

# Swansea Central Area – Regenerating Our City for Wellbeing and Wildlife

Appendix A

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This document is also available in Welsh

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## SUMMARY

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This strategy sets out the Swansea Council's and Natural Resources Wales's vision for:

“A city with high quality multi-functional green infrastructure delivering resilience, prosperity, nature, health, well-being and happiness to the citizens and visitors of Swansea.”

The landmark report by the UN Intergovernmental Panel on Climate Change (IPCC)<sup>1</sup> advises that by 2050 the Swansea Central Area will have periods of intense heavy rainfall, droughts and rising temperatures. In this strategy Swansea Council and Natural Resources Wales send a powerful message that failure to adapt to and mitigate for such a climate change scenario is no longer an option, if we are to maintain an economically prosperous hub for the Swansea Bay City Region. Environmental sustainability is the basis for a resilient and prosperous Swansea. It requires current generations to choose how they meet their needs without compromising the ability of future generations to be able to do the same.

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<sup>1</sup> IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate

The benefits and cost-effectiveness of green infrastructure are now well studied and include reduced flood risk, summer cooling, cleaner air and water, reductions in noise, better mental and physical health, gains in biodiversity and a strengthened economy. The economic benefits of green infrastructure are increasingly being recognised, for example, in terms of savings compared to drainage infrastructure, reduced heating and cooling costs of buildings, increased property values and creation of green job opportunities.

Wales has legislation; the Well-being of Future Generations (Wales) Act 2015 and Environment (Wales) Act 2016, which requires that people work together to protect and enhance nature for the long-term benefit of all. Wales also has the requirements of the Flood and Water Management Act 2010 and Statutory Standards for Sustainable Drainage Systems 2018 which requires a new approach the sustainable management of surface water. The provision of green infrastructure will enable us to meet these requirements, and this Strategy aims to create investor confidence in green infrastructure by describing how it will be applied in the Swansea Central Area.

change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)

“A City that is green is a City where I want to be seen.  
A City that is bare is a City that does not care”

Anonymous member of the public, Swansea

The development of this strategy involved over 634 face to face conversations with members of the public, including residents and visitors to the Swansea Central Area, about what nature in the city means to them. Workshops were also held with businesses, developers, architects, landscape architects, public sector staff and Swansea Councillors. The overwhelming message from this engagement was that #citynature is very important to people and will increase their enjoyment and therefore their dwell time in the city centre.

Swansea Central Area is located in an attractive setting, with Swansea beach and bay, the river Tawe, and surrounding hills and woods all within sight. However within the urban area, with the exception of churchyards, the marina and a few locations where there are street trees, sealed surfaces dominate. There are plans however to increase the amount of green infrastructure in new schemes outlined in the Swansea

Central Regeneration Framework (SCARF), which will make the area more vibrant and attractive.

This strategy considers how green infrastructure can be increased in extent and quality in the central area of Swansea in order to make it better adapted to climate change and a better place for people and wildlife. Green infrastructure is a term used to describe all the greenspace, soil, vegetation and water (ranging from parks to roof gardens) that provide the ecosystem services that make our places more liveable.

“Taking kids shopping is a headache. 30 minutes  
break for free play is a life line. Children don’t have  
that chance today.”

Anonymous shopper, Swansea Quadrant



This strategy sets out a vision for the central area of Swansea to be much greener and more biodiverse, creating green spaces and using a combination of street-level features such as street trees and rain gardens as well as vegetation on buildings, including green roofs and green walls. The intention is to double the amount of green infrastructure (with the exception of open water) within 10 years. The focus will be to create a green infrastructure network, centred on a Green Artery that will connect Swansea Station in the north, with the beach and marina in the south and the wider area, via existing, improved greenspaces including churchyards and Castle Square. Green infrastructure will be planned and designed to be multi-functional and will involve a partnership approach, using innovative solutions, including Supplementary Planning Guidance for green infrastructure and a Green Space Factor tool (GSF tool). Swansea Council is committed to using the GSF tool, designed for the Swansea Central Area, as a measure for the quantity and functionality of green space in its developments. The GSF tool is described in Appendix 3.

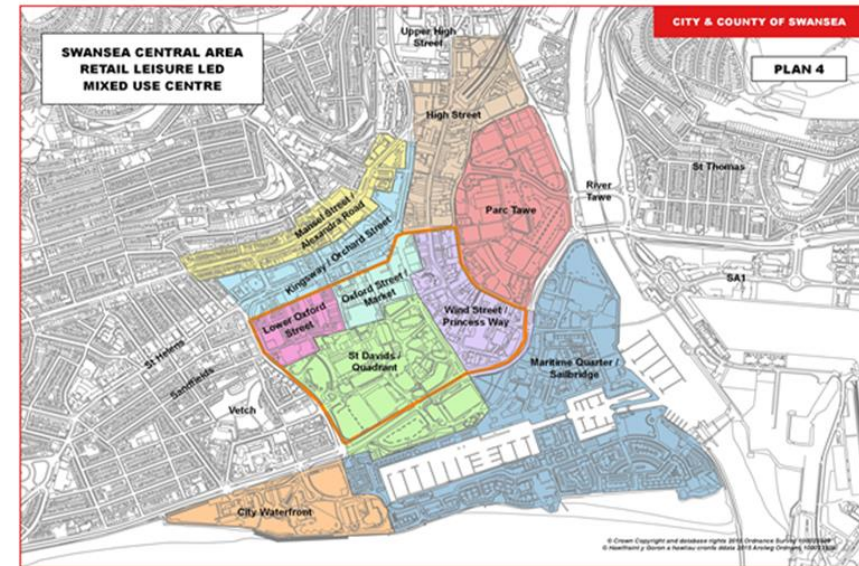


Figure 1: Swansea Central area as identified in the Swansea Central Area Regeneration Framework (SCARF)

# 1 INTRODUCTION

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## The Challenge

- 1.1 Swansea Central Area is dominated by sealed surfaces and buildings with GI making up only 13% of the area. There is clear evidence from the UN Intergovernmental Panel on Climate Change (IPCC) that by 2050 the Swansea Central Area will have periods of intense heavy rainfall, droughts and rising temperatures. Failure to adapt to and mitigate for climate change is no longer an option. The benefits and cost-effectiveness of green infrastructure (GI) are well documented. Environmental sustainability is the basis for a resilient and economically prosperous Swansea.

## The Solution

- 1.2 Increasing GI and adaptation to / mitigation for climate change as part of the regeneration of the Swansea Central Area, is an important key driver for economic prosperity in the Swansea Bay City Region.
- 1.3 This strategy is designed to provide a focused approach to enhancing and developing urban GI. Whilst this strategy is for the Swansea Central Area, it will

eventually form part of a Green Infrastructure Strategy to be developed for the whole of the County of Swansea. Implementation requires a cross-disciplinary approach across services in Swansea Council, Natural Resources Wales and partners. This strategy demonstrates how the provision of more multifunctional GI will enable us to meet the requirements of relevant Welsh legislation and policy including the Well-being of Future Generations (Wales) Act 2015, Environment (Wales) Act 2016 and Schedule 3 of the Flood and Water Management Act 2010. The strategy is intended to be used by all stakeholders involved in the redevelopment and refurbishment of the Swansea Central Area.

- 1.4 The purpose of the strategy is to outline how GI can restore nature and contribute to improving the economy, culture and health & wellbeing in the Swansea Central Area. It describes existing GI assets and sets out a vision for future provision of GI. Climatologists predict that by 2050, the Swansea Central Area will have periods of intense heavy rainfall, droughts, and rising temperatures.<sup>2</sup> In this strategy Swansea Council and Natural Resources Wales send a powerful message that

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<sup>2</sup> IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate

change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)

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failure to adapt to climate change is no longer an option, adaptation will be essential if Swansea is to continue to be an economically prosperous hub for the city-region. Maintaining existing and creating new high-quality GI is an important part of the work that Swansea Council and Natural Resources Wales will be undertaking to adapt to climate change and halt and reverse biodiversity losses. GI is essential for the health and well-being of Swansea' visitors and residents and to the vibrancy and viability of the city centre as the economic driver and key leisure destination of the Swansea Bay Region.

- 1.5 The intention is to bring about a cultural change so that a collaborative, cross-disciplinary, multifunctional approach to the planning, design, construction and maintenance of GI is adopted. The strategy sets out guiding principles and a framework for implementation. The implementation of the strategy is supported by the use of the Swansea Green Space Factor (GSF) tool, designed to increase the quantity and functionality of GI schemes (Appendix 3). The strategy is also supported by a catalogue of green infrastructure interventions (Appendix 2). Swansea Council, together with Natural Resources Wales is committed to promoting these schemes and interventions, and encourages others to use them, particularly when considering the design of proposals and associated GI schemes.

1.6 The GSF tool will help translate policy objectives into practice. It will not replace policies, strategies, plans or codes, but will help planners, and those involved in the development process to better understand how GI can be designed into schemes.

1.7 In those cities where they have been applied, GSF schemes have been shown to increase the amount of green space within developments, as well as increasing functionality, particularly with respect to surface water drainage. GSF schemes are supported by a wealth of evidence and experience, benefits include:

- a) A reported increase in the use of multifunctional green infrastructure features.
- b) Urban greening on restricted sites in densely developed areas.
- c) A simple mechanism, easily understood by non-specialists.
- d) Facilitation of conversations between developers and planners.
- e) Empowerment of local planning authorities to demonstrate the case for more greening.
- f) Greater flexibility with scores and targets able to be adjusted to reflect local priorities.



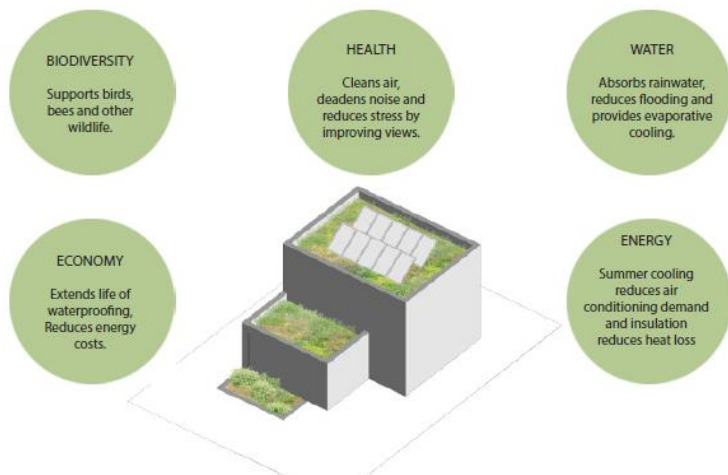


Figure 2. Green roofs for example provide many benefits which enable developers to reach GSF targets

### What is Green Infrastructure?

1.8 Green infrastructure (GI) is defined by the UK government as a network of multi-functional green space, urban and rural, which is capable of delivering a wide range of environmental and quality of life benefits for local communities. As a network it includes natural habitats ranging from grasslands, wetlands and

woodland to parks, open spaces, playing fields, street trees, rain gardens, allotments and private gardens. It can also include rivers, streams, canals, docks, beaches and other water bodies and features such as green roofs (Figure 2) walls.<sup>3</sup> It is the urban elements of GI which are of particular relevance to this strategy.

1.9 Green infrastructure (GI) is a catch-all term used to describe all the features of the natural environment between and within our towns and cities. By providing GI we are able to enjoy the many “ecosystem services” that these features provide as part of a sustainable approach to the management of natural resources where multi-functionality becomes a key objective of good design. Ecosystem services are the benefits that people derive from nature.<sup>4</sup>

1.10 GI can be accessible or inaccessible, publicly or privately owned, managed or unmanaged, designated as open space or for nature conservation or not. GI includes all soil, vegetation and water. It does not include paved or sealed surfaces or buildings, but it does include features on buildings such as green roofs and green walls.

<sup>3</sup> Landscape Institute on GI <https://www.landscapeinstitute.org/policy/green-infrastructure/>

<sup>4</sup> Ecosystem Services <https://www.iucn.org/commissions/commission-ecosystem-management/our-work/cems-thematic-groups/ecosystem-services>

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1.11 Nature-based Solutions (NbS) is a term used by the International Union for Conservation of Nature (IUCN) to describe actions that protect or restore nature for human wellbeing or biodiversity. NbS features are part of the GI network. Green infrastructure can be defined as the “network of green (soil and vegetation) and blue (water) spaces that provide ecosystem services.”<sup>5</sup>

1.12 Between 2009 and 2011 the UK National Ecosystems Assessment (UK NEA) analysed the natural environment in terms of the benefits it provides for society. It was found that our economy, health and wellbeing depend on the range of services provided by ecosystems and their components.

1.13 These include:

- Supporting services – those necessary for all others, including nutrient cycling and photosynthesis.
- Provisioning services – food, fibre and fuel.
- Regulating services – including clean water, clean air and climate.
- Cultural services – recreational, wellbeing, beauty and sense of place.

Multi-functionality is linked to spaces that provide the broadest range of ecosystem services.

1.14 The GI, ecosystem services, approach to land use planning, design, creation and maintenance enables us to gain more from the built environment, by conserving and restoring natural features and thinking about the widest range of functions, thereby ensuring benefits can be maximised. Sections 4 and 5 set out how that can be brought about. Good quality multifunctional GI requires an integrated approach that embraces many disciplines and all stakeholders. It must be considered at every level of the planning, design and management / maintenance process across all departments and disciplines, and is relevant at every scale of development, from major regeneration projects to individual buildings to site specific features such as tree pits. A positive and proactive approach will enable an area to make best use of its air, land and water, providing a better return on investment and happier and healthier residents and visitors.

1.15 There is a considerable, and rapidly growing, body of evidence that GI is essential for human health and wellbeing, provides habitat for wildlife and will help us to adapt to climate change. For a full review of the benefits

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<sup>5</sup> Nature-based Solutions <https://www.iucn.org/commissions/commission-ecosystem-management/our-work/nature-based-solutions>

of GI and key references and sources of information, see the Ecosystems Knowledge Network website.<sup>6</sup>

1.16 Given the range of benefits provided, the protection, creation, enhancement and maintenance of GI, should be a key consideration in all land use plans and projects.

1.17 GI is multi-functional and operates at different spatial scales, which means that its importance is often underestimated. The provision and maintenance of GI is the responsibility of many different authorities and landowners, which means that coordination, cooperation and collaboration is essential. There is also a wide spectrum of GI types, many of which are not included in conventional classifications of greenspace or nature conservation sites, which can lead to confusion about what should be prioritised. GI is rising up the political, legislative, social and environmental agenda, due to the burgeoning body of evidence for its benefits (see Chapter 2 for more detail on policy).

1.18 It is important that GI provides the widest range of benefits (ecosystem services). This means that

ecosystems must be protected and restored along with the microbes, plants and animals (biodiversity) that make ecosystems work. Biodiversity loss is now a major concern for civilization.<sup>7</sup> The European Commission and the UK government is committed to halting overall biodiversity loss and are seeking biodiversity net gain/benefit in development.<sup>8</sup> GI forms part of national

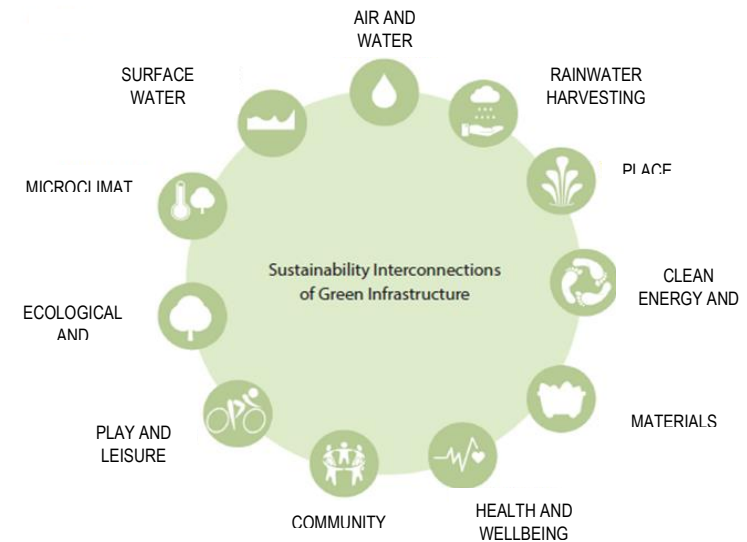


Figure 3. Interconnections of GI

<sup>6</sup> Ecosystems Knowledge Network  
<https://ecosystemsknowledge.net/resources/tools-guidelines/green-infrastructure>

<sup>7</sup> Stockholm Resilience Institute on biodiversity loss  
<https://www.stockholmresilience.org/research/research-news/2018-10-30-natures-steep-decline.html>

<sup>8</sup> UK Government consultation on biodiversity net gain  
<https://consult.defra.gov.uk/land-use/net-gain/>



policy as set out in Planning Policy Wales: Edition 10 and Welsh Government's Natural Resources Policy where it is regarded as a key mechanism for delivering the aspirations for ecological networks and creating natural and distinctive places. Figure 3 illustrates the range GI benefits.

1.19 Investment in GI benefits communities and provides a financial return. The prioritisation of green spaces in regeneration schemes may seem at odds with delivery of housing and growth targets, yet renewal and development can be an opportunity to “create places with more nature afterwards than before.”<sup>9</sup>



Street tree



Biodiverse extensive green roof



Green wall



Rain garden



Roof terrace



Allotment



Woodland



Beach

Figure 4. Various types of green infrastructure

<sup>9</sup> Berkeley Group on biodiversity net gain  
[https://www.berkeleygroup.co.uk/media/pdf/0/k/The\\_Nine\\_Concepts\\_-\\_Making\\_space\\_for\\_nature\\_and\\_beauty.pdf](https://www.berkeleygroup.co.uk/media/pdf/0/k/The_Nine_Concepts_-_Making_space_for_nature_and_beauty.pdf)

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Across Swansea, in recent years we have increasingly seen the proponents of new developments viewing GI as a valuable, multi-functional asset, supporting the delivery of quality homes and neighbourhoods. It is important that this is continued and expanded upon with developers taking greater responsibility to use the full palette of GI options, as illustrated in Figure 4 , to demonstrate how they are addressing this issue as part of demonstrating net biodiversity benefit.

### **Benefits of Green Infrastructure**

1.20 The components of GI have traditionally been valued for the amenity that they bring to the urban environment, that is, the way that they make peoples' surroundings more pleasant and their living and working environments more attractive. However, there is now a considerable, and growing, body of evidence of the wide range of benefits GI brings:

1.21 Environmental benefits:

- Adaption and mitigation to climate change i.e. cooling and shading and flood mitigation and creating micro-climate i.e. wind breaks.
- Creating habitat for wildlife, enhancing connectivity and supporting natural processes e.g. nutrient cycles.

- Reducing air and water pollution.
- Providing food.

1.22 Social and cultural benefits:

- Improving mental and physical health and wellbeing i.e. promoting physical exercise, dampening noise and lowering stress i.e. calming and inspiring.
- Facilitating social interaction i.e. multigenerational cohesion and creative play.
- Improving child development.
- Improving air quality by filtering particulates and absorbing gases.

1.23 Economic benefits:

- Saving in energy costs.
- Reduction on insurance claims e.g. from flooding
- Increased productivity.
- Increased property values.
- Increased footfall for businesses.
- Increased inward investment.
- Reduced pressure on infrastructure i.e. removal of carbon from the atmosphere, airborne particulates, interception of water run off.

1.24 More in-depth detail on the benefits of GI are provided in Appendix 1.



## 2 STRATEGIC CONTEXT

### National GI Drivers

2.1 There is legislation, policy and guidance which supports the creation and maintenance of GI at both

national and local levels. The benefits of GI (as described in the previous section) and their relationship to national guidance and legislation are outlined in Table 1 below.

Wellbeing of Future Generations (Wales) Act 2015	Environmental (Wales) Act 2016	Schedule 3 Flood & Water Management Act 2010 Statutory Standards	Active Travel (Wales) Act 2013 Manual for Streets	Planning Wales Act 2015 Planning Policy Wales 2019
<ul style="list-style-type: none"> <li>• Places a legal duty on all public bodies to improve wellbeing.</li> <li>• GI contributes to all wellbeing goals:               <ul style="list-style-type: none"> <li>○ Prosperous</li> <li>○ Reliant</li> <li>○ Healthier</li> <li>○ Cohesive communities</li> <li>○ Vibrant culture</li> <li>○ Globally responsible</li> </ul> </li> <li>• Healthy environment as a key principle of GI.</li> </ul>	<ul style="list-style-type: none"> <li>• Places a legal duty on the Council to protect and enhance biodiversity and maintain resilient ecosystems (the Section 6 Duty).</li> <li>• Ecosystems services approach must be used in the consideration of all development.</li> <li>• Resilience of ecosystem services considered against principles of diversity, condition, extent and connectivity of ecosystems and their adaptation to climate change.</li> </ul>	<ul style="list-style-type: none"> <li>• Gives duties to approve, adopt and maintain Sustainable Drainage Systems (SuDS) on the SuDS Approving Body (SAB).</li> <li>• Developers of sites of 1 or more dwellings of 100m<sup>2</sup> or more are required to implement sustainable urban drainage solutions in line with 6 statutory standards which promote SuDS design which deliver benefits of multifunctional GI.</li> </ul>	<ul style="list-style-type: none"> <li>• Duty on the Council to promote provision for walkers / cyclists and sustainable development.</li> <li>• Promotes multifunctional streets which achieve carbon reduction, health / air quality improvements, community pride / sense of ownership.</li> <li>• Promotes well-designed streets in sustainable communities where people want to live and work now and in the future'</li> </ul>	<ul style="list-style-type: none"> <li>• Planning Wales Act links land management to sustainable management of natural resources.</li> <li>• PPW guidance recognises GI as key to delivery of Placemaking and sustainable development.</li> <li>• <i>"GI is fundamental to shaping places, creating wellbeing and quality of spaces to live, work and play. It enhances the built environment when integrated appropriately and creatively."</i> (PPW 6.2.4)</li> <li>• <i>"Development of GI is an important way for Local Authorities to deliver their Section 6 duty"</i> (PPW6.2.2)</li> </ul>

Table 1: National Legislation, Policy and Guidance



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2.2 In addition to complying with the legislation described in the table, improving the quantity, quality and variety of GI in the city will contribute to compliance with other legislation which addresses air and water quality, climate change, surface water run-off, resilience planning, biodiversity, health and wellbeing (including mental and physical health) and social exclusion.

### **GI Drivers in Swansea**

2.3 Swansea Council and Natural Resources Wales Corporate Plans both recognise that our city faces a number of challenges in the years ahead, one of which is climate change (with more heatwaves and surface-water flooding, air quality problems and biodiversity losses predicted). Locally appropriate, good quality GI will help to mitigate these challenges and reduce future costs. The national legislation shown in Table 1 is supported by local strategy, policy and guidance, as outlined in Table 2 below.

Swansea PSB Local Wellbeing Plan	Swansea Council Corporate Plan	Swansea Local Development (LDP) Plan and SPG	Swansea Council Strategies	Swansea Designations and Evidence
<ul style="list-style-type: none"> <li>The Public Service Board (PSB) has embedded the Section 6 duty of the Environmental (Wales) Act 2016 into the Local Wellbeing Plan 2018.</li> <li>'Working with Nature' is one of the plan's Wellbeing objectives.</li> </ul>	<ul style="list-style-type: none"> <li>The Council has embedded the Section 6 duty into the Corporate Plan 2018 – 2022.</li> <li>Improving GI is one of the steps of the resilience objective.</li> </ul>	<ul style="list-style-type: none"> <li>LDP supported by SPG promotes sustainable development and placemaking.</li> <li>Policy ER 3 – Strategic Green Infrastructure Network – requires development to explore all opportunities to maintain and enhance GI network at all scales.</li> </ul>	<ul style="list-style-type: none"> <li>Biodiversity Action Plan / Nature Recovery Plan.</li> <li>Swansea Flood Risk Management Plan 2015.</li> <li>Air Quality Management Area Action Plan (2004)</li> </ul>	<ul style="list-style-type: none"> <li>Quiet Area (designated under Noise Action Plan for Wales).</li> <li>Open Space Assessments (Fields in Trust and Accessible Natural Greenspace provision) and emerging Open Space Strategy.</li> <li>Air Quality Management Areas</li> <li>Natural Resources Wales South West Wales Area Statement.</li> </ul>

Table 2: Local Legislation, Policy and Guidance

### 3 VISION, STRATEGIC OBJECTIVES & PRINCIPLES

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#### Vision

- 3.1 **A city with high quality multi-functional green infrastructure delivers resilience, prosperity, nature, health, well-being and happiness to the citizens and visitors of Swansea.**

#### Strategic Objectives

- 3.2 Each strategic objective contributes **directly** to any elements of the vision and **indirectly** to all the elements of the vision.
- Provide a high quality nature rich environment.
  - Create a distinctive destination city.
  - Ensure the city is resilient to the impacts of climate change.
  - Ensure stakeholder and community involvement in the design and maintenance of GI.
  - Create a skilled and knowledgeable local economy to deliver and maintain GI.
- 3.3 The vision and strategic objectives were developed following significant engagement with stakeholders from the local community, Councillors, local businesses, visitors, the public, private and third sectors. These conversations established an overwhelming desire for more nature in the city, with stakeholders talking about

the contribution nature makes to their personal mental and physical wellbeing and to their desire to live, work and visit the Swansea Central Area.

- 3.4 The engagement process recognised a need:
- to build local knowledge and skills around the opportunities and benefits of GI.
  - to provide training for all involved in the design development and maintenance of GI.
  - for robust local policy and guidance on GI supported by cross sector leadership.
  - for partnership working to implement GI projects and share learning.
  - for community involvement in the good design of GI schemes.
- 3.5 The strategy's strategic objectives have been designed to address these needs. Performance indicators and targets have been set to ensure the vision is achieved and monitor progress.
- 3.6 Applying the five principles of GI to the design process (see paragraph 3.10) will ensure the social, economic and environmental benefits of GI are maximised and the strategy's goals are achieved.
- 3.7 Table 3 below sets out the steps and actions that will need to be taken to achieve each strategic objective



along with performance indicators and targets which have been set to evaluate and measure progress.

3.8 Research findings indicate that a target of 20% to 25% canopy cover within the Swansea Central Area by 2044 is ambitious yet realistic.<sup>10</sup> An increase of terrestrial GI to 26% by 2030 requires Swansea Council, Natural Resources Wales and their partners to double the amount of GI in 10 years which is again ambitious but realistic.

3.9 The intention is to increase resilience, prosperity, health, wellbeing and happiness for citizens and visitors and to ensure that the GI network complements and improves the existing natural and built environment. This vision and strategic objectives will contribute to delivering the Swansea’s Local Well-being Plan, Local Development Plan (LDP) and Swansea Central Area Regeneration Framework.

Strategic Objective	Steps and Actions	Performance Indicator	Target
Provide a high quality nature rich environment	<ul style="list-style-type: none"> <li>Review opportunity for increasing canopy cover across the Swansea Central Area and map potential to reach 25%.</li> <li>Review opportunity for increasing biodiversity across the Swansea Central Area and map potential.</li> <li>Ensure GI is built into schemes from the outset.</li> <li>Become a Trees in the Townscapes champion by officially endorsing the 12 Trees in the Townscape principles<sup>11</sup> in Swansea Central Area.</li> </ul>	<ul style="list-style-type: none"> <li>Increase terrestrial GI</li> <li>Increase canopy cover.</li> <li>Increase biodiversity.</li> <li>GI to achieve the strategy’s five GI principles by being multifunctional, biodiverse, adapted for climate change, healthy and smart and sustainable.</li> </ul>	<ul style="list-style-type: none"> <li>Increase terrestrial GI to 26% by 2030.</li> <li>Increase canopy cover to 20 - 25% by 2044.</li> </ul>

<sup>10</sup> Doick, K.J, Davies, H. J, Moss, J., Coventry, R., Handley, P., Vaz Monterio, m., Rogers, K., Simkin, P.: *The Canopy Cover of England’s towns and Cities: baselining and setting targets to improve human health*

*and wellbeing* Conference Proceedings of TPBEIII. Urban Trees Research Conference 5-6th April 2017 Institute of Chartered Foresters, Edinburgh

<sup>11</sup> <http://www.tdag.org.uk/trees-in-the-townscape.html>

Strategic Objective	Steps and Actions	Performance Indicator	Target
	<ul style="list-style-type: none"> <li>Encourage partners to apply the 12 Trees in the Townscape principles to all developments</li> </ul>	<ul style="list-style-type: none"> <li>Number of green roofs installed to GRO code requirements.<sup>12</sup></li> </ul>	
Create a distinctive destination city	<ul style="list-style-type: none"> <li>Build GI into Swansea Central Area improvement programmes and grants.</li> <li>Ensure the Green Space Factor tool (GSF tool) is used on Council led developments.</li> <li>Encourage developers and land managers to improve GI.</li> <li>Encourage the use of GSF tool by partners and on non Council led developments.</li> <li>Investigate and attain wildlife and well-being friendly city schemes such as; Biophilic City<sup>13</sup>, National Park City<sup>14</sup>, UNESCO Biosphere Reserve<sup>15</sup>.</li> <li>Report and monitor improvements to economic, social and environmental welling in the Swansea Central Area.</li> </ul>	<ul style="list-style-type: none"> <li>Number of GI projects enabled by the Target Regeneration Investment (TRI) programme or similar.</li> <li>Monitor using mapping data.</li> </ul>	<ul style="list-style-type: none"> <li>Increase terrestrial GI to 26% by 2030.</li> <li>Increase canopy cover to 20 - 25% by 2044.</li> </ul>
Ensure the city is resilient to the impacts of climate change	<ul style="list-style-type: none"> <li>Design and implement GI solutions.</li> <li>Develop Swansea as a sponge city<sup>16</sup> through implementation of good multifunctional SuDs.</li> </ul>	<ul style="list-style-type: none"> <li>GI solutions to achieve the strategy's five GI principles by being multifunctional, biodiverse, adapted for climate change,</li> </ul>	<ul style="list-style-type: none"> <li>Increase terrestrial GI to 26% by 2030.</li> <li>Increase canopy cover to 20 - 25% by 2044.</li> </ul>

<sup>12</sup> GRO Green Roof Code 2014 <https://livingroofs.org/wp-content/uploads/2016/03/grocode2014.pdf>

<sup>13</sup> <https://www.biophiliccities.org/>

<sup>14</sup> <https://www.nationalparkcity.org/>

<sup>15</sup> <https://en.unesco.org/biosphere>

<sup>16</sup> <https://www.worldfuturecouncil.org/sponge-cities-what-is-it-all-about/>

Strategic Objective	Steps and Actions	Performance Indicator	Target
	<ul style="list-style-type: none"> <li>• Monitor the success of GI solutions and adapt design to maximise resilience where necessary.</li> <li>• Create Baselines for measuring the success of GI solutions</li> </ul>	<p>healthy and smart and sustainable.</p> <ul style="list-style-type: none"> <li>• Working with partners to assess all available data for monitoring.</li> </ul>	
Ensure stakeholder and community involvement in the design and maintenance of GI	<ul style="list-style-type: none"> <li>• Involve communities in the design and development of GI</li> <li>• Work in partnership with community groups to identify sites and plant trees to increase canopy cover.</li> <li>• Work with community groups to identify innovative ways to maintain GI.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of GI projects incepted / co-produced and/or maintained by stakeholders.</li> </ul>	
Create a skilled and knowledgeable local economy to deliver and maintain GI	<ul style="list-style-type: none"> <li>• Work with industry experts to build local knowledge base.</li> <li>• Develop interactive webpages for Strategy.</li> <li>• Develop a plan for communicating GI development and successes.</li> <li>• Work with partners to design, develop and provide training.</li> <li>• Design and deliver events / contunited professional development to build GI skills and raise awareness.</li> <li>• Promote best practices through local case studies and pilots.</li> </ul>	<ul style="list-style-type: none"> <li>• Number of events to raise awareness of green infrastructure for businesses / organisations to build the local green infrastructure sector.</li> <li>• Number of SME's specialising in delivery and maintenance of GI.</li> </ul>	

Table 3: Actions and Targets for achieving the Strategic Objectives



## Principles of GI

3.10 The five principles (Figure 5) should be considered by all who plan, design, build, vegetate and maintain green infrastructure. By following these principles, interventions maximise the number and intensity of benefits for people and wildlife. Applying these principles will successfully achieve the strategy's vision.

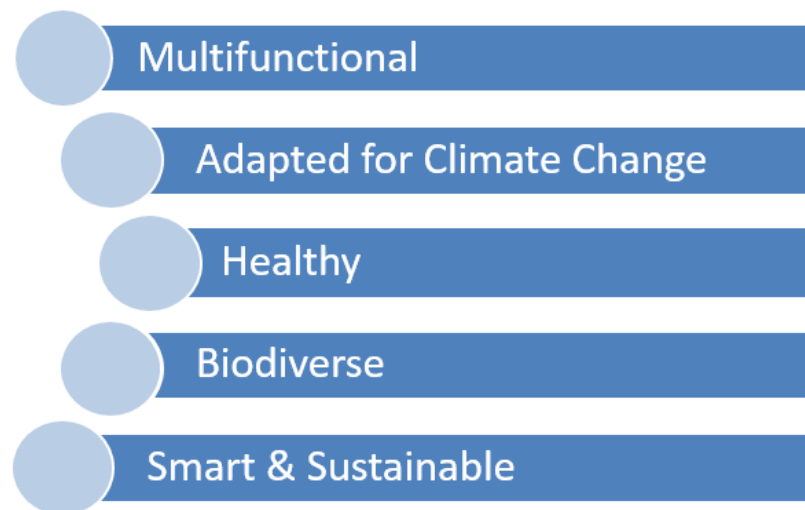


Figure 5. Principles of GI

## Multi-functional

3.11 Nature itself is multi-functional. A natural area simultaneously provides a full range of ecosystem services. Humans tend to modify land use for limited purposes – for example, an arable field produces food, or a car park stores cars. The conventional approach is for specialist individuals or organisations or departments to provide a facility that does one thing well. However it is important, given the scale of the difficulties facing urban areas, which are likely to be exacerbated by climate change and biodiversity loss that every effort is made not to miss opportunities to make features multi-functional. Although there can be trade-offs, more often than not, extra provision of GI elements does not interfere with the primary purpose and the return on any extra investment is positive as illustrated in Figure 6.

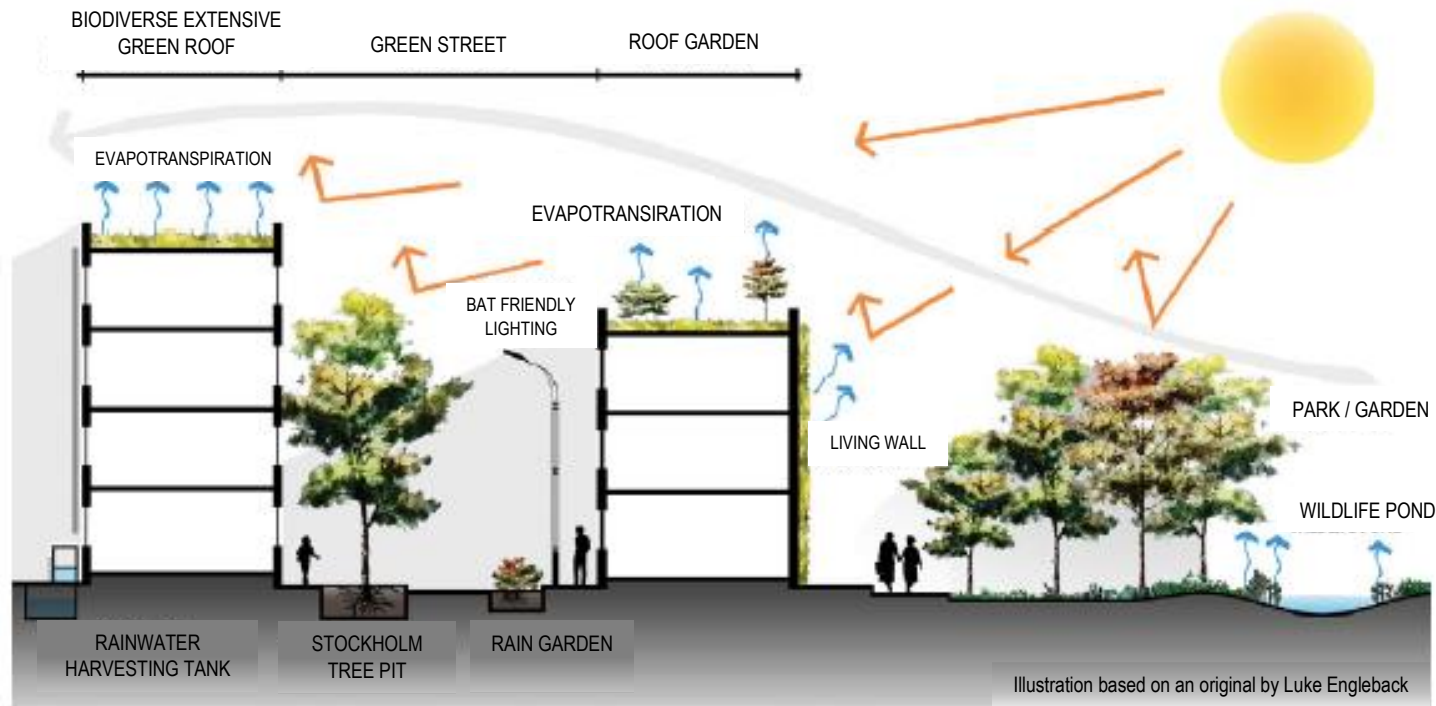


Figure 6. Green infrastructure improves microclimate

3.12 A cycle path can be an ecological as well as a transportation corridor. Extra tree planting in a car park can improve amenity, provide summer shade, sustainable drainage and biodiversity. Sometimes there are synergistic effects. An example is a biosolar roof (photovoltaics combined with a green roof) where a cooler microclimate increases the output of the photovoltaics.

3.13 Multi-functionality is also illustrated in Appendix 2 in the petal diagrams, designed to demonstrate the contribution of various ecosystem services in GI typologies. The more balanced and bigger the petals the more multi-functional the GI type.

## Adapted for Climate Change

3.14 According to the Met Office Hadley Centre Climate Programme, climate change is predicted to lead to sea level rises, warmer and wetter winters and hotter and drier summers.<sup>17</sup> Summer heatwaves are likely to be more frequent and more intense. Heavier downpours, even in summer, are likely to lead to flash flooding. Even if greenhouse gas emissions and associated global

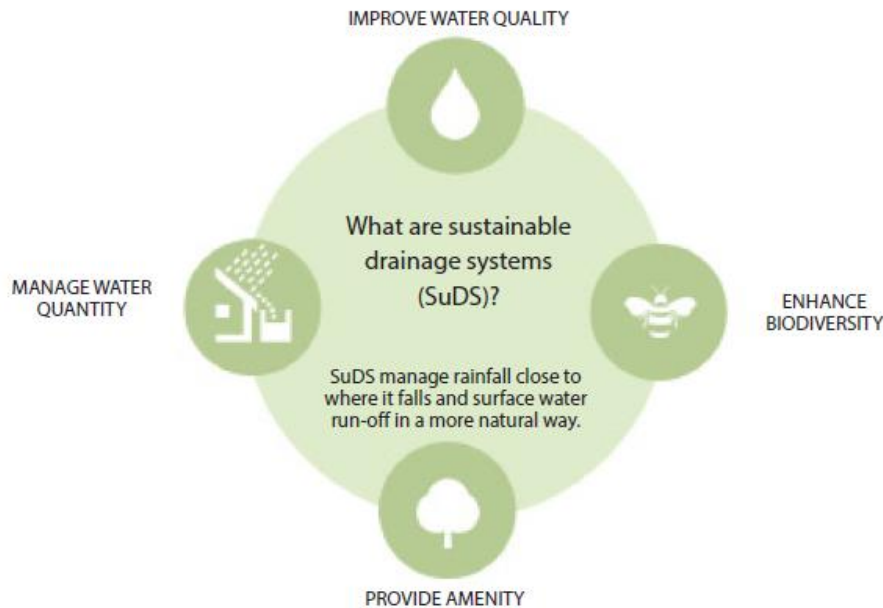


Figure 7. What are SuDS?

<sup>17</sup> <https://www.metoffice.gov.uk/research/collaboration/ukcp/derived-projections>

warming can be limited, some increases in heatwaves and surface water flooding will occur. For example Figure 7 illustrates the benefits of sustainable urban drainage systems as part of GI solutions to mitigate for and adapt to the impacts of climate change.

3.15 In general, an increase in GI will be a cost-effective way of adapting to these changes. More specifically, features that provide shade and evaporative cooling in summer (Figure 8 and 9), close to where people live and work and features that intercept and filter rainwater and surface water run-off, should be incorporated into schemes.



Figure 8. Infra-red image of masonry wall (left) and green wall (right)



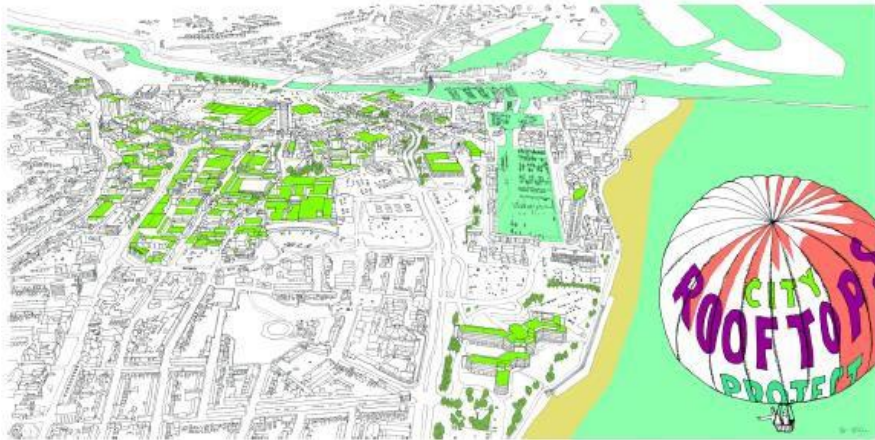


Figure 9. Potential for green roofs across Swansea city centre produced by Andrew Nixon/Powell Dobson Architects for the CIVIC 2014 Exhibition at the Mission Gallery

### Healthy

3.16 For good health and a sense of wellbeing, people need clean air, clean water, food, exercise, contact with nature and places to socialise, play and learn. GI can provide these benefits. Conventional, readily accessible greenspace is important, however other GI features, even if simply overlooked like green walls, can be important for mental health. Unseen features, like extensive green roofs for example, may be providing relief in a heatwave, filtering water, or absorbing air pollution. The precise location and specific design of

green infrastructure can be an important factor with respect to providing health benefits (Figure 10).



Figure 10. Cycle path as a green corridor

### Biodiverse

3.17 Biodiversity is the whole range of living things and systems on earth, it includes ecosystems, animals, plants, microbes and the genetic variation between them. All life depends on biodiversity and ecosystems function better when high biodiversity is maintained. In responses to continuing losses, Natural Resources Wales has recently set out a fresh approach to

conserving biodiversity, named 'Vital Nature'<sup>18</sup> sets out priorities for protecting and restoring Wales' biodiversity, the variety of habitats and species and the ecosystems they depend on. Central to the report is the principle that everyone's wellbeing depends on a healthy environment, which in turn depends on healthy biodiversity

3.18 Swansea has a Local Biodiversity Action Plan (LBAP).<sup>19</sup> There is a strong emphasis on partnership, engagement and learning in the LBAP. Urban wildlife referred to includes bats, song thrush, bumble bees, mason bees, butterflies and stag beetle, amongst others.

3.19 Wherever GI occurs in Swansea, consideration should be given to how biodiversity can be maintained and enhanced. Planting schemes, native species or species with a documented value for wildlife, where justified, should be used, along with appropriate habitat features such as decaying logs, nesting and roosting boxes for birds and bats and refugia for invertebrates (bug hotels) and wildflowers.

<sup>18</sup> <https://naturalresources.wales/about-us/news-and-events/news/nrw-sets-out-a-fresh-approach-to-wildlife-in-wales/?lang=en>

<sup>19</sup> Swansea LBAP <https://www.swansea.gov.uk/article/10113/Swansea-Local-Biodiversity-Action-Plan>



Figure 11. Mason bees using bee

### Smart & Sustainable

3.20 A transition in the economy, away from fossil fuels, in order to avoid the worst effects of climate change, is essential and the Welsh Government has published a decarbonisation programme.<sup>20</sup> In addition, reductions in pollution and waste, with more recycling and waste increasingly used as a raw material (for example, the circular economy) is sought.<sup>21</sup>

<sup>20</sup>

<https://gov.wales/topics/environmentcountryside/climatechange/emissions/?lang=en>

<sup>21</sup> Circular economy <https://www.ellenmacarthurfoundation.org/circular-economy/concept>



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3.21 The provision and maintenance of urban GI should support these efforts, helping to save energy, working alongside efforts to provide energy from renewable sources (for example solar and biogas from green waste) and using recycled materials and recycled green waste for growing media.

3.22 Vehicles and equipment used to build and maintain GI should wherever possible run on renewable energy. GI should be, wherever possible, low maintenance. Also wherever possible, GI should not rely on artificial irrigation and where irrigation is required, consideration should be given to using harvested rainwater. Smart technologies should be used to monitor and share data with practitioners, the community and education institutions. This information might include energy and water consumption and biodiversity records. Staff working on the maintenance of GI should receive appropriate training and support.

### **Cross-Disciplinary Working**

3.23 Tackling the causes and effects of issues such as biodiversity loss and climate change requires a radical step change in approach across all sectors, and this step change must occur in the short term. The conversations required to deliver quality GI provide a well-timed opportunity to increase the skills and knowledge capacity needed to achieve this. Culture change will be required across organisations and our partners to work together in an innovative and collaborative way to ensure that development is resilient and adaptable to climate change. Achieving cross-sector agreement to the principles in this green infrastructure strategy is key to the delivery of the joint vision for Swansea Central Area (Figure 12).





Figure 12. Cross-disciplinary and partnership working required to deliver the vision for quality GI.

### The Principles and the Green Space Factor tool

3.24 The GSF tool (Appendix 3) provides a useful and simple way to explore the function and benefits of GI and ensure that these principles are embedded into the early

stages of the development and design process. It provides a simple and clear way to navigate the many overlapping and interrelated issues.

## 4 SWANSEA'S GREEN INFRASTRUCTURE

### Setting

4.1 The Swansea Central Area lies in an attractive coastal location. It is bordered by three wildlife corridors which provide oases of nature and tranquillity close to the heart of the city; the Swansea Bay Wildlife Corridor, the River Tawe Wildlife Corridor and the Hillside Wildlife Corridor. One of the aims of this Strategy is to create connections, both for people and wildlife, from green spaces within the central area to these surrounding wildlife corridors.

4.2 The **Swansea Bay Wildlife Corridor** (Figure 13) is located to the immediate south of the City and sweeps for 8 kilometres to the west. Its bounded by a promenade which is accessible to pedestrians and cyclists, who enjoy splendid views and fresh air. The whole bay is a Site of Importance for Nature Conservation (SINC)<sup>22</sup> and the western half of the bay is a Site of Special Scientific Interest (SSSI), an important intertidal habitat for migratory birds.

4.3 The eastern boundary of the Swansea Central Area is bordered by the **River Tawe Wildlife Corridor** (Figure 14), which has had a barrage at the river mouth since 1992. The Tawe Wildlife Corridor supports a surprising

diversity of wildlife including otters, herons and kingfishers. It has good access for walkers and cyclists along its whole length, linking to the Swansea Vale Nature Reserve south of the M4, and to the Brecon Beacons beyond. Across the Tawe to the immediate south east is the SA1 Swansea Waterfront district. Along the northern edge of the docks, on the opposite side of the river, are new commercial and education facilities.



Figure 13. Swansea Bay Wildlife Corridor

4.4 North of Fabian Way, which is the main highway access to the east of the city, is primarily a residential area. To the north of that is Kilvey Hill, which provides good views of the city centre. Kilvey Hill is covered with plantation

<sup>22</sup> Swansea Bay SINC <https://www.swansea.gov.uk/swanseabay>

woodland, grassland, heathland and wetlands. Part of it is managed as Community Woodland. To the immediate east of Kilvey Hill, is Crymlyn Bog National Nature Reserve, another SSSI.<sup>23</sup>



Figure 14. River Tawe Wildlife Corridor

- 4.5 The **Hillside Wildlife Corridor** to the north of the city centre provides a linear strip of woodland, heathland, grassland and wetland habitat stretching from the Tawe River Corridor in the east to Cockett Valley and the open countryside in the west. It offers spectacular views over the City Centre, Swansea Bay and on a clear day across the channel to Devon. The corridor connects Bryn-y-Don Park<sup>24</sup> with the Rosehill Quarry Community Park<sup>25</sup> and

the Mayhill Washing Lake and Community Food Garden. Beyond the corridor to the north west of the central area are residential suburbs, including Townhill and Mayhill.

- 4.6 To the west and south-west of the central area is Sandfields a residential area of predominantly terraced properties which includes the Vetch Veg allotments and open space sited on the former Swansea City FC ground.<sup>26</sup>

### Existing Assets

- 4.7 Swansea Central Area was badly damaged by bombing in 1941. The 1950s and 1960s saw a period of significant post-war reconstruction (Figure 15), which has left a legacy of spaces dominated by sealed surfaces, including many large car parks. This makes the area vulnerable to surface water flooding and the urban heat island effect. There are street trees, with large trees in selected locations (church yards and Castle Square) however tree canopy cover is patchy. There is very little semi-natural vegetation, with ground cover, where it occurs, usually dominated by amenity grassland and

<sup>23</sup> Crymlyn Bog <https://sac.jncc.gov.uk/site/UK0012885>

<sup>24</sup> Bryn Y Don Park <https://www.swansea.gov.uk/brynydon>

<sup>25</sup> Rosehill Quarry <https://www.opengreenmap.org/greenmap/swansea-green-map/rosehill-quarry-1288>

<sup>26</sup> Veg Vetch <http://www.sustainableswansea.net/vetch-veg.html>





Figure 15. Swansea at dusk

non-native shrubberies. There is however semi-natural vegetation around the dunes along the beach front and scrub and other rough vegetation along the River Tawe. The southern part of the central area is very different in character, with the large area of open water of the former dock in the Maritime Quarter and the lawn and trees surrounding the Council's Civic Centre. Figure 16 and 17 illustrate existing GI assets in in and around the central area and Table 4 shows cover of various categories of GI in Swansea Central area. Overall terrestrial GI cover in Swansea Central Area is 13%.

Category of GI	Area (hectares)	%
Amenity greenspace	9.8	7
Cemeteries & Churchyards	0.4	<1
Civic greenspace	3.3	2
Semi-natural	4.2	3
Total terrestrial GI (total of areas above)	17.7	13
Water (marina)	7	5
Total GI (including water)	24.7	18
Total Swansea Central Area	133.4	100

Table 4: GI in Swansea Central Area by category, based on Ordnance Survey map data, Jan 2019, updated via ground survey October 2020



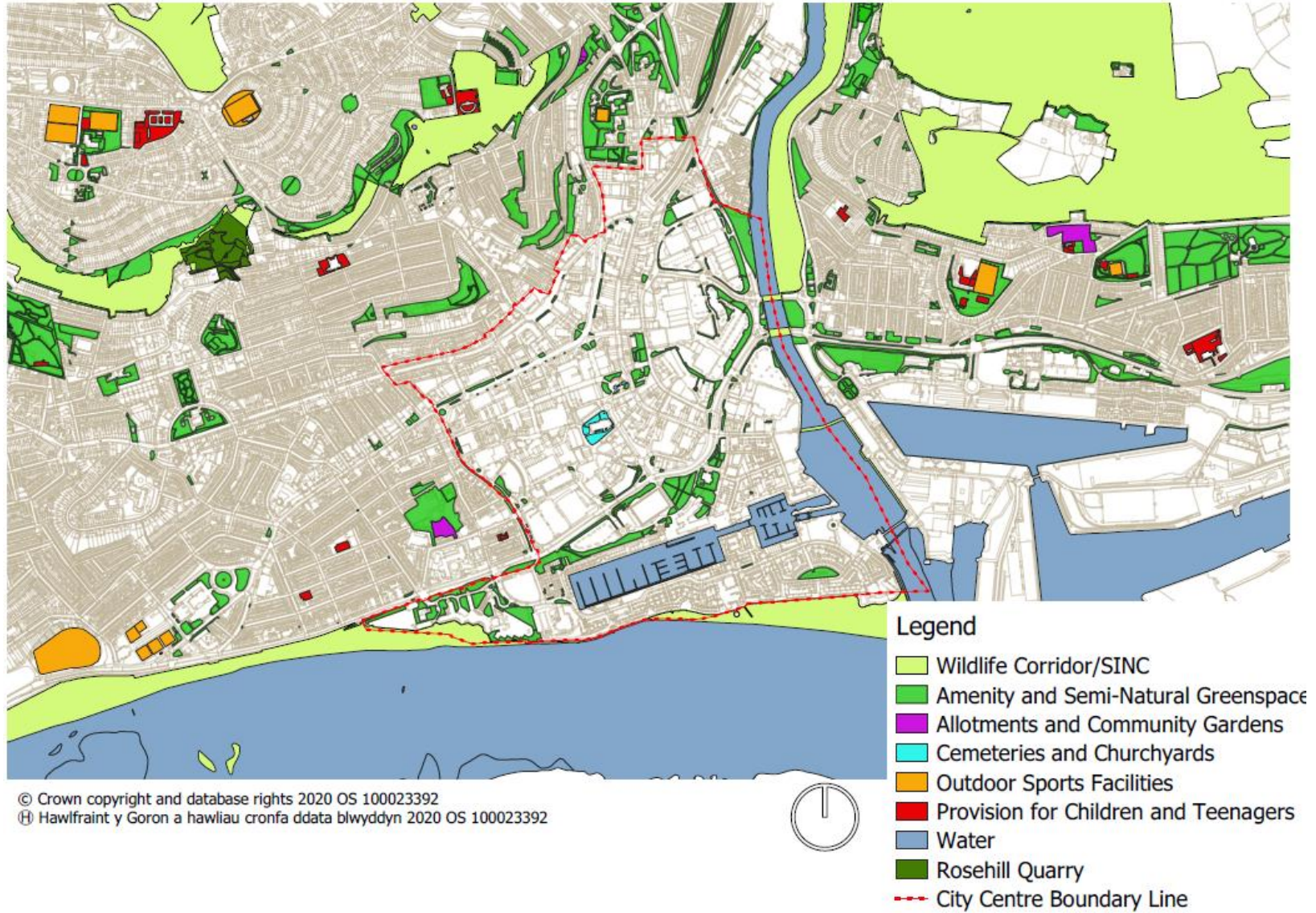
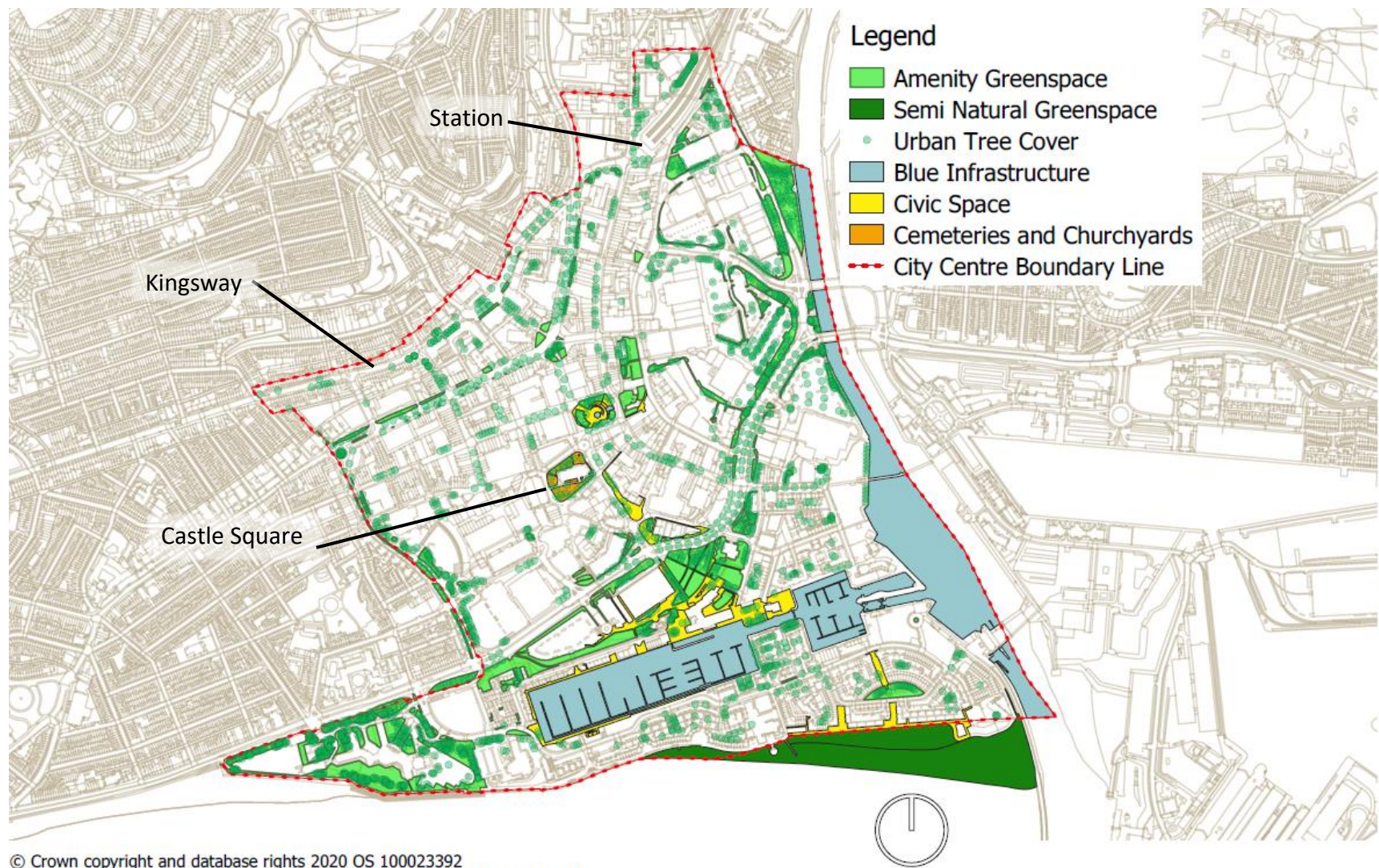


Figure 16. Existing Assets

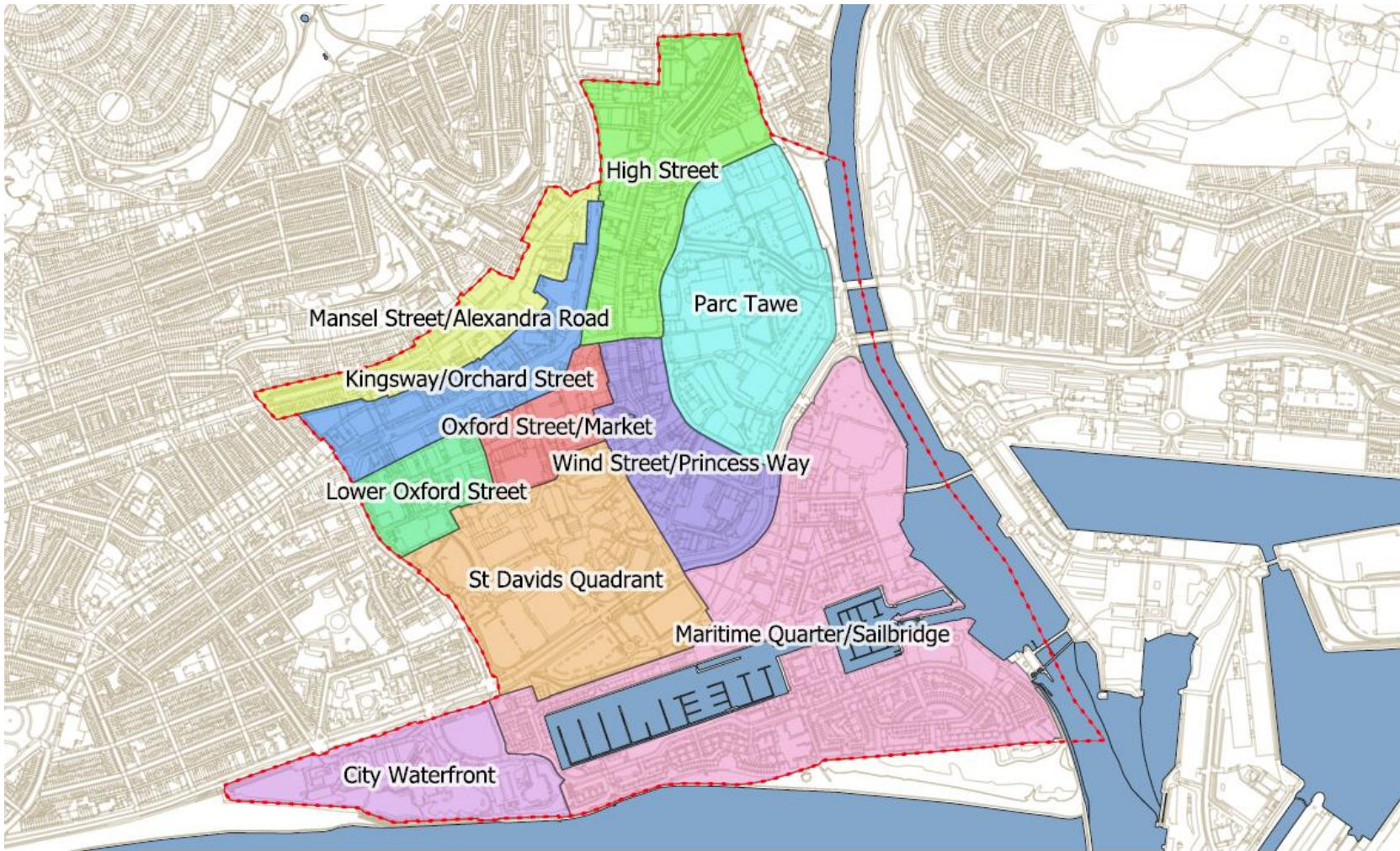




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Figure 17. Existing Green Infrastructure in Swansea's Central Area





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Figure 18. The 10 Swansea Districts



- 4.8 The Swansea Central Area Regeneration Framework divides the central area into 10 districts, as shown in Figure 18. The districts are described in the following paragraphs.
- 4.9 The High Street area is the key route from the railway station south towards Kingsway to the west and Wind Street to the south east. Its importance as a retail street has declined over the years following the establishment of the Quadrant Shopping Centre. There are improvements underway associated with the Urban Village scheme,<sup>27</sup> whilst a new high rise student accommodation block is being constructed on the former Mariner Street surface car park site. The High Street area is heavily built-up - there are a few pockets of vegetation, including 'wasteland' vegetation of self-established trees and shrubs at the rear of the Grand Hotel. There are street trees along some sections of High Street and occasional ornamental planters and amenity tree plantings elsewhere, including a grassed areas here. The Strand runs past the multi-storey car park and grassed area and trees outside of Alexandra House.
- 4.10 Wind Street and Princess Way continue south from High Street. This is a densely developed commercial and

residential area with bars, clubs and restaurants. Wind Street itself has an almost continuous avenue of London plane trees, planted on the eastern side of the street. At the northern end of this area is Castle Square and Swansea Castle. Castle Square (Figure 19) is mainly paved and includes a large water feature, and mature trees around the perimeter of the square, including Norway maple, birch and cherry with amenity grassland and shrubberies beneath. Swansea Castle has amenity grassland within its curtilage. There are hanging baskets and ivy is growing on the castle walls in a few places.



Figure 19. Castle Square

<sup>27</sup> Urban Village <https://www.coastalha.co.uk/Pages/Next-phase-of-Urban-Village-development-given-green-light.aspx>

4.11 Parc Tawe is a retail park located on a former dockland area to the south-east of High Street. It is dominated by large retail warehouse type buildings served by surface level car parks. The car parks have shrubberies planted with non-native ornamental species and there are lines of trees, mainly maples, with some lime and whitebeam. Where Parc Tawe meets the River Tawe, there are two highway crossings and the river bank is urbanised as a walkway. However semi-natural vegetation occurs on the river banks extending northwards.

4.12 To the south of Parc Tawe on the opposite side of Oystermouth Road, is the Maritime Quarter. This is the largest district within the central area, consisting of residential and commercial development around the Tawe Basin, formerly part of the Swansea Docks and now used as a marina. There are shrubberies and trees (including pines) around the Sainsbury's supermarket car park. Travelling west there is an open area of amenity grassland in front of Museum Green leading on to the district's largest green space within the curtilage of National Waterfront Museum. Both green spaces consist of amenity grassland, birch trees and shrubberies planted with ornamental species. In addition, there are tree plantings along Oystermouth

Road and amenity grassland and ornamental plantings by Fisherman's Way. Just outside the Maritime Quarter, to the south and close to the river mouth, is a small area of sand dunes managed as a nature reserve.

4.13 West of the Maritime Quarter, is the City Waterfront. This consists of the Civic Centre, library, hotel and associated car parks. The landscape around the Civic Centre is amenity grassland, mature stone pines, and maples with shrubberies alongside.

4.14 Just beyond the Civic Centre, on the beach, is an artificial dune project,<sup>28</sup> designed to create habitat and to reduce the amount of sand blowing onto the promenade.

4.15 St Davids and the Quadrant is a commercial area to the north of Oystermouth Road and the Maritime Quarter. It is dominated by car parks and commercial / residential buildings. During 2020 the area immediately south and north of Oystermouth Road forms part of the construction site for regeneration proposals at Swansea Central. To the north of the Tesco supermarket and around the edges of the Tesco car park are lines of trees. Other greenspaces in this area are the lawns and trees around St David's Priory Church and St Mary's

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<sup>28</sup> Sand dune project, Swansea Bay  
<https://www.coastalha.co.uk/Pages/Next-phase-of-Urban-Village-development-given-green-light.aspx>



Churchyard, which includes a number of fine mature trees, including London plane, and amenity grassland. The churchyard pre-dates the commercial development that surrounds it.

4.16 To the north of St David's Church is the Oxford Street and Market area which is also one of the city's main commercial and retail areas. GI is limited to street trees (mostly London plane). The Lower Oxford Street area is a continuation of the commercial and residential development associated with Oxford Street. There are street trees, including Norway maple and London Plane in a few locations, although canopy cover is fragmented.

4.17 Kingsway (Figure 20) and Orchard Street is another mixed commercial area to the north of Oxford Street. Prior to 2019 there were street trees in a few locations, and canopy cover was patchy with mature trees confined to pockets such as that at Mount Pleasant Baptist Church. However during 2019 the Council commenced the construction of the Kingsway Urban Park project which included a more pedestrian friendly environment, with wider footways and significant street tree planting.

4.18 Mansel Street (Figure 21) and Alexandra Road are located to the north of Kingsway and Orchard Street. This is a mixed commercial / residential area with retail and professional services fronting the streets. Although

most rear gardens are covered with extensions, there are some that retain vegetation. There are street trees, including lime and whitebeam, however canopy cover is intermittent.

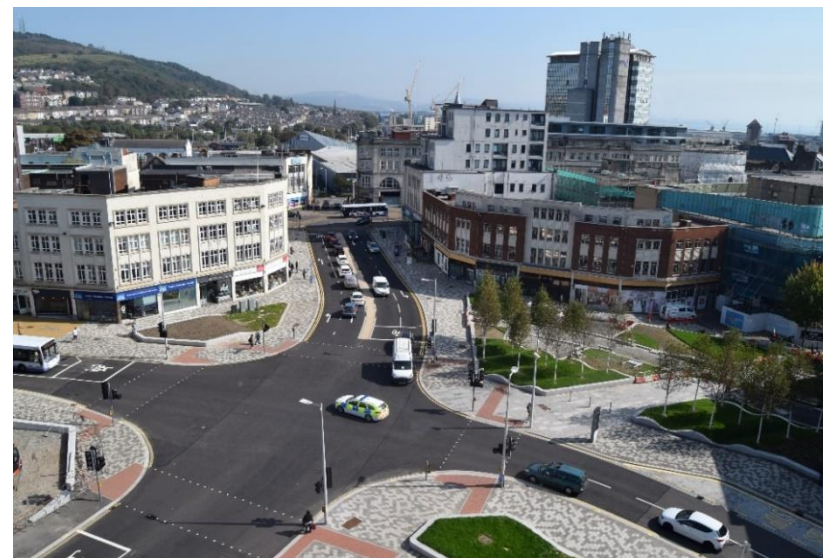


Figure 20. Recent redevelopment of Kingsway

4.19 Swansea as a whole has historically experienced losses in greenspace through redevelopment and regeneration projects and a decline in biodiversity as a consequence. Increased traffic has resulted in a deterioration in air quality and poor water quality in the Lower Tawe and Swansea Bay adjoining the central area. People living



Figure 21. Green suburbs to the north of Kingsway

next to major highways suffer from noise pollution<sup>29</sup> whilst those living in the central area north of Oystermouth Road do not live within easy reach of a substantial accessible greenspace as defined by Fields In Trust<sup>30</sup>. Countryside Council for Wales (now part of Natural Resources Wales), recommended that no person should live more than 300m from their nearest natural greenspace<sup>31</sup>. This is roughly the equivalent of a six-minute walk. The proposals outlined in this strategy

<sup>29</sup> Environmental challenges in Swansea <https://www.swansea.gov.uk/article/30953/The-natural-environment-is-healthy-and-resilient>

<sup>30</sup> Fields in Trust <http://www.fieldsintrust.org/>

will help reduce inequalities in access to greenspace. Swansea Central Area's resident population of approximately 10,000 (swollen daily by workers and visitors), includes some of the most deprived and vulnerable people in Wales.<sup>32</sup>

### Proposals and Redevelopment Initiatives

- 4.20 The Swansea Central Area Regeneration Framework (2016) and the Swansea Local Development Plan (2019) include proposals and redevelopment initiatives which have the potential to include GI. These are described in brief here and shown in Figure 22.
- 4.21 A number of the locations for these proposals and initiatives are essential elements of the proposed Green Artery and wider GI network. Potential GI enhancements should be considered from the outset in any redevelopment and refurbishment schemes and it is important that every opportunity is taken at the initial design stage to maximise the area of soil, water and vegetation created both at ground level, but also on buildings.

<sup>31</sup> <http://www.teebweb.org/wp-content/uploads/2013/01/Natural-Spaces-and-Health-Mapping-Accessible-Natural-Greenspace-in-Wales-UK.pdf>

<sup>32</sup> PPW Technical Advice Note 16 Sport Recreation and Open Space <https://gov.wales/sites/default/files/publications/2018-09/tan16-sport-recreation-open-space.pdf>



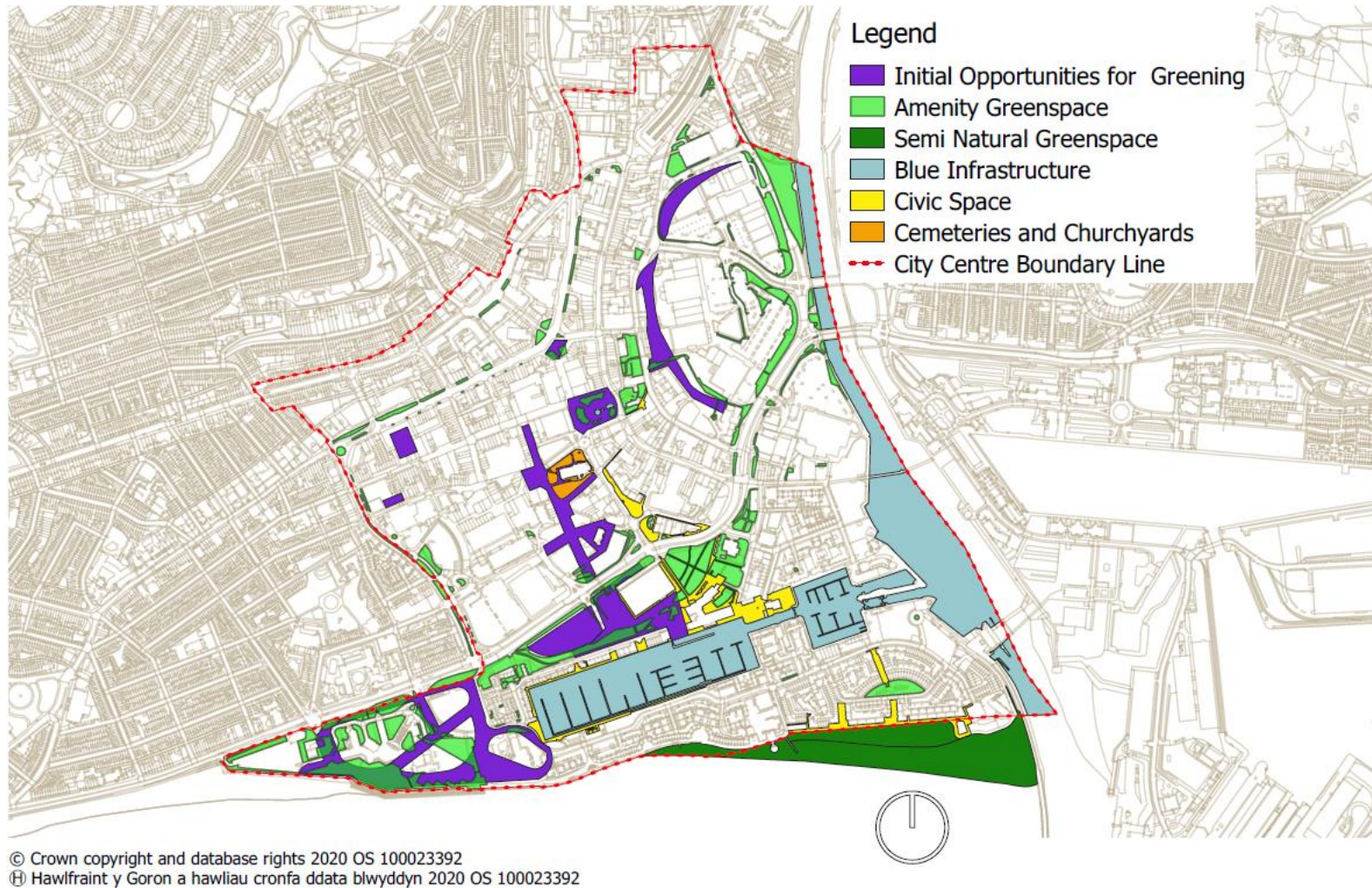


Figure 22. Opportunities for greening



4.22 At the heart of the Swansea Central Area's GI network will be the Green Artery (see Figure 25). The proposal is set out in the Swansea Central Area Regeneration Framework (2016).<sup>33</sup> The Green Artery will be a GI corridor connecting Swansea Station in the north to the Maritime Quarter in the south, making the centre of Swansea more permeable to both people and wildlife. Within the Green Artery, pedestrians and cyclists will have priority. From the community engagement there was a strong mandate for nature in the city, the prominence of which is illustrated in Figure 23.

4.23 Interventions along High Street will connect the station with Castle Square, where there will be an overall reduction in sealed surfaces. Heading south from Castle Square, connections will be made with St Mary's Church, St David's Church and across Oystermouth Road via a new landmark bridge to the new Coastal Park. From the Coastal Park it will be a short walk to other destinations in the Maritime Quarter, the beach and Waterfront. The Green Artery will be a primary focus, however green links will be made with Oxford Street and Kingsway to the west and Parc Tawe and the River Tawe to the east, with other arms of the GI network extending to the natural environment on the outskirts of the city, including,

the Tawe Riverside, Hillside and Swansea Bay wildlife corridors

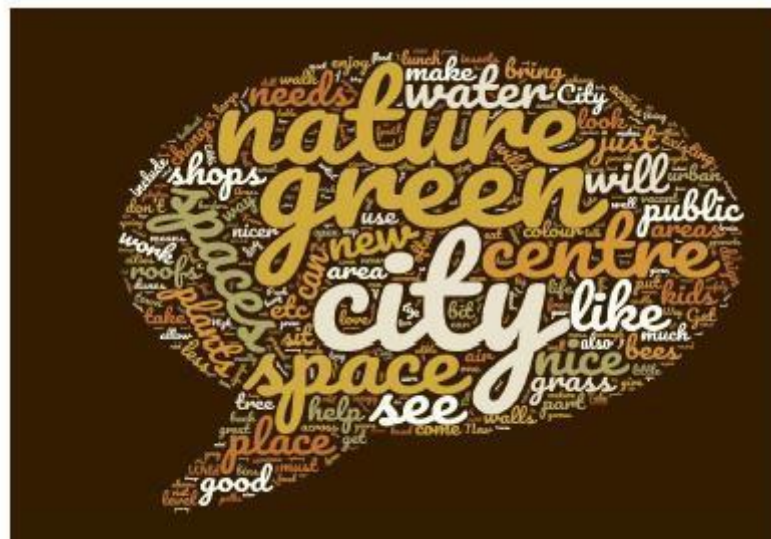


Figure 23. Opportunities theme 'word cloud' from the community engagement

4.24 As well as the Green Artery itself, GI interventions can be made anywhere in the city, as opportunities arise through redevelopment and also through routine repair and maintenance or by retrofitting features. There may also be locations, identified through future GI audits or ecosystem services analyses, where small interventions can be identified that can have a disproportionately large

<sup>33</sup> Swansea Central Area Regeneration Framework 2016  
<https://swansea.gov.uk/citycentreframework>

impact, including, for example, tree and wildflower planting, rain gardens, green roofs and green walls.

4.25 The Swansea Central Phase 1 and 2 schemes will make a substantial contribution towards GI. Swansea Central Phase 1 includes the construction of a new arena, adjacent car park with a rooftop coastline park and green walls. A bridge will connect to the north side Oystermouth Road and Swansea Central Phase 2. Phase 2 will incorporate mixed use development to complement the St Mary's and St David's Church and to connect to Whitewalls and Castle Square (via Caer Street).

4.26 In Oxford Street there will be opportunities for urban greening on the Oxford Street School site. There will also be new public spaces, and pockets of public realm in the surrounding streets with opportunities for greening.



Figure 24. Oxford Street



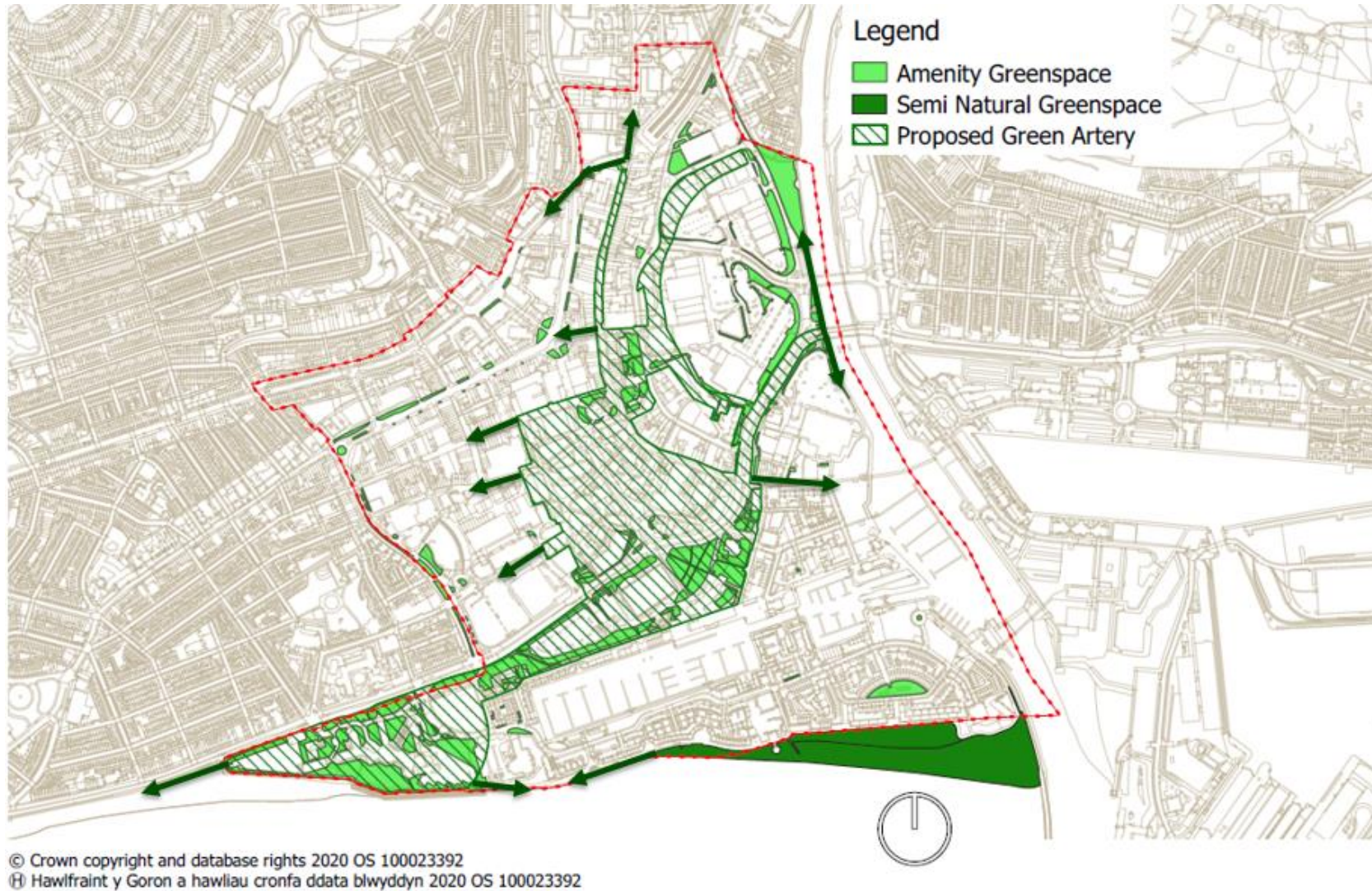


Figure 25. Proposed Green Artery





however there are opportunities to enhance existing urban greening to increase multi-functionality and more biodiverse vegetation. Additional connecting linkages may come forward between High Street and the Strand and Parc Tawe.

4.32 In Parc Tawe, the edge of centre retail park may offer opportunities to green car parks through de-paving and when buildings are re-developed green roofs and green walls can be included in the plans. In the longer term the site could accommodate extensive GI forming part of strategic connections to adjacent areas, and blue (water space) which symbolise the former pre industrial river alignment along the Strand.

4.33 The Civic Centre and City Centre Waterfront sits within a swathe of existing greenspace. In the medium to long term, redevelopment of this area is envisaged with mixed leisure and residential uses set within a layout with a key north/south route which is part of the Green Artery, and which encourages walking and cycling between the central area and the Swansea Bay seafront. Public spaces and thoroughfares in the scheme would provide the opportunity to incorporate rain gardens and street trees offering shade and shelter, and buildings would have the potential to incorporate green walls and roofs.

4.34 In the adjacent Maritime Quarter and its conservation area, there are pockets of street trees, and limited formal landscaped areas within the largely hard-surfaced areas focused around the former South Dock. The Swansea Point dunes are an area of natural habitat and a significant area of GI on the seaward frontage of the Maritime Quarter. There are also several development sites where targeted urban greening can be brought forward as part of future new development, including vacant development sites adjacent to Swansea Point, and the Sailbridge site adjacent to the River Tawe.



Figure 27. Maritime Quarter



## 5 IMPLEMENTATION

### Working Together

- 5.1 GI benefits everybody. Whilst national and local government can coordinate and set direction by producing policies, strategies and guidance, it is important that organisations and individuals who are not traditionally involved with soil, water and vegetation etc. are aware of opportunities for them to contribute. A communication network needs to be developed that promotes partnership working and shares information and experiences through social media, training and events. Time should be taken to acknowledge and celebrate progress (Figure 28).



Figure 28. Planting a rain garden

### Feasibility

- 5.2 All of the urban GI typologies described in this strategy (see Appendix 2) are proven, even though some of the techniques are relatively new in the UK. At ground level, the planting of trees and the provision of ornamental planters is already standard practice in the public realm and private gardens are popular. With proposals submitted for planning permission, applicants would normally expect to be required to include some GI, in line with LDP Policy ER03 and forthcoming Green Infrastructure SPG.
- 5.3 The challenges are to maximise the area of green infrastructure provided, to ensure that as many ecosystem services as possible are provided and to ensure a net gain in biodiversity. Figure 29 illustrates the process required to enable high quality multifunctional GI.

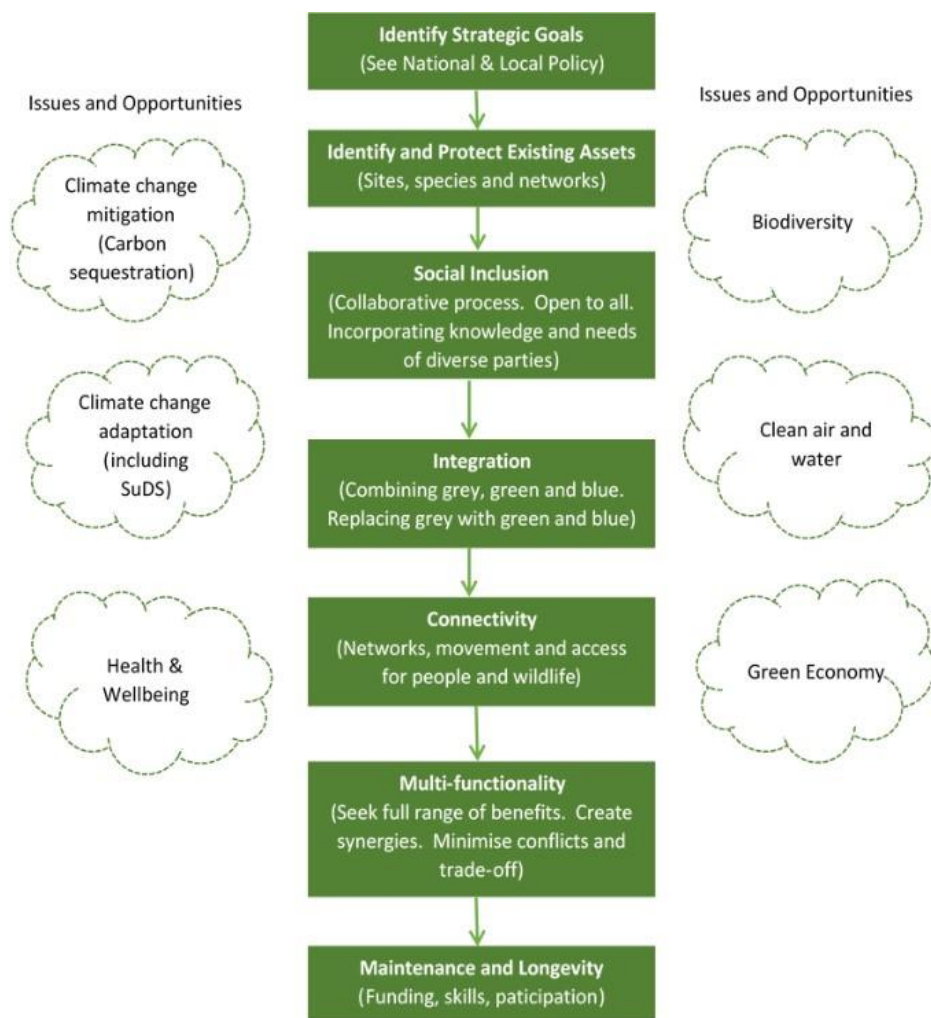


Figure 29. Planning and implementing green infrastructure

<sup>34</sup> Environment Systems (2018) Green Infrastructure Opportunity Mapping and Multi-Scale Delivery. Swansea Castle Ward Case Study

## Impact

- 5.4 GI can play a useful role wherever it is located, however it is often helpful to prioritise particular locations for the most appropriate interventions. The report on Green Infrastructure Opportunity Mapping and Multi-Scale Delivery Swansea Castle Ward Case Study (2018) shows locations where there are demands for reduction in air pollution, standing water and pluvial (surface water) flooding, improvements in water quality and where there is an absence of accessible green space.<sup>34</sup>
- 5.5 This strategy will be strengthened by more a detailed GI audit, to identify issues and opportunities at a smaller scale and include specific proposals which can be taken forward for detailed design and delivery.
- 5.6 Swansea Council will apply the Green Space Factor Tool (GSF tool) in consideration of all development in the Swansea Central Area (see Appendix 3). This is a simple method for measuring the extent and likely effectiveness (in providing various ecosystem services) for various interventions included in project proposals. The Council will use this tool to assess the quantity and quality of GI and may choose to set minimum targets in



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the central area where redevelopment is proposed. Complimentary to this, software that can model microclimates and identify priority areas for the location of GI (including for example Greenpass<sup>35</sup>) can be used by planners and designers of large-scale developments to ensure development maximise their contribution to the strategic objectives.

5.7 The GSF tool is considered the effective measure for assessing how much permeable green space is needed across a development. Natural Resources Wales and Swansea Council see the GSF tool as best practice for planning the enhancement of GI in the central area, delivering the green artery as set out in the Swansea Central Area Regeneration Framework and meeting obligations under Schedule 3 to the Flood and Water Management Act 2010. Natural Resources Wales and Swansea Council expect and encourages developers to use the tool as part of the design and application process.

## Value

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<sup>35</sup> Greenpass - modelling urban green infrastructure for climate change adaptation. See [greenpass.at](http://greenpass.at)

<sup>36</sup> DEFRA & Natural England 2013. Green Infrastructure's contribution to economic growth: A Review

5.8 The challenge of linking the provision of infrastructure to specific economic benefits is not unique to GI. Like all other infrastructure needed to support development, effective GI is essential to support a healthy and economically successful city. GI makes a very important contribution to the attractiveness of the city and neighbourhoods for investors, residents and visitors. This contribution is well described and understood by planners and many developers and increasingly supported through good practice.<sup>36</sup>

5.9 The evidence shows that increasing the attractiveness of an area through investment in high quality multifunctional GI increases inward investment and property values, visitor dwell time and spend, and can reduce the long-term cost burden on public services. Development costs can also be reduced as traditional equivalent grey infrastructure, is often more expensive to design and install. For example the Welsh Government Analysis of the Evidence for SuDS, concludes:<sup>37</sup>

[http://sciencesearch.defra.gov.uk/Document.aspx?Document=11406\\_GI\\_Economic\\_Catalyst\\_Final\\_Report\\_July2013.pdf](http://sciencesearch.defra.gov.uk/Document.aspx?Document=11406_GI_Economic_Catalyst_Final_Report_July2013.pdf)

<sup>37</sup> Welsh Government 2017. Sustainable Drainage Systems on new developments. Analysis of evidence including costs and benefits of SuDS construction and adoption Final Report.

- The overall capital costs of well-designed, good quality landscaped SuDS solutions are always less than those for conventional solutions. In most cases, overall operational and maintenance costs are also lower.
- SuDS are not just an alternative to conventional drainage solutions. They can provide significant and multiple benefits (Figure 30) and have particular potential to help Wales meet well-being and wider sustainability goals. Although the arrangements for the way in which water and surface water systems are managed in Wales has evolved in the last decade and there are still many players with diverse responsibilities, all key stakeholders support the role that SuDS can play in achieving these aims.
- Across the 110,000 new homes planned for Wales by 2021, analysis suggests that the use of landscaped SuDS on new developments that are compliant with required standards could save Wales nearly £1 billion in capital construction costs and generate benefits of over £20 million per year.

5.10 Budgetary constraints and competing cost demands on development schemes mean that greening is often an element that is considered at the end of the design

process and is often scaled back and compromised. Given the proven positive returns on investment from GI, a more positive forward-thinking approach should be applied to GI.

5.11 Now that SuDS are mandatory for new development in Wales, more money will be spent on GI, however it is important that water quality, biodiversity and amenity are fully considered in such schemes, as well as the volume of water being stored or attenuated. Sustainable drainage, the use of the GSF tool and the planning process will require GI to be provided to meet local planning authority requirements. In turn budgets for construction projects should include an allowance so that these new expectations can be met.

5.12 GI is typically a very small proportion of the total cost of construction, and good planning, with the principles set out in this strategy, embedded in schemes at an early stage in the design process, will ensure that GI is given due consideration in any assessment of viability.



“Much has been discussed and documented about the bottom-line benefits of green infrastructure but planting trees, building rain gardens or using porous paving alone are not enough to create sustainable real estate\*. To be truly sustainable, green infrastructure must add value, enhance the occupier experience and be flexible enough to adapt and respond to changing social, economic and technological conditions.”

Professor Yolanda Barnes of the Bartlett, UCL

\* Real estate is defined here as physical land, structures and the resources attached to it, whether man made or natural i.e. built and green / blue (water) infrastructure.

5.9 With place making high on the public and political agendas there is an increasing expectation that real estate / assets contribute to our social, economic and environmental and cultural wellbeing. With rising costs of energy and maintenance eroding capital returns, resilient and sustainable buildings with lower maintenance costs result in a better long-term option for owner occupiers and investors. Therefore increasingly the success of built infrastructure will depend on its interaction with GI investment, the local economy, culture and popular appeal. Placemaking

requires an understanding of the whole-place and a focus on interventions which are not prescriptive, but which encourage innovation and holistic solutions.



Figure 30. SuDS should be multifunctional (Credit: Robert Bray Associates)

### Maintenance

5.10 Greenspace, trees, sustainable drainage features, green roofs and green walls all require regular maintenance. Whenever GI is proposed, a maintenance plan (which identifies responsibilities, purpose, regular upkeep and contingency for remedial measures and budget), should be prepared. As well as the requirement to follow conventional best practice, there should be consideration

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of how ecosystem services can continue to be provided and how biodiversity can be maintained over the long term. There is a need to become more innovative and less conventional in approaches to maintaining GI. For example, the engagement in developing this strategy highlighted a clear and strong desire from local communities to be involved in future maintenance

## **Monitoring**

5.11 Outside of academic research, relatively little information is available on how GI continues to function after installation and how it continues to support habitats and species. Effective monitoring is therefore vital to assessing the effectiveness of the strategy and its implementation. Monitoring will be carried out as part of the Council's Section 6 Duty under the Environment (Wales) Act 2016 every three years and through the Council Wellbeing Objective and Swansea Public Service Board Local Wellbeing Plan. Ideally this will include GI mapping by remote sensing at periodic intervals, with appropriate ground-truthing. The monitoring and evaluation process will be set out in the Strategy's Action Plan.



# APPENDIX 1 – BENEFITS OF GREEN INFRASTRUCTURE



Figure A1.1 Benefits of Green Infrastructure

A1.1 There is a wealth of evidence on the benefits of high quality multifunctional GI to environmental, social, economic and cultural wellbeing as summarised in Figure A1.1. The following paragraphs focus on

some of the benefits more relevant to the Swansea Central Area.

A1.2 Climate change is predicted to increase the frequency and intensity of both heatwaves and heavy downpours<sup>38</sup>. Heavy rain can cause surface water flooding. GI has been shown to reduce the severity of these problems by providing **summer cooling** and by **absorbing rainwater** that might otherwise exacerbate surface water flooding.

A1.3 The Urban Heat Island (UHI) effect occurs when summer sunshine beats down upon the dense materials (including asphalt, concrete, masonry and brick) that make up the built environment. Energy is absorbed into dense materials and is re-radiated at night, which is the main cause of the UHI effect, which can make the centre of a city up to 10 degrees centigrade warmer than its rural hinterland in the middle of a summer day.<sup>39</sup> The UHI effect exacerbates heatwaves and leads to an increase in energy consumption, through the increased intensity

<sup>38</sup> Met Office climate change projections <https://www.metoffice.gov.uk/research/collaboration/ukcp/derived-projections>

<sup>39</sup> EPA on UHI <https://www.epa.gov/heat-islands>

of use of air conditioning. The UHI also exacerbates air pollution and risks to health.

A1.4 The soil, vegetation and water in GI prevents heat islands from developing by **reflecting sunlight** and **providing shade**. Water evaporating from soil and water bodies and transpiring from leaves provides **evaporative cooling**. On hot summer days, the ambient temperature of vegetated areas can be up to 4 degrees centigrade cooler than those areas of the city where there is no vegetation. The difference in surface temperature between conventional roofs and green roofs on hot summer days is even more marked, with the temperature difference often exceeding 20 degrees centigrade.<sup>40</sup>

A1.5 The soil in GI is important as a store of water, which can provide **evaporative cooling**, however soil (whether in the guise of green roofs, tree pits, rain gardens or other planted features) is also important as a **sponge for rainwater** (Figure A1.5), which would otherwise go straight into downpipes and drains, which may be overwhelmed during extreme rainfall events, causing surface water flooding.

<sup>40</sup> GI and the urban heat island  
<http://www.vcccar.org.au/sites/default/files/publications/VCCCAR%20Urban%20Heat%20Island%20-WEB.pdf>

Extensive green roofs, for example, have been shown to absorb the first 5mm of rain that falls upon them. Approximately half of the rain that falls on a typical extensive green roof over the course of a year is retained within the substrate (soil) and subsequently lost through evapo-transpiration.<sup>41</sup> Rain gardens and tree pits at street level can be designed to intercept and **store large volumes of stormwater**.<sup>42</sup>



Figure A1.2. Roof gardens are an effective source control element in sustainable drainage systems

<sup>41</sup> Green roofs rain Livingroofs.org on green roofs and stormwater  
<https://livingroofs.org/storm-water-run-off/>

<sup>42</sup> Rain Garden Guide <https://raingardens.info/wp-content/uploads/2012/07/UKRainGarden-Guide.pdf>



A1.6 The **economic and monetary valuation** of GI is subject to various methods of assessment (necessary because of the wider spectrum of benefits) and the process can be difficult and controversial (because it is argued that some attributes of nature cannot, meaningfully, have a value assigned to them), however some work has been undertaken to place monetary values on GI assets in London. London's public parks have a gross asset value in excess of £91 billion and the GLA estimates that for every £1 invested in parks, Londoners reap £27 in benefits.<sup>43</sup>

A1.7 Another example of the monetary valuation of GI is the iTrees method. This was used to estimate the value of trees in Swansea's River Tawe Catchment (2015), which includes the Swansea Central Area.<sup>44</sup> The study concludes that the trees in the catchment:

- **Intercept** an estimated 252 million litres of water every year, equivalent to an estimated £333,900 in sewerage charges avoided.

- **Remove** an estimated 136 tonnes of **airborne pollutants** each year, worth more than £715,500 in damage costs.
- **Remove** an estimated 3,000 tonnes of carbon from the atmosphere each year, this amount of carbon is estimated to be worth £671,000.
- **Store** an estimated 102,000 tonnes of carbon, estimated to be worth £23.1 million.

A1.8 In addition to these various indirect economic benefits, the planning, design, installation and maintenance of GI is an economic activity in itself. For example, the UK annual expenditure for extensive green roofs, which is centred on London, exceeded £26m for 2017.<sup>45</sup>

A1.9 GI is associated with improved health and wellbeing and the mechanisms for this include:

- **Access** to greenspace whereby people maintain good health through **exercise**.

<sup>43</sup> London Natural Capital Accounts <http://www.vivideconomics.com/wp-content/uploads/2017/11/Natural-Capital-Accounts-Report-GLA-NT-HLF.pdf>

<sup>44</sup> iTrees <https://naturalresources.wales/media/680678/revised-english-wales-urban-canopy.pdf>

<sup>45</sup> London Living Roofs and Walls 2019 [https://www.london.gov.uk/sites/default/files/2019\\_london\\_living\\_roofs\\_walls\\_report.pdf](https://www.london.gov.uk/sites/default/files/2019_london_living_roofs_walls_report.pdf)

- **Exposure** to vegetation and natural features facilitates social interaction, are **calming and inspiring**, lowers stress and improves mental health and wellbeing.
- **Reduction** in pollutants that can cause disease.

A1.10 The evidence for these effects is considered in turn and summarised in the paragraphs that follow.

A1.11 Epidemiological studies have shown that access to nearby greenspace encourages increased physical activity, lowers rates of obesity and lowers morbidity.<sup>46</sup> The reasons for this are complex, however an important factor is that a greener environment increases the prevalence of walking and other physical activity. The importance of exercise in preventative medicine is now being emphasised by health professionals, who recognise that easy, local access to GI is essential if prescriptions for exercise are to be effective.<sup>47</sup>

A1.12 The sight of vegetation, outside as well as inside, lowers stress and blood pressure and helps concentration.<sup>48</sup> **Cognitive development** in children and the recuperation of patients are also reported to be improved when vegetation is visible. Productivity is increased and the symptoms of conditions including Alzheimer’s disease, dementia, depression and ADHD (Attention Deficit Hyperactivity Disorder) may be alleviated.<sup>49</sup> This was reflected in the engagement findings for this strategy; with emotional benefits of green spaces in the city centre a clear theme for residents and visitors of all ages (see Figure A1.3 and A1.4). GI can be very important in child development. Research in Barcelona, using brain imaging techniques, which compared children growing up in areas without vegetation with children in areas with vegetation, found that children in the areas with vegetation had beneficial structural changes in their brains, which were permanent.<sup>50</sup>

<sup>46</sup> Links between natural environment and health  
<http://eprints.gla.ac.uk/4767/1/4767.pdf>

<sup>47</sup> Walking for Health <https://www.walkingforhealth.org.uk/>

<sup>48</sup> Chang, C.Y., and P.K. Chen. 2005. Human Response to Window Views and Indoor Plants in the Workplace. *Hortscience* 40, 5: 1354-59

<sup>49</sup> Nature and mental health

[https://depts.washington.edu/hhwb/Thm\\_Mental.html](https://depts.washington.edu/hhwb/Thm_Mental.html)

<sup>50</sup> <https://www.childinthecity.org/2018/03/28/childhood-exposure-to-green-space-may-help-brain-development/?gclid=...>





A1.15 Health is impacted by poor air quality. Air pollutants of particular concern in cities are particulates and nitrogen dioxide. In Wales, more specifically, for the latest year for which data are available (2017), the long-term mortality burden attributable to air pollution (fine particulate matter and nitrogen dioxide combined) is an estimated effect equivalent to 996 to 1,417 deaths.<sup>53</sup> The vegetation that makes up GI has been shown to improve air quality by filtering particulates and absorbing gases. Studies have shown that planting on buildings in street-canyons reduces street-level concentrations by as much as 40% for nitrogen dioxide and 60% for particulate matter.<sup>54</sup>

A1.16 The various benefits provided by GI combine to provide economic benefits in terms of energy savings, fewer insurance claims (for example, after flooding), fewer working days lost, preventative health measures, reductions in crime, increased productivity, increased property values, increased footfall for businesses and increased inward

investment. The health benefits of urban GI, in terms of reductions in provision by the health service are estimated at £2.1 billion in the UK.<sup>55</sup>

A1.17 Opportunities for **local food production**, in allotments, community gardens and orchards or even through temporary projects, increases access to healthy, locally sourced and distinctive food and provides education and training opportunities. It also contributes to **food security** and reconnects communities with their local environment. One example is 'Vetch Veg'<sup>56</sup>, located at Swansea City's former football ground (Figure A1.5). This green oasis in the middle of an urban area has enhanced the community spirit, has people sharing experiences, swapping recipes and tasting and sampling new dishes. This reflects the diverse cultures of Swansea.

A1.18 Another example is the Swansea Community Green Spaces project to create green spaces for social interaction and cohesion including the site at Seaview Green Space, Mount Pleasant. This is a

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<sup>53</sup> Public Health Wales on air pollution [https://public.tableau.com/views/Nationallong-termannualairpollutionconcentrationsanthropogenicandmortalityburdenranges/Dashboard1?:embed=y&:displaycount=yes&:publish=yes&:origin=viz\\_share\\_link](https://public.tableau.com/views/Nationallong-termannualairpollutionconcentrationsanthropogenicandmortalityburdenranges/Dashboard1?:embed=y&:displaycount=yes&:publish=yes&:origin=viz_share_link)

<sup>54</sup> GI and air quality in street canyons <https://pubs.acs.org/doi/abs/10.1021/es300826w>

<sup>55</sup> Health and GI: Evidence of benefits <http://nhsforest.org/evidence-benefits>

<sup>56</sup> Veg Vetch, Swansea <http://www.vetchveg.co.uk/>



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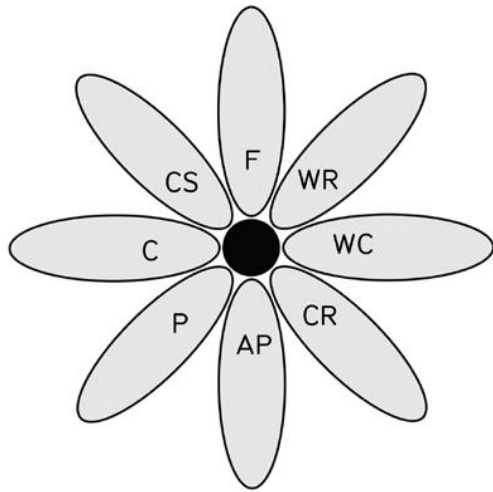
food growing project working with asylum seekers and refugees, in collaboration with the African Community Centre. It has encouraged local residents to become involved by actively engaging with people passing by. As a result, the community have formed their own successful growing project and have leased the site from the Council. This project has contributed to bringing the community together and has improved the physical and mental wellbeing of individuals.



Figure A1.5. Vetch Veg (Credit: Kathryn Campbell Dodd)

## APPENDIX 2 – URBAN GREEN INFRASTRUCTURE TYPOLOGIES


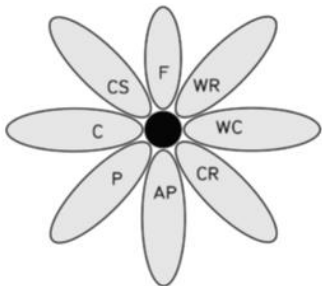

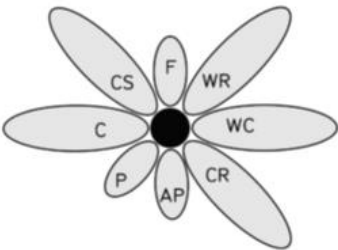
A2.1 This Appendix describes the range of urban GI types referred to in the Green Space Factor tool and to consider the ecosystem services (benefits) that are likely to be provided. It is not intended to be encyclopaedic (other types and features are available) and does not consider the biodiverse sub-types included in the Swansea Green Space Factor scoring system.


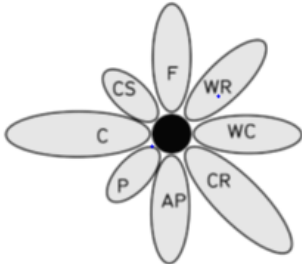

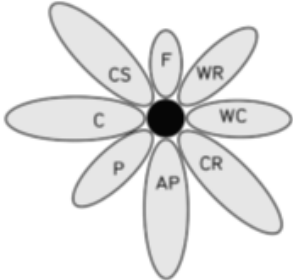


Petal Diagram Key	
F	Food
WR	Water Regulating
WC	Water Cleansing
CR	Climate Regulation
AP	Air Pollution Abatement
P	Pollination
C	Culture
CS	Carbon Sequestration

A2.2 Each petal represents a different category ecosystem service provided by the GI type. The size of the petal gives an approximate measure of the relative strength of that ecosystem service.



Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
Semi-natural vegetation (e.g. woodland flower-rich grassland)	Although unusual to have semi-natural vegetation with native species in urban areas, this can occur and is desirable in terms of biodiversity and the range and ecosystem services provided. An example is the sand dune habitat close to the river mouth as well as woodland associated with the Tawe River corridor.			High	1
Wetland and open water created on site	Usually limited opportunities in open areas, however extremely valuable where it does occur			High	1


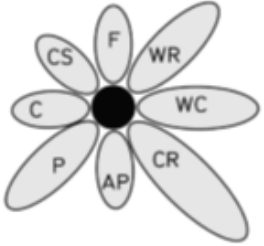

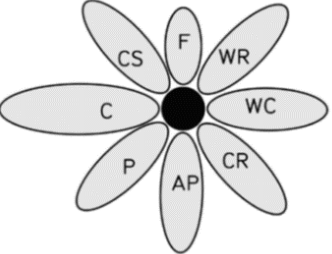
Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
Intensive green roof or vegetation over structure. Vegetated sections only. Substrate minimum settled depth of 150mm. See <a href="http://livingroofs.org.uk">livingroofs.org.uk</a> for descriptions <sup>57</sup>	Extremely variable, important amenity space in locations where greenspace may be limited. Biodiversity can be boosted by following wildlife gardening advice. <sup>58</sup>			Low - Moderate	0.8
Standard trees planted in natural soils or in connected tree pits with a minimum soil volume equivalent to at least two-thirds of the projected canopy area of the mature tree - see <a href="http://www.tdag.org.uk/trees-in-hard-landscapes.html">Trees in Hard Landscapes</a> for overview. <sup>59</sup>	Important that tree pits are designed to receive surface water run-off by using soil cells or Stockholm tree pits. Biodiversity value will depend on species selection.			Low - High	0.8

<sup>57</sup> <https://livingroofs.org/intensive-green-roofs/>

<sup>58</sup> <https://www.wildlifetrusts.org/gardening> and <https://www.rspb.org.uk/birds-and-wildlife/advice/gardening-for-wildlife/>


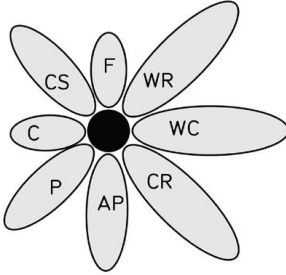

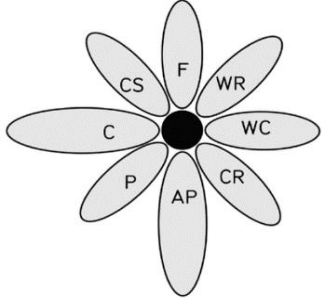
<sup>59</sup> <http://www.tdag.org.uk/trees-in-hard-landscapes.html>



Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
Extensive green roof with substrate of minimum settled depth 80mm (or 60mm beneath vegetation blanket) – meets the requirements of GRO Code 2014. <sup>60</sup>	Essential that adequate substrate depth is provided to absorb rainfall and store water for subsequent evapo-transpiration. Biodiversity value will depend on species selection.			Moderate - High	0.7
Flower-rich perennial planting – see Centre for Designed Ecology. <sup>61</sup>	Can include species to attract pollinating insects.			Moderate	0.7

<sup>60</sup> <https://livingroofs.org/wp-content/uploads/2016/03/grocode2014.pdf>


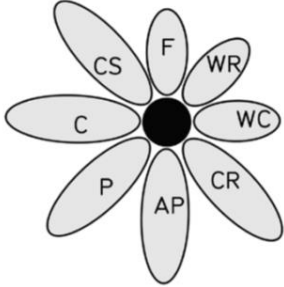

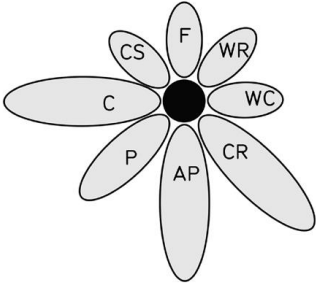
<sup>61</sup> <https://cfde.co.uk/front-page/about/case-studies/>

Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
<p>Rain gardens and other vegetated sustainable drainage elements – See CIRIA for case studies.<sup>62</sup></p>	<p>Careful design required to ensure levels are correct, that soil has been amended to be free-draining and water-absorbent and that overflow route is created in event that capacity of rain garden is exceeded. Biodiversity value will depend on size and planting palette.</p>			<p>Moderate - High</p>	<p>0.7</p>
<p>Hedges (line of mature shrubs one or two shrubs wide) – see RHS for guidance<sup>63</sup></p>	<p>Hedge should be large enough (width and height) to provide cover for nesting birds. Value for larvae food plants will be increased if native species are used.</p>			<p>Moderate - High</p>	<p>0.6</p>


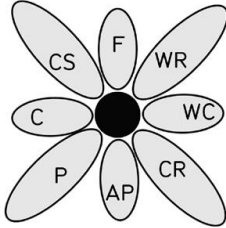

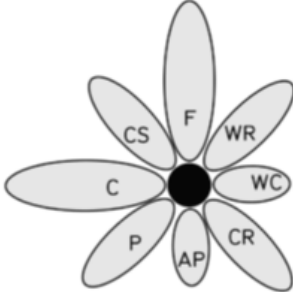
<sup>62</sup> <http://www.susdrain.org/>

<sup>63</sup> <https://www.rhs.org.uk/advice/profile?pid=351>




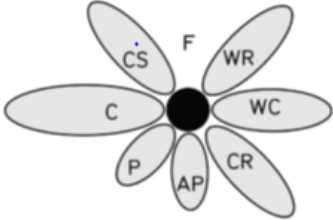

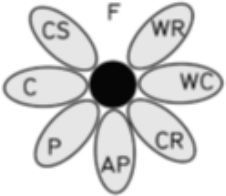
Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
<p>Standard trees planted in pits with soil volumes less than two thirds less than the projected canopy area of the mature tree.</p>	<p>Ideally larger tree pits will be used, however sometimes available space is limited. Biodiversity value depends on species selection.</p>			<p>Low - Moderate</p>	<p>0.6</p>
<p>Green wall – modular system or climbers rooted in soil – see NBS Guide to Façade Greening for overview.<sup>64</sup></p>	<p>Wide range of systems and planting methods. Wherever possible should use climbers rooted in soil. Where irrigation is required harvested rainwater should be used if feasible. Biodiversity value will depend on plant species selection.</p>			<p>Moderate - High</p>	<p>0.6</p>

<sup>64</sup> <https://www.thenbs.com/knowledge/the-nbs-guide-to-facade-greening-part-two>


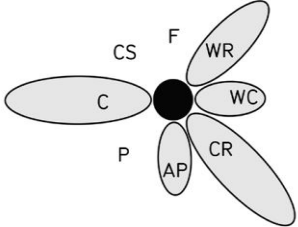

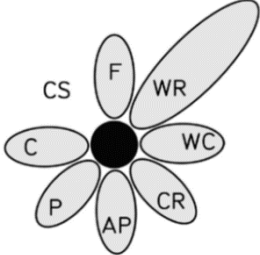
Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
Groundcover planting – see RHS Groundcover Plants for overview <sup>65</sup>	Wherever feasible, planter beds should be designed to receive surface-water run (see rain garden). Planting should be native or of documented value for wildlife in order to maximise biodiversity value.			Low - Moderate	0.5
Allotments or raised beds for food growing	Although growing food is the main focus, consideration should be given to providing flowers for pollinating insects and avoiding the use of biocides that harm wildlife			Low – Moderate	0.5

<sup>65</sup> <https://www.rhs.org.uk/advice/profile?PID=818>


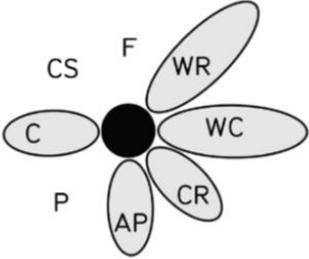




Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
Amenity grassland (species-poor, regularly mown lawns)	This is the default vegetation type with urban greening (often combined with tree planting). Unless there is a specific requirement for a lawn for amenity or recreational purposes, this should be avoided. Where possible, lawns should be planted with a range of low-growing wild flowers (e.g. birds foot trefoil) to attract pollinating insects.			Low - Moderate	0.4
Extensive green roof of sedum mat or other lightweight systems that do not meet GRO Code 2014. <sup>66</sup>	To be avoided			Low	0.3

<sup>66</sup> <https://livingroofs.org/wp-content/uploads/2016/03/grocode2014.pdf>

Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
Open water (chlorinated)	Although this feature may form part of an amenity landscape, it receives a low GSF score because of its low biodiversity value. Most important ecosystem services are cultural (aesthetic, recreational) and evaporative cooling			Low	0.2
Unplanted detention basins	Although this feature may form part of a sustainable drainage system, it receives a low GSF score because of its low biodiversity value.				



Urban Green Infrastructure type	Comments	Image	Ecosystem Services	Biodiversity Value	GSF Score
Permeable paving - see CIRIA for overview <sup>67</sup>	Although this feature may form part of a sustainable drainage system, it receives a low GSF score because of its low naturalness/biodiversity value.			Low	0.1
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone)	Sealed surface should be avoided unless there is a requirement for hard wearing surfaces or smooth surfaces for cycles, wheelchairs etc.			Negligible	0
Bird boxes, bat boxes, bug hotels etc	Although these are not landscape typologies, applicants will be encouraged to include these features in their plans.			High	N/A

<sup>67</sup> <http://www.susdrain.org>

# SWANSEA CENTRAL AREA GREEN SPACE FACTOR TOOL



## A3.1 INTRODUCTION

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- A3.1.1 Green Space Factor (GSF) tools are used by planners, designers and planning authorities to make an assessment of the quantity and functionality of green infrastructure included in planning applications.
- A3.1.2 Planting types within a site are measured and scored, and an overall score for a site (between 0 and 1) is calculated. A minimum target for a scheme to meet can be set. (See section 2 for more details of how the measurements are undertaken).
- A3.1.3 GSF schemes have been applied in a number of cities around the world, beginning with Berlin in the 1990s. Similar schemes spread to other German cities (including Hamburg) and then overseas, including Sweden (Malmö), the United States (including Seattle and Washington DC) and Canada (Toronto). The City of Southampton was the first UK planning authority to develop a GSF scheme. A partnership led by the Red Rose Forest developed a GI Toolkit based on a GSF approach for England's North-West region in 2008. More recently the Greater London Authority has proposed the use of a GSF scheme as part of its urban greening policy in the draft New London Plan<sup>68</sup>. The City of London was the first local planning authority in London to promote the approach.<sup>69</sup>
- A3.1.4 Swansea Central Area is undergoing significant re-development and there is growing awareness of, and an associated body of evidence for, the multiple benefits of GI, including measurable net positive impacts on physical health and mental wellbeing. Swansea Council and Natural Resources Wales are committed to realising these benefits. It is also the case that GI will have a critical role in improving the City's capacity to adapt to climate change.
- A3.1.5 Natural Resources Wales, Swansea Council and Green Infrastructure Consultancy have developed a GSF tool. It assists developers and planners to determine the appropriate level of urban greening required for development in the Swansea Central Area, in order to achieve the vision set out in the Swansea Central Area Regeneration Framework (SCARF) and the Swansea Central Area Regenerating Our City for Wellbeing and Wildlife Strategy. Multifunctionality is illustrated in the Appendix 2 petal diagrams, designed to demonstrate

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<sup>68</sup> <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/draft-new-london-plan/chapter-8-green-infrastructure-and-natural-environment/policy-g5>

<sup>69</sup> <https://www.architectsjournal.co.uk/news/all-schemes-in-square-mile-to-include-urban-greening-under-new-20-year-plan/10036754.article>

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the contribution of GI typologies. The more balanced and larger the petals the more effective and multifunctional the GI type is.

A3.1.6 Natural Resources Wales and Swansea Council are committed to using this GSF tool as a way of increasing the quantity and quality of green infrastructure in the Swansea Central Area with a special emphasis on schemes that contribute to the establishment of a 'Green Artery'. There are numerous opportunities to add greenery to new buildings and refurbished buildings, and where options to add more vegetation to certain buildings (e.g. Listed Buildings) may be limited, the tool can still be used to ensure all opportunities are explored.

A3.1.7 The GSF will be used as a planning tool and to facilitate pre-application discussion. It is to be used in combination with the Council's Local Development Plan (LDP) and the suite of Supplementary Planning Guidance (SPG) documents relating to amenity, GI and biodiversity. The tool will also help developers to demonstrate how they are integrating Sustainable Urban Drainage (SuDS) into their schemes. SuDS is now required by legislation.

A3.1.8 Whilst it will not be compulsory for the GSF tool to be applied to all proposals within the Swansea Central

Area, applicants are expected to submit a GSF calculation in support of their plans. Where a GSF calculation is not provided applicants will need to provide extensive evidence demonstrating how the application meets the vision of the Green Infrastructure Strategy and supporting legislation. GSF scores may be calculated for application sites, buildings, buildings and their ground-level curtilage or street-level public realm for new building and refurbishment.

A3.1.9 The benefits of the GSF tool include:

- Increase in the use of multifunctional green infrastructure features.
- Urban greening on restricted sites.
- A simple calculation mechanism, easily understood by non-specialists.
- Facilitation of conversations between developers and planners.
- Flexibility: scores and targets can be adjusted to reflect specific priorities.

A3.1.10 GSF schemes are part of a response to the problems associated with the increasing density of cities. They are usually applied in locations that tend to be dominated by high density zones or districts like Swansea Central Area. Areas where large-scale



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urban renewal is planned, where rapid development is expected, or where there are particular problems including, for example, biodiversity losses, surface water flooding exacerbated by inappropriate development. Achieving a satisfactory GSF score in developments with limited or no ground level greenspace (where a building covers most or all of a site) will normally require green roofs and green walls to be included.

A3.1.11 Conventional GI planning is characterised by ground-level mapping that usually overlooks the potential to green the roofs, terraces and facades of buildings. With high-rise developments with green roofs and walls located on multiple levels and aspects it will be increasingly important that not only GSF schemes, but all policies related to GI, biodiversity and climate change adaptation, take account of the challenges and opportunities associated with denser developments and taller buildings.

A3.1.12 Depending on how they are embraced, GSF schemes encourage developers to obtain more specialist advice (usually from landscape architects) in order to ensure that their plans meet the local community and the planning authority's expectations for GI improvements. With most GSF schemes, the

purpose is easily explained and understood and the calculation of the overall score using the tool is a relatively straightforward and inexpensive process. Schemes allow flexibility with respect to plot layout and landscape design and are not prescriptive. Scores for particularly desirable features can be increased in order to encourage use.

A3.1.13 GSF schemes may be perceived as an unnecessary additional administrative burden. This is more likely to be the case in cities, like those in the United States for example, where the attainment of a particular score is a pre-requisite of the permitting process. It will consequently be considered unacceptable for fragile landscape features (like intensive green walls for example) to be included in plans for the purpose of meeting a target, without appropriate controls to prevent those features subsequently failing if not properly installed or maintained. It should be noted that artificially engineered features tend to require more maintenance and are more vulnerable to failure than retained existing features or more traditional planting in natural soils.

A3.1.14 Although scoring schemes are relatively simple, the score assigned to any particular surface cover may vary from city to city and the assignment of a

particular score to a particular landscape treatment can be subject to debate. There is the potential for low quality features (for example green roofs with inadequate substrate depth) to be used to formulate unsatisfactory schemes that meet the target score. These difficulties can be overcome by providing good definitions and accurate descriptions of the various types of surface cover. If necessary, scoring schemes can be reviewed to address persistent shortcomings.

A3.1.15 GSF schemes have been confused with certification or benchmarking methods designed to measure the sustainability or environmental performance of developments. BREEAM, for example, which assesses the sustainability of building and infrastructure projects, includes five assessment categories included under the themes of landscape and ecology.<sup>70</sup> These categories are: site selection; ecological value of sites and protection of ecological features; mitigating ecological impact; enhancing site ecology and long-term impact on ecology. In contrast with the GSF calculation process, these BREEAM assessments require detailed baseline surveys, calculations and reports, which must be undertaken by suitably qualified persons. BREEAM schemes

may also incur substantial costs. Although BREEAM is a valuable way of measuring environmental performance and encouraging designers to strive for excellence, it has not been devised as a tool for planners and could not be readily applied to the task of improving GI provision across entire planning zones or neighbourhoods.

A3.1.16 Potential issues (depending on how a GSF scheme is implemented) can include the following:

- given that a GSF calculation determines only the quantum of broadly described categories, the design quality of each treatment cannot be assessed in detail.
- there is a possibility of the GSF scheme being too rigidly interpreted, with proposals meeting, but not exceeding, targets.
- Not promoting green roof and green walls could result in insufficient GI being created in schemes with tall buildings and a small ground-level curtilage.

A3.1.17 In light of these issues, it will be essential to be clear and precise about how a GSF scheme relates to the full suite of policies that influence greenspace planning and design. The GSF tool is the

<sup>70</sup> <http://www.breeam.com/>



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assessment tool promoted by Swansea Council and Natural Resources Wales. However, it will not be the sole method of assessing GI proposed as part of a development scheme and cannot be a replacement for good design. The GSF tool should be seen to complement and help deliver policies and standards on, urban greening, wellbeing, biodiversity and climate change adaptation, including summer cooling and sustainable drainage.

## A3.2 SWANSEA CENTRAL AREA GREEN SPACE FACTOR TOOL

A3.2.1 The Swansea Green Space Factor (GSF) tool is aimed primarily at new developments and refurbishments. It can be used to establish a baseline for retrofit projects and used to measure the associated improvements. Minimum target scores will be an expectation and will be as follows:

- 0.3 for predominantly commercial developments, and
- 0.4 for predominantly residential developments.

A3.2.2 These scores are based on experience of successful GSF schemes and will drive up standards. The scores can be increased in the future where there is the potential for further gains, as well as an appetite, to extend the scheme. GSF scores may be calculated for application sites, buildings, buildings and their ground-level curtilage or street-level public realm. Designs for taller buildings can easily meet the 0.3/0.4 target scores by including green roofs and green walls or by vegetating balconies and other features on upper floors.

A3.2.3 The tool should be used from the conception, setting the tone of the scheme. For example, for schemes going through the RIBA stages, the tool should be used from RIBA Stage 0 and be revised and amended throughout the process.

A3.2.4 In calculating an overall GSF score for any given proposed development it is necessary to measure the overall area of the site and then to map and measure the coverage of various surface cover types within the site (see Figure A3.1). Surface covers include sealed surfaces, permeable paving, amenity grassland, trees and shrubs, extensive green roofs, roof gardens and green walls.

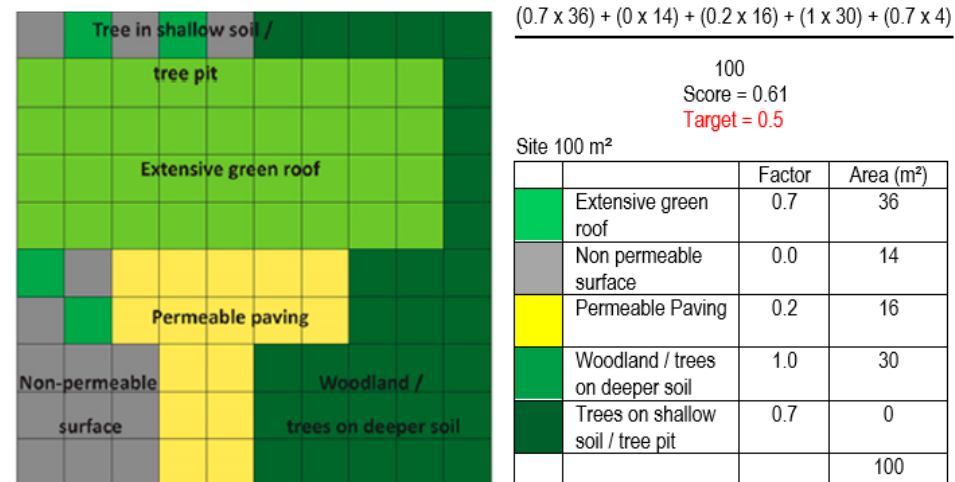


Figure A3.1. Diagram of simplified theoretical development site to demonstrate how the GSF works (modified from Southampton City Councils Guidance notes)

A3.2.5 Once the various parcels have been measured and categorised, then the total coverage of each surface

cover can be quantified. Scores are then assigned to each surface cover. Then the calculation of the overall green space factor can begin. The score for each surface cover within a site is multiplied by its area. This generates a series of figures which are then added together. This new total is then divided by the site area to give an overall GSF score (as set out in Figure A3.2).

A3.2.6 Figure A3.1 and A3.2 show a theoretical square development site of 100 square metres, explaining how the site has been analysed in terms of surface cover and areas of each type.

$$\frac{(\text{Score A} \times \text{Area}) + (\text{Score B} \times \text{Area}) + (\text{Score C} \times \text{Area}) + (\text{Score D} \times \text{Area}) \text{ etc.}}{\text{Total Site Area}}$$

Figure A3.2 Calculation for GSF score

A3.2.7 A completed GSF tool score spreadsheet should be submitted in support of an application (such as SuDS or planning applications).

A3.2.8 Scores are assigned according to the rate of infiltration of rainwater for each landscape element in a development.<sup>71</sup> This basis in infiltrations highlights that the GSF tool is useful in demonstrating compliance with the Welsh Government statutory SuDS Standard 2019.

A3.2.9 In effect, scores are a simplified measure of the various benefits (ecosystem services) provided by soils, vegetation and water and are usually assigned on the basis of potential for rainwater infiltration. This is because the water-holding capacity of surface cover and associated soil is a good proxy for their ability to provide the range of benefits associated with natural systems.

A3.2.10 Ecosystem services provided by urban landscapes include supporting services, provisioning and cultural services (particular therapeutic benefits), however there is a special interest in regulating services (notably climate regulation and the cleaning of water and air). Scores between 0 and 1 (in increments of 0.1) are allocated to each surface cover type, with impermeable surfaces such as concrete and asphalt

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[http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index\\_en.shtml](http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/bff/index_en.shtml)



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assigned a score of 0 and the most natural surface cover such as open water/trees or woodland on deeper soils, awarded a score of 1. (See Table A3.1) listing all types between 1 and 0) The scoring system takes into account existing land cover, encourages retention of existing natural features and requires an overall increase in score compared with the existing condition. The performance requirements for surface cover types are not prescribed

A3.2.11 Table A3.1 lists the surface cover type and their corresponding scores for the Swansea Central Area and should be used to achieve the overall score. It covers most eventualities, however, if a surface cover type is encountered which is not listed, it should be assigned the same score as the category in the figure that is most functionally similar. An increase in scoring is specified for biodiverse versions of landscape typologies, in order to encourage efforts to ensure net gain/ benefit in biodiversity value.

### A3.3 REVIEW OF GREEN SPACE FACTOR SCHEMES

Surface Cover Type	Score
Semi-natural vegetation (e.g. woodland, flower-rich grassland) created on site	1
Wetland or open water (semi-natural; not chlorinated) created on site	1
Biodiverse intensive green roof or vegetation over structure. Vegetated sections only. Substrate minimum settled depth of 150mm – See livingroofs.org for descriptions. <sup>72</sup> Planting to be with native species and/or species with documented value for biodiversity.	0.9
Intensive green roof or vegetation over structure. Vegetated sections only. Substrate minimum settled depth of 150mm – See livingroofs.org for descriptions. <sup>73</sup>	0.8
Standard trees planted in natural soils or in connected tree pits with a minimum soil volume equivalent to at least two-thirds of the projected canopy area of the mature tree -see Trees in Hard Landscapes for overview. <sup>74</sup>	0.8
Biodiverse extensive green roof with substrate of minimum settled depth 80mm (or 60mm beneath vegetation blanket) – meets the requirements of GRO Code 2014. <sup>75</sup> For advice on attracting invertebrates to extensive green roofs see BugLife. <sup>76</sup>	0.8
Biodiverse rain gardens and other vegetated sustainable drainage elements – See CIRIA for case studies. <sup>77</sup> Planting to be with native species and/or species with documented value for biodiversity.	0.8
Extensive green roof with substrate of minimum settled depth 80mm (or 60mm beneath vegetation blanket) – meets the requirements of GRO Code 2014. <sup>78</sup>	0.7
Flower-rich perennial planting – see Centre for Designed Ecology. <sup>79</sup>	0.7
Rain gardens and other vegetated sustainable drainage elements – See CIRIA for case studies. <sup>80</sup>	0.7
Biodiverse green wall – modular system or climbers rooted in soil – see NBS Guide to Façade Greening for overview. <sup>81</sup>	0.7
Native hedges (line of mature native shrubs one or two shrubs wide)	0.7
Hedges (line of mature shrubs one or two shrubs wide) – see RHS for guidance <sup>82</sup>	0.6

<sup>72</sup> <https://livingroofs.org/intensive-green-roofs/>

<sup>73</sup> <https://livingroofs.org/intensive-green-roofs/>

<sup>74</sup> <http://www.tdag.org.uk/trees-in-hard-landscapes.html>

<sup>75</sup> <https://livingroofs.org/wp-content/uploads/2016/03/grocode2014.pdf>

<sup>76</sup> [https://www.buglife.org.uk/sites/default/files/Creating%20Green%20Roofs%20for%20Invertebrates\\_Best%20practice%20guidance.pdf](https://www.buglife.org.uk/sites/default/files/Creating%20Green%20Roofs%20for%20Invertebrates_Best%20practice%20guidance.pdf)

<sup>77</sup> <http://www.susdrain.org/>

<sup>78</sup> <https://livingroofs.org/wp-content/uploads/2016/03/grocode2014.pdf>

<sup>79</sup> <https://cfde.co.uk/front-page/about/case-studies/>

<sup>80</sup> <http://www.susdrain.org/>

<sup>81</sup> <https://www.thenbs.com/knowledge/the-nbs-guide-to-facade-greening-part-two>

<sup>82</sup> <https://www.rhs.org.uk/advice/profile?pid=351>

Surface Cover Type	Score
Standard trees planted in pits with soil volumes less than two thirds less than the projected canopy area of the mature tree.	0.6
Green wall – modular system or climbers rooted in soil – see NBS Guide to Façade Greening for overview. <sup>83</sup> 0.6 Native groundcover planting	0.6
Groundcover planting – see RHS Groundcover Plants for overview <sup>84</sup>	0.5
Species-rich lawns (species-rich – with at least 5 species of low-growing wildflowers - regularly mown lawns)	0.5
Allotments or raided beds for food growing (exclude paved areas)	0.5
Amenity grassland (species-poor, regularly mown lawns)	0.4
Extensive green roof of sedum mat or other lightweight systems that do not meet GRO Code 2014. <sup>85</sup>	0.3
Open water (chlorinated)	0.2
Unplanted detention basins 0.2 Permeable paving - see CIRIA for overview <sup>86</sup>	0.1
Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone)	0

Table A3.1. Swansea Central Area GSF

A3.3.1 GSF schemes are well established - they have been used in various countries and cities in Europe and North America for more than 20 years. The following examples show the history, range, type and success of GSF schemes.

A3.3.2 City of Berlin - has operated the Biotop Flächenfaktor or Biotope Area Factor (BAF) since 1994. The BAF is applied, in combination with Landscape Plans, in a number of Berlin's inner-city neighbourhoods. Landscape Plans address spatial

issues and opportunities and the BAF ensures that adequate green space is provided within each development parcel. BAF targets are adjusted according to land use, with sites with educational use, for example, requiring the highest scores. Minimum scores for sites within neighbourhoods covered by the scheme vary between 0.3 and 0.6. Problems with surface water flooding and an overall lack of green space were the catalysts for the BAF initiative, and surface cover types are assigned scores (between 0 for impermeable surfaces and 1 for vegetated surfaces completed connected with the

<sup>83</sup> <https://www.thenbs.com/knowledge/the-nbs-guide-to-facade-greening-part-two>

<sup>84</sup> <https://www.rhs.org.uk/advice/profile?PID=818>

<sup>85</sup> <https://livingroofs.org/wp-content/uploads/2016/03/grocode2014.pdf>

<sup>86</sup> <http://www.susdrain.org>



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soil below) based on their ability to infiltrate, store and evaporate water. The BAF is viewed positively by city planners, architects and developers, who have praised its simplicity and flexibility, however, it is recognised that it cannot be used to assess the environmental impact of a scheme.

A3.3.3 Malmö, Sweden - A complex GSF scheme was trialled in 2001 in a new residential development in the post-industrial Western Harbour area of Malmö. The original purpose was to ensure that adequate green space was provided on every plot and that sealed surfaces were minimised. A minimum score of 0.5 was set. The quality of some development did not match the planning authority's expectations so the scheme was subsequently revised to include a Green Points System. The system was designed to improve the quality of landscape design and to encourage the inclusion of features that increase biodiversity. The scheme is now being applied to a wider area within Malmö as well as the neighbouring town of Lund.<sup>87</sup>

A3.3.4 Seattle, USA – Seattle, in the State of Washington, adopted a GSF scheme in 2006 and expanded it in 2009. It was modelled on the Berlin BAF. The three priorities of

Seattle's scheme were: live-ability; ecosystem services; and climate change adaptation. As with other schemes, Seattle's has a catalogue of landscape elements, each with its own score, and a requirement for project proposals to meet a minimum overall score. Minimum scores vary according to zones, with residential zones requiring the highest scores and commercial and industrial areas, lower scores. To qualify for certain scores, landscape features must comply with detailed standards set by the city. For example, bio-retention facilities must include adequate soil volumes.<sup>88</sup> Increased diversity of planting is also encouraged. The scheme includes a provision for bonus credits for drought tolerance, irrigation with harvested rainwater, landscape features visible to passers-by and food cultivation. For a scheme to be awarded a score, it must be submitted with a landscape plan and landscape management plan and submitted by a licensed landscape professional. A landscape professional must also verify that the landscape scheme has been installed in conformance with the approved plan. Since the scheme was adopted, Seattle's Department of Planning and Development has noted higher quality and better-integrated landscape design, with increased use of permeable paving, green roofs, and green walls.

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<sup>87</sup> Annika Kruuse (2011) GRaBS Expert Paper 6 the green space factor and the green points system

<sup>88</sup> City of Seattle (2015) Director's Rule 30-2015: Standards for Landscaping, including Green Factor

A3.3.5 Washington DC, USA – Washington DC has the Green Area Ratio (GAR).<sup>89</sup> It was introduced in 2013 and revised in 2016 and is very similar to the Seattle scheme. It has been established by regulation and applies to all applications for building permits for new buildings and major renovations (with a few exemptions). The satisfactory implementation of a landscape scheme, that has met the minimum GAR score, must be demonstrated by a Certified Landscape Expert, before a certificate of occupation may be granted. The scheme gives high scores for trees (measured by canopy size), intensive green roofs and the conservation of existing soil. Target scores vary according to planning zones, with differentiation between residential, mixed use and downtown (city-centre) areas.

A3.3.6 Helsinki, Finland - Helsinki considered a GSF scheme as part of its Climate-Proof City – Tools for Planning (ILKKA) project (2012-2014).<sup>90</sup> The approach was to test the operation of a tool and to use the tool to assess design options in two new development sites (Kuninkaantammi and

Jätkäsaari). A unique scoring system was developed by a panel of local experts. Issues considered were ecology, functionality, amenity and maintenance, with the ecological and functional goals prioritised over amenity and maintenance. Minimum scores were set for various land use classes, including residential (0.5), office (0.4), commercial (0.3) and industrial/logistics (0.2), with an expectation that higher targets would be met. These targets reflect the typical differences in the extent of greenspace provided within these development types in Helsinki.

A3.3.7 Singapore – Singapore, which has promoted the ‘City in a Garden’ vision, has explored a Green Plot Ratio (GnPR), which measures overall leaf area and compares this with site area. Typical leaf area indices for trees, palms, shrubs and grasses are used in the calculations and it is hoped that the intention is for the GnPR approach to assist in evaluating green infrastructure on tall buildings.<sup>91</sup> Singapore has also been at the forefront of promoting green roofs and green walls on tall buildings through its Skyrise Greenery scheme of

<sup>89</sup> Washington DC zoning codes <http://handbook.dcoz.dc.gov/> and map <http://maps.dcoz.dc.gov/zr16/map.html#!=14&x=8565251.4999999998&y=4709970.999999999&mms=18!26!21!24!22!19!4!8!1!2&dcb=0>

<sup>90</sup> [http://ilmastotyokalut.fi/files/2014/11/Developing\\_Helsinki\\_Green\\_Factor\\_Summary\\_13032014.pdf](http://ilmastotyokalut.fi/files/2014/11/Developing_Helsinki_Green_Factor_Summary_13032014.pdf)

<sup>91</sup> <http://global.ctbuh.org/resources/papers/download/286-greening-the-urban-habitat-singapore.pdf>

incentives and awards.<sup>92</sup> Singapore is also noted for promoting high-rise bridges and gardens, which provide opportunities to exercise and relax without descending to the ground (e.g. the Pinnacle@Duxton skybridge).<sup>93</sup>

A3.3.8 London - The Greater London Authority (GLA) included the Urban Greenspace Factor (UGF) tool as part of its Urban Greening policy in the draft New London Plan.<sup>94</sup> The UGF tool follows the approach first developed in Berlin, with some uplift of scores to encourage good quality green roofs and larger tree pits. Following on from the approach advocated by the GLA, the City of London's planning department has endorsed the use of a GSF tool as part of its approach to urban greening. Urban greening is now part of its draft City Plan 2036.<sup>95</sup>

A3.3.9 Southampton - Using a GSF tool is a requirement for applications within Southampton's City Centre Action Plan (AP 12), which in 2015, required 'all developments (and especially key sites) to assess the potential of the site for appropriate GI

improvements by using the Council's Green Space Factor tool, and to improve the score for the site.'<sup>96</sup> For other sites not within the City Centre, the council encourages, but does not require, use of the tool. Scores are assigned according to the rate of infiltration of rainwater for each landscape element.<sup>97</sup> The scoring system takes into account existing land cover, encourages retention of existing features and requires an overall increase in score compared with the existing condition. Performance requirements for surface cover types are not prescribed (as they are in the US for example). A completed spreadsheet is submitted as part of an application; however, there is no requirement for a suitably qualified professional to do this and no mechanism for verifying that a scheme has been implemented satisfactorily.

A3.3.10 All schemes allocate scores to various categories of surface cover included in planning proposals. Depending on how a scheme is operated by an authority, failure to meet the target can result in rejection of a planning application, or an indication that a proposal needs to be amended, to include a

<sup>92</sup> <https://www.nparks.gov.sg/skyrisegreenery>

<sup>93</sup> <https://www.timeout.com/singapore/things-to-do/the-pinnacle-duxton-skybridge>

<sup>94</sup> <https://www.london.gov.uk/what-we-do/planning/london-plan/new-london-plan/draft-new-london-plan/chapter-8-green-infrastructure-and-natural-environment/policy-g5>

<sup>95</sup> <https://www.cityoflondon.gov.uk/services/environment-and-planning/planning/planning-policy/Pages/Local-Plan-Review.aspx>

<sup>96</sup> Southampton City Centre City Centre Action Plan, Adopted Version 18 March 2015

<sup>97</sup> <https://www.southampton.gov.uk/policies/Green-Space-Factor-tool.xls>



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larger area of GI overall, or elements with higher functionality. Cities usually set a minimum score that must be met and some have targets to encourage developers to be more ambitious and innovative, or they may have requirements which relate to the delivery of a specific function or outcome (e.g. stormwater management).