru
- NRW
- Angling clubs and organisations
- Dwr Cymru Welsh Water
- Amber International
- Landowners

Outline cost

4.32 An initial feasibility and prioritisation study, as well as delivery of early-stage quick-win barrier removal / bank rewilding / structure removal projects would need limited capital investment. However, subsequent larger-scale barrier removal / bank rewilding / structure removal projects would require substantial funding.

Potential funding opportunities

- Nature Networks Fund (funded by the Welsh Government and administered by the National Lottery Heritage Fund in Wales)
- National Lottery Community Fund
- Local Places for Nature Fund
- NRW grants
- Dwr Cymru Welsh Water Community Fund
- Ofwat Innovation Fund
- Emerging Welsh Government Sustainable Farming Scheme

Timescale

Quick win (<1 year)

4.33 An initial feasibility and prioritisation study, as well as delivery of early-stage quick-win barrier removal / bank rewilding / structure removal projects would be relatively straightforward to deliver.

Medium-term (1-5 years)

4.34 Subsequent larger-scale barrier removal / bank rewilding / structure removal projects would require comprehensive planning, design and consultation.

Potential constraints

4.35 Initial constraints are limited to the availability of existing data and existing studies on barriers, structures and engineered banks from existing projects – it is hoped that this would be made available by partner organisations to help seed the project.

4.36 Constraints regarding delivery would largely be associated with the need for landowner involvement and consent. For structures on larger rivers, there may also be a requirement for planning permission, Flood Risk Activity Permit and hydrological modelling.

Maintenance and stewardship

4.37 There may be some initial maintenance required of newly planted river margins, or of newly re-exposed river banks or channels.

Monitoring for success

4.38 Utilise the existing body of citizen scientists, angling clubs and other stakeholders to help monitor the effect of interventions. Existing NRW monitoring stations may also provide information on the effects on watercourse flow, river water quality and the response of the watercourse to rainfall events.

Next steps

4.39 Establish a working group with those already undertaking this work in the county – West Wales Rivers Trust, Afonydd Cymru, Swansea University and others.

4.40 Review the state of knowledge in Pembrokeshire catchments and identify areas for further survey in order to inform feasibility and prioritisation work.

Figure 4.5: Prembrokeshire

SP3 – Rebalance urban drainage to improve our rivers

4.41 Pembrokeshire has suffered from twin issues in the past, in the form of surface water flooding events and also incidents where foul sewage has overflowed and resulted in flooding (known as Combined Storm Overflows (CSOs)). These overflows originate from increased pressure on sewer systems due to the input of storm water to old sewage systems that take both rainwater and foul effluent. Large areas of impermeable land use, drained directly via pipes into the sewers and then rivers, exacerbate both of these issues. Implementation of Sustainable Drainage Systems (SuDS) interventions which divert storm water from combined sewers could reduce pressure on infrastructure, helping to reduce fluvial influence in times of flooding.

4.42 Examples of SuDS that should be delivered on a site-specific basis include:

- Utilisation of street tree planting within tree pits, which are fed by storm sewer runs, thus taking water out of the wider sewer system
- Identification of areas where surface water (historic streams, ditches and land drains) enters combined sewers and feeds into watercourses or soakaways
- Identification of areas where storm sewer flow can be drained to ground in soakaways
- Creation of wetlands, rain gardens, swales, attenuation basins and other features into which stormwater can be fed, providing a means of slowing flow during rainfall events and lessening rapid flow towards streams and rivers
- Identification of areas where stormwater sewers discharge to sewers which carry foul effluent, capturing this discharge and carrying it to soakaways, rain gardens, swales, attenuation basins or watercourses thus reducing the risk of combined storm overflows

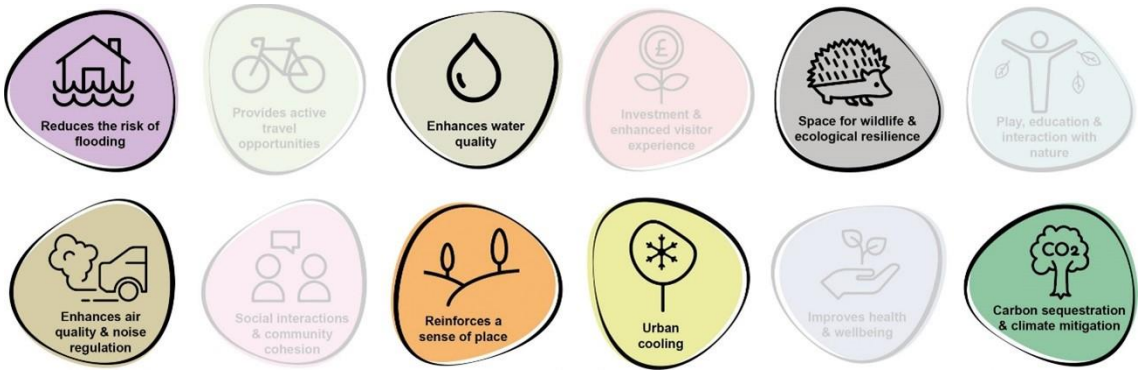
- Retrofitting of areas with a high percentage of impermeable cover with permeable paving, swales and rain gardens

4.43 Dwr Cymru Welsh Water has undertaken work to map areas of high impermeable cover, including known points where surface water enters sewers which carry foul effluent. Detailed records of combined storm overflow events have been assimilated, providing indicators of areas where surface water flows are affecting the performance of the foul sewerage infrastructure. These datasets, combined with flood risk mapping, should be leveraged to help identify areas where SuDS interventions might be best targeted across the county. A series of priority pilot projects should be identified based on the need for intervention and on the feasibility of delivery. An options appraisal for priority projects would identify possible SuDS opportunities for delivery.

4.44 Benefits of the project, as depicted below in Figure 5.6, include:

- Reduction of the risk of flooding
- Enhancement of water quality
- Space for wildlife and ecological resilience
- Enhancement of air quality and noise regulation
- Reinforcement of a sense of place
- Urban cooling
- Carbon sequestration and climate mitigation

Figure 4.6: Benefits of the project



Delivery of nature-based solutions and ecosystem services

4.45 SuDS interventions mimic drainage in nature where precipitation is absorbed into the ground, slowed by vegetation. The quantity and quality of water that ends of up in local watercourses is therefore improved, helping to alleviate flooding and reduce CSOs. Sustainable management of water in urban areas also ensures towns are more resilient to the pressures of climate change and population growth.

Delivery mechanisms

4.46 Performance improvements with respect to CSOs form part of the obligations of Dwr Cymru Welsh Water in order to provide ongoing environmental improvement. Responsibility for stormwater sewerage sits with Dwr Cymru Welsh Water or the Local Authority and so partnership would be necessary for successful delivery of the project. An example of such a partnership working well is the Rainscape Project in Llanelli.

4.47 Existing datasets relating to the sewer infrastructure should be collated and combined to create a SuDS risks and opportunities map. Data from both

Dwr Cymru Welsh Water and Pembrokeshire County Council (PCC) would be required. A ranking process should be undertaken to create a list of priority pilot projects, where the potential delivery benefits of SuDS retrofitting to the sewer infrastructure are ascertained.

4.48 This should then be progressed to an options appraisal process for each priority pilot project, assessing which SuDS intervention(s) should be progressed.

Potential partners

- Dwr Cymru Welsh Water
- PCC Highways and Transport Department
- PCC StreetCare / Amenity Maintenance Team
- Property owners / landlords / freeholders (where opportunities exist on large industrial or retail parks, for example)
- West Wales Rivers Trust and Afonydd Cymru
- Natural Resources Wales (NRW)

Outline cost

4.49 The risk and opportunity mapping, listing priority pilot projects and options appraisal would be relatively low cost. However, the delivery of SuDS retro-fitting would require significant capital investment, dependent on the scale and number of interventions.

Potential funding opportunities

- Dwr Cymru Welsh Water funding
- UK Community Renewal Fund

- UK Shared Prosperity Fund
- Nature Networks Fund (funded by the Welsh Government and administered by the National Lottery Heritage Fund in Wales)
- National Lottery Community Fund
- Local Places for Nature Fund
- NRW grants
- Ofwat Innovation Fund

Timescale

Quick win (<1 year)

4.50 The risk and opportunity mapping, listing priority pilot projects and options appraisal would be relatively straightforward to deliver.

Medium-term (1-5 years)

4.51 Subsequent delivery of SuDS retro-fitting would require comprehensive planning, design and consultation.

Potential constraints

4.52 Cooperation with Dwr Cymru Welsh Water would be vital to the successful delivery of this project, so early buy-in would be crucial. Constraints thereafter would be focussed on the physical deliverability of retrofit solutions in often tightly laid out urban centres, amongst the myriad of above and below ground constraints.

Maintenance and stewardship

4.53 All SuDS interventions would result in an element of maintenance over their lifetime (decades). It is anticipated that these features would be adopted by either Dwr Cymru Welsh Water or PCC and become part of their ongoing asset register for maintenance and upkeep.

Monitoring for success

4.54 Subject to availability of funding, monitoring of the success of the project could be undertaken through simple citizen science, using the existing body of citizen scientists, angling clubs and other stakeholders to help monitor the effectiveness of interventions. Techniques could include monitoring of water quality using simple hand-held equipment, or installation of a simple stream-gauge to monitor streamflow.

4.55 Existing NRW monitoring stations would also provide information relating to the effects on watercourse flow, river water quality as well as the watercourse's response to rainfall events.

Next steps

4.56 Establish a collaboration agreement or similar with Dwr Cymru Welsh Water.

4.57 Gather the various datasets already compiled by both Dwr Cymru Welsh Water and PCC into a combined digital dataset from which the risks, opportunities and options appraisal processes should be based.

Figure 4.7: Prembrokeshire

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