

Belfast Green and Blue Infrastructure Plan

Energising
Belfast



Project

Belfast



View from Divis looking North East
Source: AECOM

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Executive Summary

This is the first Green and Blue Infrastructure Plan for Belfast. It recognises that our vegetated areas – the Green – and our waterways – the Blue – provide a broad range of economic, social and environmental benefits in and around our more urban areas. As such, we are starting to think of these natural and semi-natural assets as ‘infrastructure’ and like any type of infrastructure, these assets will only continue to provide us with these benefits if we actively plan, invest in and manage them to ensure that they are utilised sustainably.

To do this, the Plan sets out an ambitious vision that by 2035 green and blue infrastructure will be strategically planned and delivered to enhance ecosystem services that benefit all living, working in and visiting Belfast.

This vision is supported by 5 strategic principles:

1. Biodiverse

Although not all green and blue infrastructure assets will be delivered and managed primarily for biodiversity, all green and blue infrastructure should help enhance biodiversity. This is because biodiversity underpins the effectiveness of ecosystem services and the range of benefits that green and blue spaces provide to everyone.

2. Planned, interconnected networks

To maximise the benefits of green and blue infrastructure it needs to form an interconnected network. Doing so requires strategic planning to target delivery against the needs of the local communities. The Green and Blue Infrastructure Plan sets out a strategic framework for the future delivery of green and blue spaces.

3. Integrated into the urban environment

As with all urban systems, green and blue infrastructure should not be seen as independent. It needs to form an integrated part of the urban fabric of the city. This Plan highlights a range of opportunities for integrating green and blue infrastructure into the public realm and buildings through, for example, the use of sustainable drainage systems to manage surface water.

4. Well designed and managed

To work effectively, all infrastructure, including green and blue assets, need to be well designed and regularly maintained. This Green and Blue Infrastructure Plan sets out nine principles for the provision of all green and blue spaces.

5. Appropriately funded

Green and blue infrastructure brings considerable value to the city. This value needs to be recognised and used to help attract sustainable funding to ensure the benefits continue to be felt. The delivery of the Plan will require collaboration and resource from a number of sources, including working with developers and the use of section 76 developer contributions.



Ormeau Park, Belfast
Source: Belfast City Council

Introduction

Purpose

Our green and blue infrastructure affects the quality of life for everyone in our city. It helps to define a sense of place and the character of our communities; provides important spaces for recreation with associated health and wellbeing benefits and strengthens the resilience of our natural environment to change. Protecting these assets and enhancing the benefits that they provide is therefore integral to the future of Belfast.

This is a transformational time for our city, with the newly published Belfast Agenda setting out shared commitments across public services to an ambitious vision to create a better quality of life for us all. Through local government reform we also have, for the first time, taken responsibility for land use planning for the city. We are preparing a new Local Development Plan (LDP) to provide new homes as our population is expected to grow by 66,000 people and space for 46,000 additional jobs by 2035.

“Green” and “blue” assets such as parks or rivers have not traditionally been considered to be critical infrastructure. However, when considered holistically they form an extensive citywide network that can provide many functions and bring many benefits to our city as a whole. This Green and Blue Infrastructure Plan (GBIP) sets the strategic spatial framework,

vision and five strategic principles for the future delivery, management and enhancement of the whole green and blue infrastructure network; helping to meet the outcomes envisaged in the Belfast Agenda’s vision. It is supported by a number of other strategies which focus on specific sub-sets of green and blue infrastructure, such as the Belfast Open Spaces Strategy.

In the spirit of the partnership collaboration advocated through the Belfast Agenda, the GBIP has been developed with input from a wide range of stakeholders, and builds on the significant amount of work that the city and partners have already undertaken.



Example of biodiversity found in the city

Source: Belfast City Council

Structure

This GBIP is structured around:

- Section 1: Green and Blue Infrastructure – Provides an overview of what we mean by green and blue infrastructure, the policy context and the benefits of green and blue infrastructure
- Section 2: Vision and strategic principles - Outlining the overarching vision for the GBIP and the 5 strategic principles
- Section 3: Principle 1 - Biodiverse
- Section 4 Principle 2 - Planned, interconnected network
- Section 5: Principle 3 - Integrated into the urban environment
- Section 6: Principle 4 - Well designed and managed
- Section 7: Principle 5 - Appropriately funded
- Section 8: Making it happen

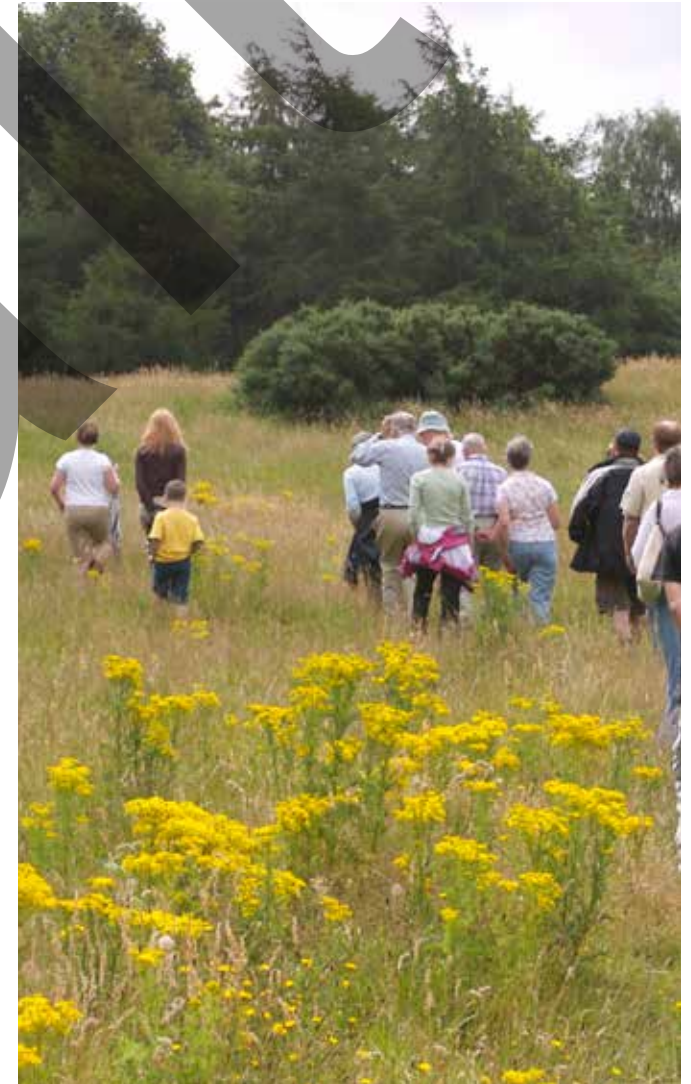
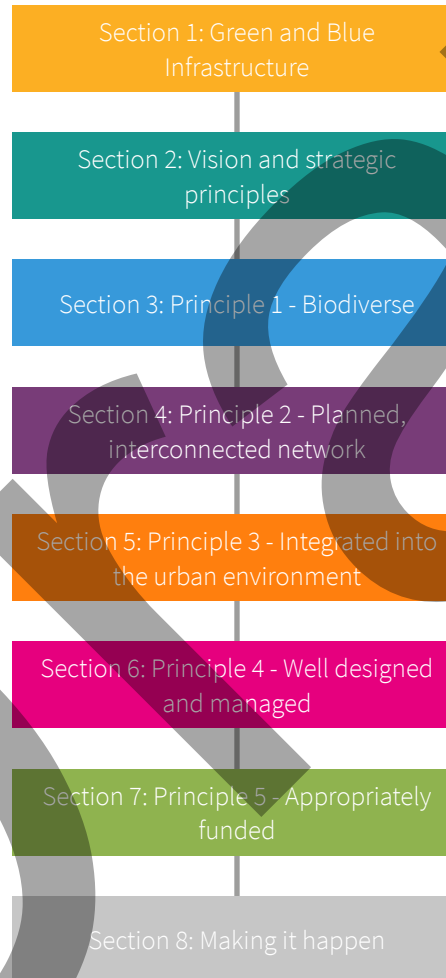


Figure 1. Document hierarchy

Lagan Meadows, Belfast
Source: Belfast City Council

What is Green and Blue Infrastructure?

Surrounded by the Belfast and Castlereagh Hills, and with the River Lagan flowing down to the Belfast Lough, the city of Belfast has been fundamentally shaped by the landscape and water. As we learn more about our vegetated areas – the Green – and our waterways – the Blue – we are beginning to understand that they provide a broad range of economic, social and environmental benefits in and around our more urban areas. We are starting to think of these natural and semi-natural assets as ‘infrastructure’ and like any type of infrastructure, these assets will only continue to provide us with these benefits if we actively plan, invest in and manage them to ensure that they are utilised sustainably.

Green infrastructure includes a wide range of natural and semi-natural land cover including the swathes of upland and agricultural land that surround the city, as well as smaller sites such as parks, amenity spaces as well as gardens and even single trees. Blue infrastructure refers to waterways and bodies, including rivers and streams, reservoirs, lakes and ponds. The main typologies have been summarised overleaf.



Upland

Generally over 200m and rising to 478m at Divis Mountain, they are characterised by their open and wild character with swathes of grassland and heath as well as pockets of other habitats such as bogs, woodland, and rocky outcrops.



Agricultural Land

Land devoted to the rearing of livestock or the cultivation of crops intended for consumption by people.



Amenity Greenspace

Landscaped green spaces to improve visual amenity and enhance residential and commercial areas. They can be used for informal play and recreation and include village greens, urban commons and other incidental space.



Parks

Open spaces of varying size and function which generally offer a range of facilities such as recreation and sports as well as areas of natural landscape. Depending on the park's size and status - country, city, district or local - different population catchments are served and facilities provided.



Playing fields and recreational space

Natural or artificial surfaced sports and recreation facilities which can include football, rugby, hockey, bowling, cricket and Gaelic games. There are many public playing fields across the city as well as those associated with schools and universities which have more restricted access.



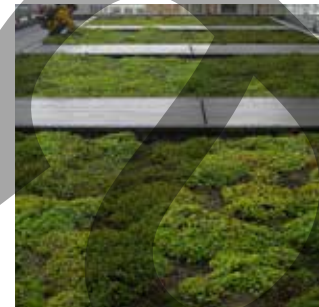
Other greenspaces

Areas such as allotments, community gardens and cemeteries, are valuable green infrastructure assets particularly in urban areas as they provide space for residents to grow their own produce, for quiet reflection as well as for wildlife conservation, cultural heritage and biodiversity.



Woodland and trees

Woodlands comprise land under stands of trees with a canopy cover of at least 20% (or having the potential to achieve this), including felled areas that are awaiting restocking. There are also street trees lining roads and individual tree specimens.



SuDS

Sustainable Drainage Systems (SuDS) are surface water management devices to help reduce the run-off rate, help improve water quality and where possible support biodiversity. There are a wide variety of SuDS for different types of ground conditions, including for infiltration, attenuation and conveyance.



Gardens

Parcels of land which are under the ownership of householders, traditionally gardens were defined as enclosed pieces of ground devoted to the cultivation of flowers, fruits or vegetables.



Waterways and waterbodies

Waterways are considered to be rivers, canals and streams including their banks. Culverted waterways are included.

Reservoirs, lakes and ponds are considered to be waterbodies. They can be both natural and manmade features.



Greenways

Greenways are linear routes for walking and cycling segregated from other vehicles. These can be vegetated such as Connswater Community Greenway providing important ecological corridors and contributing to urban greening.



Coastal waters

The interface between land and ocean and where freshwater mixes with seawater.

Making the most of Green and Blue Infrastructure

The term 'infrastructure' implies something that is essential for the operation of society. We use it to describe 'green and blue infrastructure' to highlight that these spaces are not simply unbuilt areas, but are vitally important for the effective functioning of our urban areas.

They provide a wide range of tangible social, environmental and economic benefits including providing space for recreation, relaxation, reflection and exercise which promotes healthier and happier lifestyles through increased physical activity, as well as improved social cohesion. Larger designated areas through to smaller habitats and even individual trees provide spaces suitable for wildlife and increase biodiversity. Attractive open spaces improve peoples satisfaction with their urban areas; encouraging people to stay and even relocate to areas which in turn increases inward investment and improves attractiveness as a place to do business.

As with all infrastructure, however, these spaces need to be supported with appropriate ongoing maintenance and investment to ensure that they are able to continue to function effectively and provide these benefits for all.

Northern Ireland's Regional Development Strategy 2035 (RDS Dept. for Regional Development, 2010) recognises the importance that networks of green and blue infrastructure play in providing these benefits, often referred to as 'ecosystem services' and the need to 'conserve, protect and, where possible, enhance our built heritage and our natural environment' (RDS RG11).

Similarly the Strategic Planning Policy Statement (SPPS), which sets out the overarching planning framework for the region, recognises this and highlights that green and blue infrastructure 'should be designed and managed as a multifunctional resource capable of delivering on a wide range of environmental and quality of life benefits for communities' and that Local Planning Authorities including Belfast City Council should 'seek to identify and promote green and blue infrastructure' in developing their Local Development Plan (LDP)' (Paragraph 6.196 of the SPPS).



*View across Cavehill towards Belfast Lough
Source: Duggan, L - Belfast City Council provided*

The Belfast Agenda, the city's new community plan, highlights the key community needs and sets out four priority pillars of joint objectives across local government partners, residents and community organisations for tackling these issues. As shown in Figure 2 these pillars are: growing the economy, city development, living here and working and learning.

We are also preparing a new Local Development Plan which provides the policy framework for how our city will grow by 2035; making provision for the existing population as well as growth in the population of an expected 66,000 new residents, attracting high quality jobs and supporting social infrastructure. This significant growth will increase pressure on spaces within our city. We will need to carefully balance the needs of our residents, existing and new, as well as our valuable natural habitats, to ensure this growth occurs in tandem with the protection and enhancement of our green and blue infrastructure. The LDP has four strategic aims of shaping a liveable place, creating a vibrant economy, a smart connected and resilient place, and a green and active place, as shown in Figure 2.

Figure 3 highlights how the benefits of green and blue infrastructure provision has a key role to play across the Belfast Agenda's pillars and to meet the LDP's objectives.

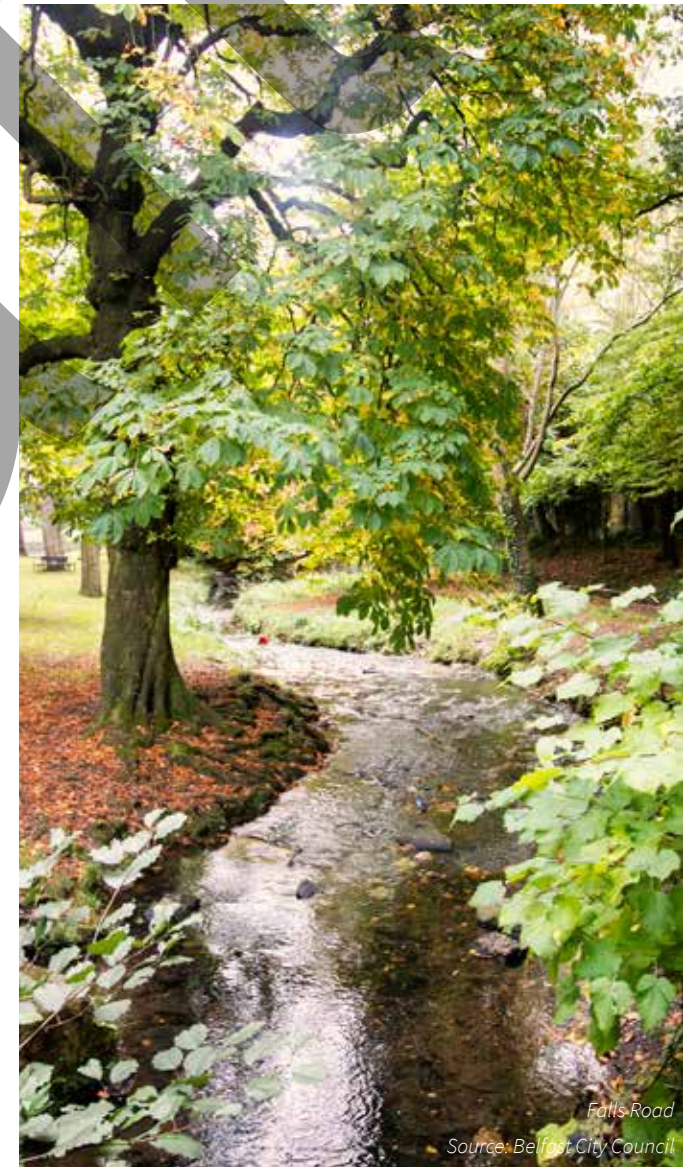
Belfast Agenda: Priority Pillars



Local Development Plan: Strategic Aims



Figure 2. Belfast Agenda Priority Pillars and Local Development Plan Strategic Aims



Falls Road
Source: Belfast City Council

Shaping a liveable place

Living Here

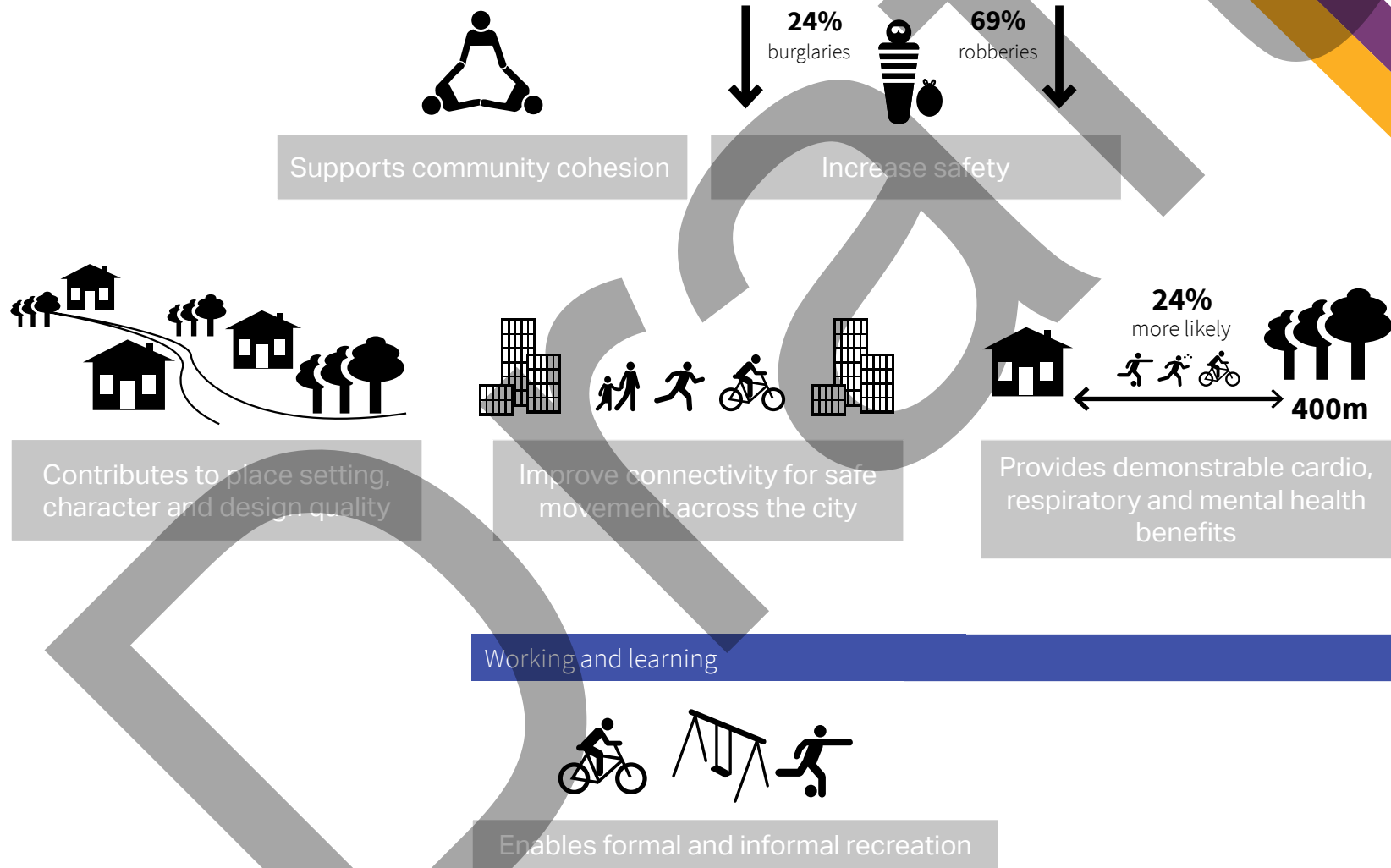
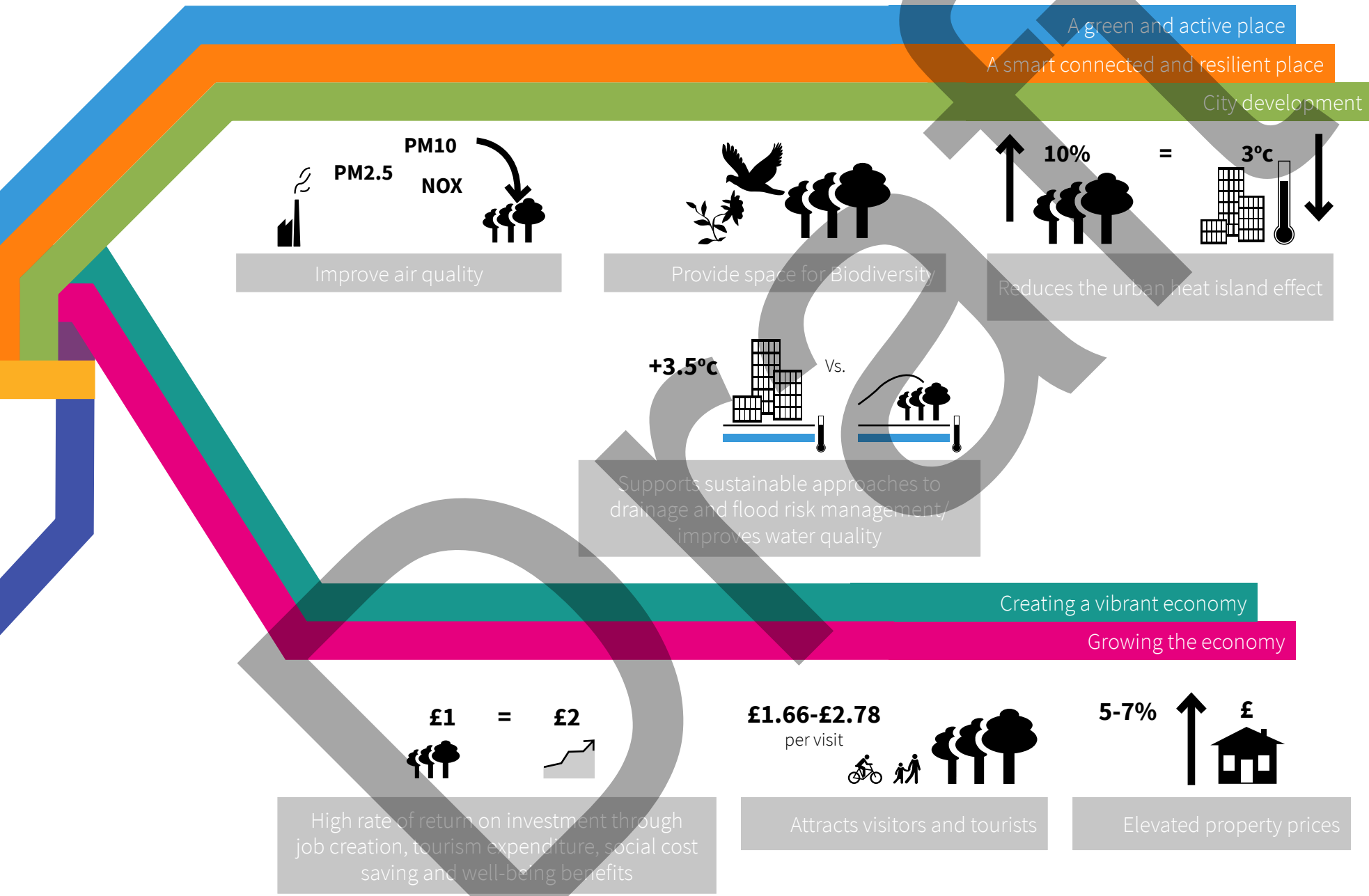


Figure 3. Belfast Agenda Priority Pillars and Local Development Plan Strategic Aims mapped to the benefits of Green and Blue infrastructure



We see a future where, by 2035...

Draft

The background is a solid teal color. It features several white geometric shapes: a large 'V' shape in the top left, a large 'L' shape in the bottom right, and a large 'U' shape in the bottom left. A large, dark teal watermark is centered on the page, consisting of a stylized 'B' and 'S' intertwined. The text is centered and reads:

...Green and blue infrastructure will be strategically planned to enhance ecosystem services that benefit all living, working in and visiting Belfast.

Vision and strategic principles

Our vision for green and blue infrastructure builds on the direction given by Northern Ireland’s SPPS to strategically plan and recognises the benefits these assets bring to help meet the objectives set out through the Belfast Agenda’s Priority Pillars and the Local Development Plan’s Strategic Aims.

The vision will be supported by five strategic principles for green and blue infrastructure delivery:

1. Biodiverse – Although not all green and blue infrastructure assets will be delivered and managed primarily for biodiversity, all green and blue infrastructure should help enhance biodiversity.
2. Planned, interconnected networks – To maximise the benefits of green and blue infrastructure it needs to form an interconnected network. Doing so requires strategic planning to target delivery against the needs of the local communities.
3. Integrated into the urban environment – As with all urban systems, green and blue infrastructure should not be seen as independent. It needs to form an integrated part of the urban fabric of the city.
4. Well designed and managed – To work effectively, all infrastructure, including green and blue assets, need to be well designed and regularly maintained.
5. Appropriately funded – Green and blue infrastructure brings considerable value to the city. This value needs to be recognized and used to help attract sustainable funding to ensure the benefits continue to be felt.

The strategic principles within this GBIP should extend to all development, particularly those that have an impact on our natural, semi-natural and water environments. To

support this GBIP a number of companion strategies will be developed to provide more details for specific elements of the network. This includes Belfast’s Open Spaces Strategy, which focuses on planning for recreational spaces in the city

and the Local Biodiversity Action Plan which sets out the need for the creation and management of priority habitats and species across the city. This structure is illustrated in Figure 4.

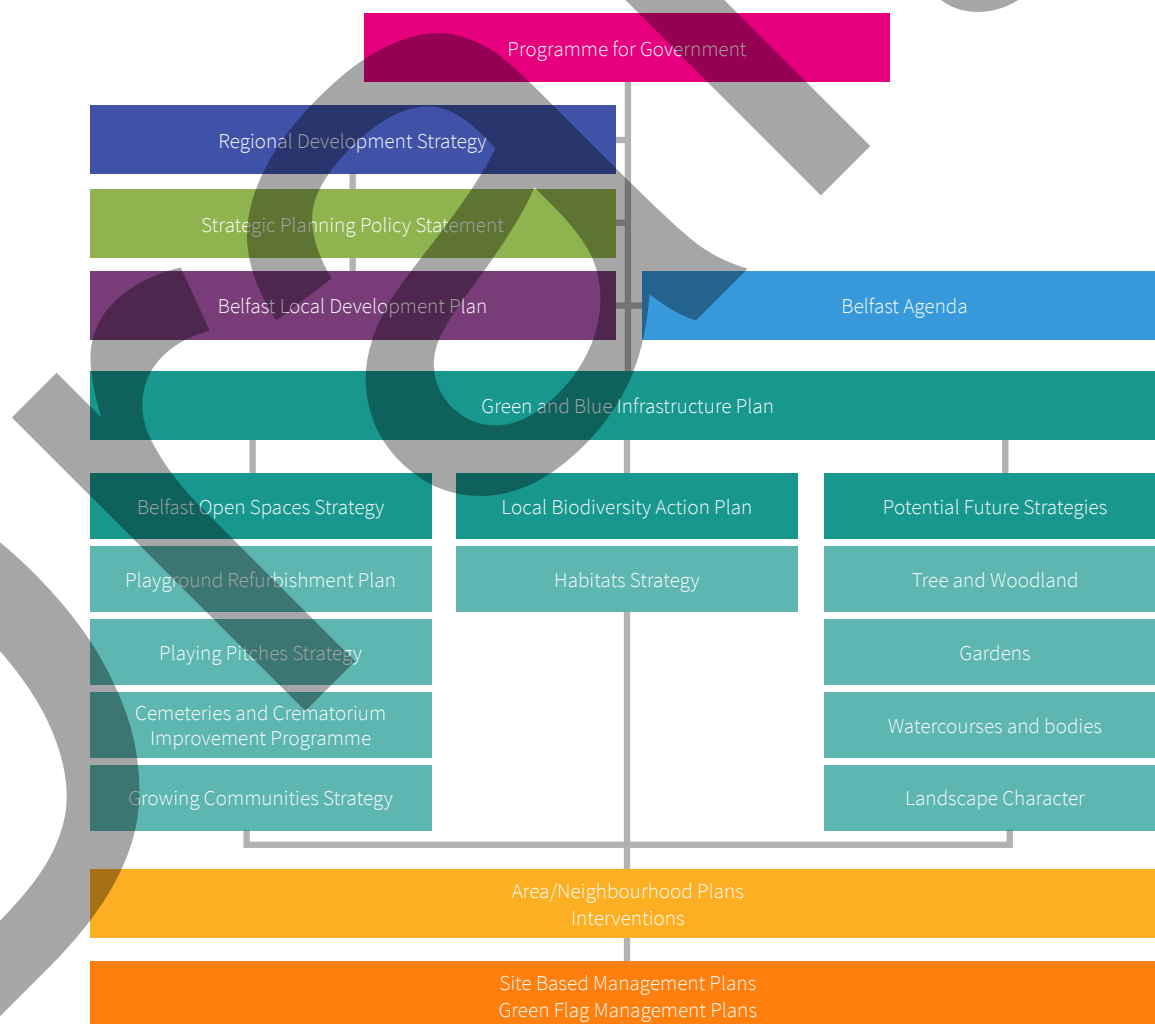


Figure 4. Northern Ireland and Belfast policy hierarchy

Vision:

Green and blue infrastructure will be strategically planned to enhance ecosystem services that benefit all living, working in and visiting Belfast.

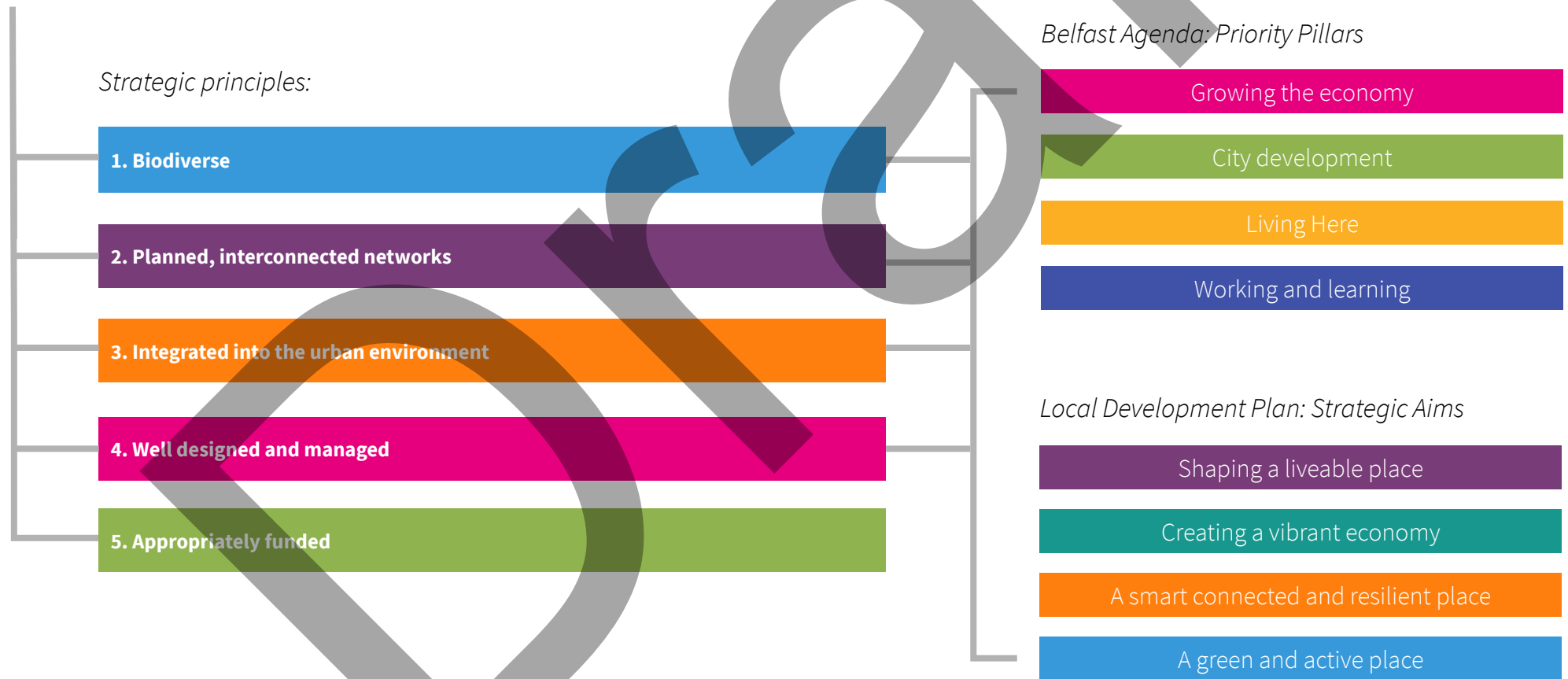


Figure 5. Vision and principles mapped to Belfast Agenda Priority Pillars and Local Development Plan Strategic Aims

Principle1: Biodiverse

Ecosystems are created by the interaction of communities of organisms and their physical environment. These interactions create a wide range of benefits for us known as ecosystem services, including air, soil and water quality improvements, helping crop pollination and regulating the climate. Functional, robust ecosystems are underpinned by a variety of life within the ecosystem, or biodiversity. Urban areas can fragment habitats, making it difficult for wildlife to find sufficient food or mates. This in turn reduces the biodiversity in urban areas and the ecosystem service benefits that are provided. Supporting biodiversity across the city is therefore essential if we are going to utilise the benefits of ecosystem services to meet our objectives in the Belfast Agenda.



Biodiversity in Belfast

Outside of Belfast's urban area there are significant areas recognised for their biodiversity rich habitats as with significant Countryside and Coast Sites of Local Nature Conservation Importance (SLNCl) designations across the Belfast Hills and to the east of city as illustrated in Figure 6. Within the city, parts of Belfast Lough have been protected as part of the European Natura 2000 Network of sites (designated as a RAMSAR under the EU Habitats Regulations and Special Protection Area (SPA) under the EC Birds Directive) and regionally by the NI Executive as an Area of Special Scientific Interest (ASSI) for its ecological importance due its high quality marine habitat and wintering bird populations. In some cases, such as RAMSAR and SPA, designations will have implications for development and activities that could be considered to have a detrimental impact on the habitats. These areas should be treated with sensitivity and be used to guide the types of development that come forward.

There is an ASSI at Belvoir as well as other local nature conservation designations across the city. There are also a number of habitats including bog meadows local wildlife site, woodland, waterways and grassland across the city that support biodiversity but do not have formal protection. However, these spaces are relatively limited when compared to the areas surrounding the urban area. It should be noted that smaller non-designated sites and even single trees provide significant wildlife habitats, especially in urban environments where space is limited, as well as improving air quality and the overall amenity value of our urban spaces.

Examples of biodiversity found in the city

Source: Belfast City Council

The new Local Biodiversity Action Plan (LBAP), which builds on the previous 2007 LBAP, highlights that we have not previously had a good understanding of the quality of biodiversity across the city. For the first time it aims to draw together data from a range of sources to build a better understanding of the habitat distribution not in designated sites and sets out priorities for supporting and enhancing biodiversity across the city.



Example of biodiversity found in the city
 Source: Belfast City Council

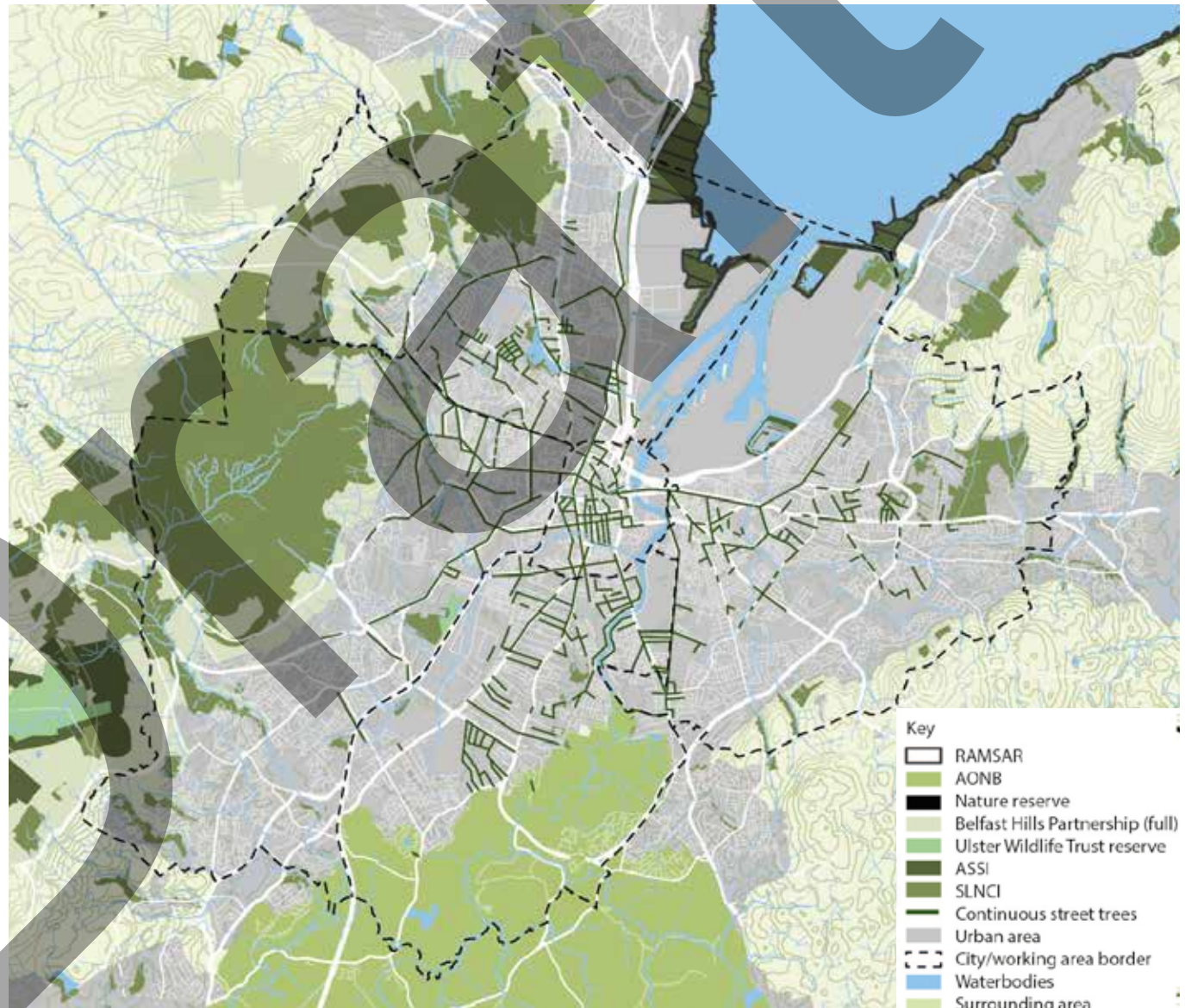


Figure 6. Environmental designations

Opportunities for making Belfast more biodiverse

Enhancing biodiversity is an overarching principle of green and blue infrastructure. Although not all spaces are designed principally for biodiversity, all spaces should however consider how they can support biodiversity. The rest of this GBIP sets out a wide range of potential actions and interventions to extend and enhance the green and blue infrastructure network, all of which have capacity to embrace opportunities for enhancing biodiversity. Specific actions for biodiversity include:

Central biodiversity data centre

There is currently no single central or standardised data repository for biodiversity across the city. Understanding ecological assets is key to understanding how to enhance and manage their long term future. We are keen to work with partners to build on the LBAP and gather existing survey work into a central database; supplementing with additional survey work where necessary. Data should be part of an open source platform that can also be supplemented through crowd sourcing contributions. This will need to be regularly reviewed and updated with the spatial distribution and quality of the priority habitats across the city.

Protect important sites

The most important sites have statutory protection. Planning can also be used to protect important sites, and as such, through the Local Development Plan we have set policies for protecting open spaces throughout the city unless there is a clear and demonstrable benefit from changing their land use.

New development

New development offers an important opportunity to integrate green and blue infrastructure into the urban environment. All new development above 25 units will be required to deliver new open spaces that also help to deliver a net gain in biodiversity on site or where this is deemed not possible, make a development contribution through section 76 of the Planning Act (Northern Ireland) 2011. We are currently developing a framework to guide developers and set out our expectations regarding contributions. Potential measures that could be integrated into new developments are explored in more detail under Principle 3.

Habitat creation and enhancement

The way in which we manage our spaces can have a significant impact on the biodiversity of that site, for example not all of our larger parks have areas of more natural and semi-natural planting. Through our park management plans we will identify areas that can be managed to encourage habitats creation. Furthermore, we will work with our partners who manage our amenity spaces to identify opportunities for enhancing biodiversity, for example through the introduction of species rich grassland and reducing mowing regimes as opposed to using standard turf grass where practical.

Case Study: Green Estates, Sheffield

Faced with hundreds of hectares of ecologically poor quality amenity space to manage across Sheffield's neighbourhoods and dwindling budgets, the City Council teamed up with the University of Sheffield's Landscape Department to create what became the 'Green Estates'. Focusing on the Manor Estate, once labelled the 'worst estate in Britain', and areas of Wybourn and Skye, which had seen years of social decline. The grant funded project looked to seed areas of amenity grassland with species rich meadow planting. Creating an ecologically diverse, hard wearing and long term flowering seed mix. The team helped simultaneously reduce the cost of regular maintenance (particularly summer mowing) and created a low cost but highly attractive landscape well loved by locals. Although the programme will not resolve all the ingrained social issues, it has helped restore some sense of pride in the area and has subsequently grown into a social enterprise to help enable long term revitalisation of other areas.

Benefits:

- Increased the biodiversity of ecologically inert amenity grassland
- Created a low maintenance, highly visual landscape
- Engendered a sense of local pride
- Provided space for play

De-culverting

Many of Belfast’s waterways have been covered or culverted, and are now effectively used as part of the sewer system. Without light, and with increased surface water pollution, these waterways effectively become ecologically ‘dead’. ‘Daylighting’ or opening up these waterways provides an opportunity to revitalise the aquatic ecosystem. Although the entire stretch of some culverts might be difficult to daylight, vegetation can be used at culvert openings to help clean the water and making the water quality safe. Similarly, several waterways are in concrete channels with limited ecological value which could be opened up to become more naturalised. Opening culverts and channels also helps reduce flood risk, increasing storage capacity in times of heavy rainfall.

Belfast Opportunity: waterway de-culverting

Farset River

Flows from the Belfast Hills under Shankill and through to High Street to join the Lagan. The currently culverted river offers significant opportunity for the creation of a new green corridor developed around the waterway. The project would enhance the urban environment in west Belfast and support greater community cohesion.

Blackstaff River

Flows from Black Mountain, under the city centre and joins the Lagan. The waterway offers potential to create a significant new city centre feature that will support flood mitigation measures, improve the urban environment and also act as a new tourist destination.

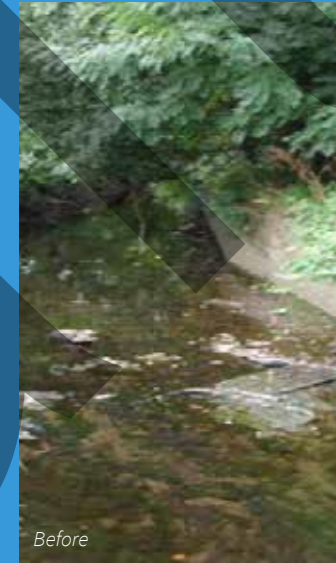
Case Study: Orangefield Park, Belfast

Over 600m of the Knock River had previously been diverted to run through a man-made channel along the edge of Orangefield Park. This had led to a drastic decline in the quality of the water, resulting in poor biodiversity, a prevalence of invasive species and pollution. During heavy rainfall, the constrained channel would overtop posing a flood risk to over 150 properties.

As part of the Connswater Community Greenway project, the East Belfast Flood Alleviation Scheme created a new, more natural river channel, which supports healthier river ecosystems and provides safe attenuation areas in times of heavy rainfall. The new natural design was supported by the creation new native wildflower areas to support biodiversity and retains an important recreational role with cycle and walking routes.

Benefits:

- Improved water quality
- Healthier aquatic ecosystems
- Reduced flood risk
- Improved recreational facilities
- High amenity value



Before



After

Orangefield Park naturalised river channel, Belfast

Source: AECOM

Principle 2: Planned, interconnected network

In order to enhance and extend the green and blue infrastructure network to maximise benefits it needs to be strategically planned. These networks need to transcend political boundaries and extend out from our city centre to the Belfast Hills, Lagan Corridor, Belfast Lough and Castlereagh Hills. It provides an overarching structure for future creation and enhancement of the green and blue infrastructure network.

Connectivity is particularly important, as well as enabling residents and visitors to move more sustainably around the city, it also connects habitats and improves the permeability of the city to wildlife. Supporting wildlife to move more freely and safely to pass through, find mates and forage for food.

As our city grows, there is a risk that our busy roads will become increasingly congested. Over half of commuters move through the city by private vehicle and, without an alternative, planned growth could add 100,000 vehicle trips in peak hours. In addition to the pressure this would add to our road networks capacity, the additional emissions would have climate change and air pollution impacts. As such, finding alternative routes through the city that accommodate more sustainable and healthy cycling and walking is imperative.

The benefits of more active modes of movement extend beyond physical health such as reduced risk of cardiovascular or respiratory diseases, it also improves overall wellbeing, with those walking or cycling recognised as being some of the happiest commuters when compared those driving or taking the bus.



River Lagan, Belfast

Source: Hully, J, provided by Belfast City Council



Creating a strategic framework for Green and Blue Infrastructure

In order to plan for the development of our interconnected network, we have developed a strategic framework which is comprised of three structuring elements:

1. Green space network

Belfast has a wide variety of green spaces, ranging from expansive areas of natural and semi-natural land in the Belfast Hills and along the Lagan Valley, nearly 900ha of city parks, significant areas of informal amenity grassland and around 2,000 street trees. There are also a number of more functional green spaces; such as playing fields, that although are managed for recreation could have biodiversity value around the periphery. The GBIP seeks to improve or enhance smaller green and blue assets while also rethinking the role that more urbanised public realm can play in the provision of green and blue infrastructure.

2. Blue infrastructure network

The River Lagan forms a central spine running south to north through Belfast, connecting the Lagan Valley, city centre, Titanic Quarter, into the docks and Belfast Lough. Although the Lagan has historically shaped the city, the City Centre Regeneration and Investment Strategy highlighted that the value of the river is underplayed, particularly in the city centre. Making more of this important feature and rejuvenating the water front could help attract investment, provide more recreational space and enhance connectivity across the city.

There are also numerous smaller waterways flowing into the Lagan such as the Farset, Forth, Connswater, Knock and Loop Rivers. Many of these have been culverted or channelised. This GBIP seeks opportunities for opening these waterways up to restore these aquatic environments, improve drainage and integrate blue infrastructure better into the urban environment.

3. Strategic connections

Belfast has a growing number of greenways and community paths linking across the city. Greenways are dedicated movement corridors free of motor vehicles to provide a safe environment for walkers, runners and cyclists to move around the city. Where segregation from other road users is impossible, we have developed community paths with a strong identity to help users navigate efficiently across the city. These links help connect our green spaces and often run parallel to our blue infrastructure. As well as helping develop a new approach to travel, they provide an excellent opportunity for urban greening to enhance the green space network. Possible opportunities for extending this network have been explored through stakeholder consultation and highlight key missing links for improving connectivity of the network are presented in Figure 9.

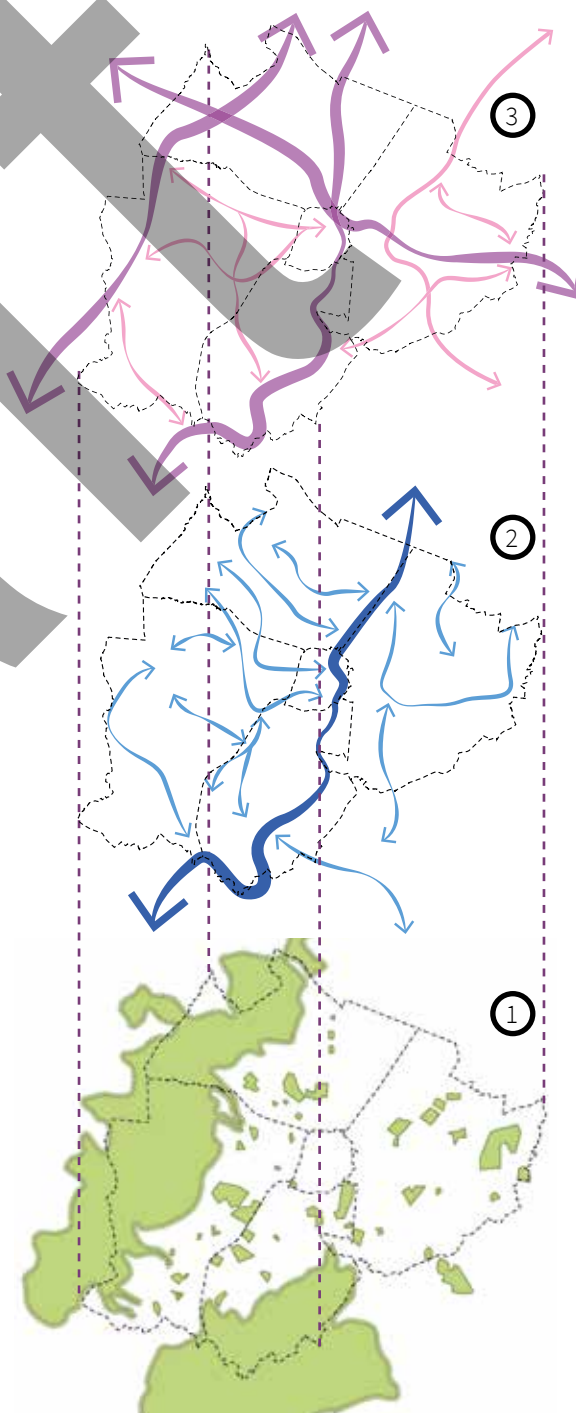


Figure 7. Green and Blue Infrastructure Strategic Framework components

Green and Blue strategic framework

The green and blue strategic framework shown in Figure 8, draws upon the three structuring elements to illustrate the spatial vision for the future of green and blue infrastructure in Belfast. The existing blue network and strategic connections were combined to identify opportunities for integration and the opening up of waterways; including as part of street enhancements and the expansion of our safe pedestrian and cycle network. When layered over our green spaces and key natural heritage assets, primary and secondary axis and key connectors were identified which will be either greenways or community paths. As part of this framework we will also support new and enhanced green and blue spaces in the city centre and improve overall connectivity across the network.

Primary axis

- 1 North-South: Aims to better integrate the Lagan Valley, the Lagan and the Lough into the city and make the most of Belfast's key water features.
- 2 East-West: Seeks to extend the existing greenway network up into the Belfast and Castlereagh Hills; creating a strong connection between the city centre and the surrounding countryside.

Key connectors

A number of smaller possible routes link existing green spaces throughout the city, including along currently culverted waterways. Increased street tree planting and greater integration of urban infrastructure will form part of this.



Figure 8. Green and Blue Infrastructure Strategic Framework

Belfast greenway routes

Greenway routes provide safe pedestrian and cycle routes across the city. Figure 9 sets out the existing Greenway routes such as the Connswater Community Greenway and the Comber Greenway as well as those proposed in the Belfast Metropolitan Area Plan, 2015 and Northern Ireland's Strategic Plan for Greenways, 2016 and other future possibilities. The routes are intended to extend the network to connect with open spaces across the city and out to the surrounding countryside where they can link to the broader Northern Ireland greenways and cycle network.

The existing network is already proving to be a success with the Lagan Tow Path attracting an estimated 1 million visitors per annum; demonstrating the economic potential of green and blue infrastructure. The extension and enhancement of this network will support a greater uptake of active transport modes and reduced reliance on cars, which will improve the health and wellbeing of us all through improved fitness and air quality. The network will also support the safe movement of wildlife across the city, creating new and linking existing habitats together.

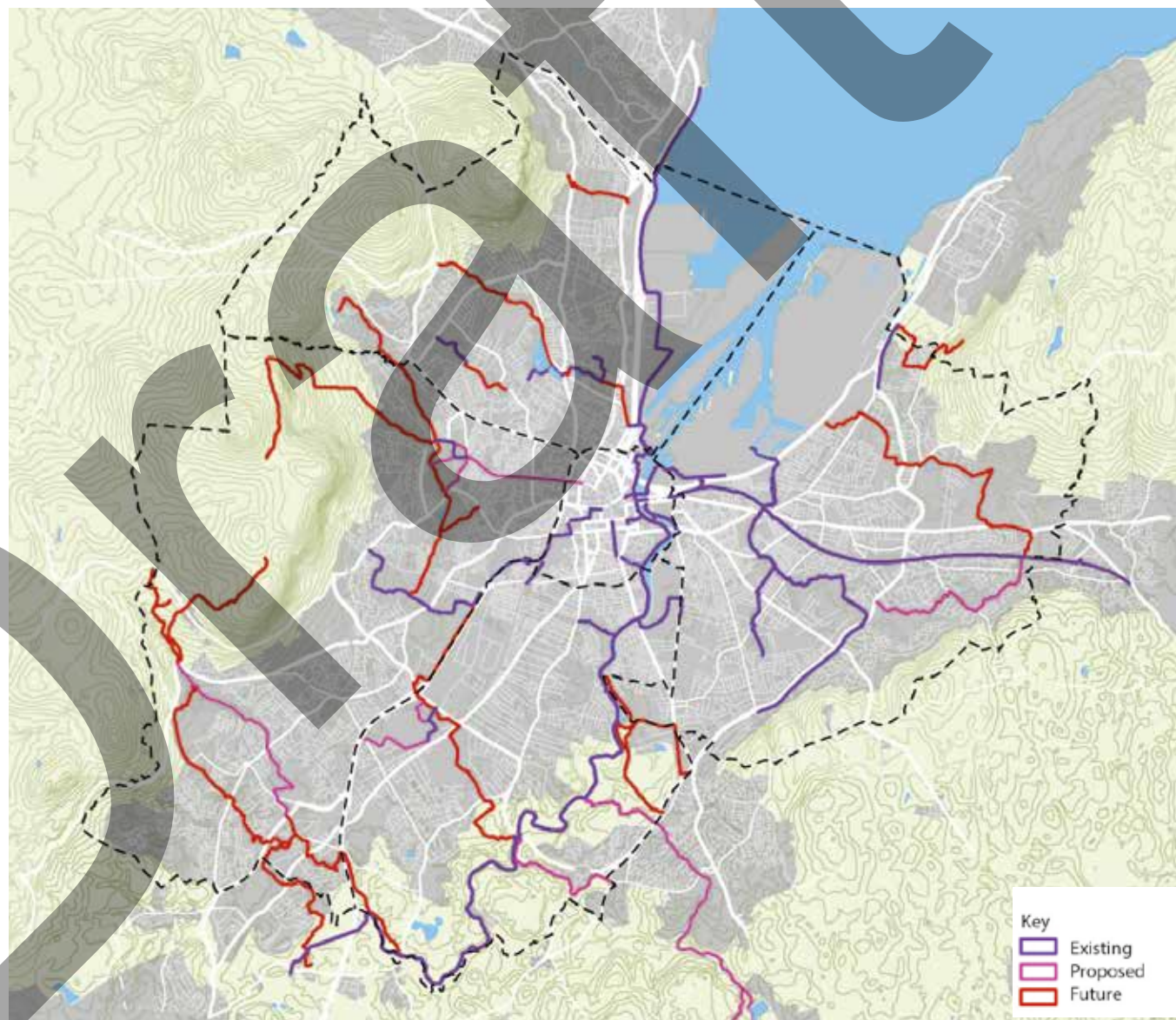


Figure 9. Belfast Greenway routes

Case study: Connswater Community Greenway

The Connswater Community Greenway was a £40m investment to effectively create a 9km long linear park. Following the route of the Knock, Loop and Connswater Rivers, the Greenway links a number of open spaces including Victoria Park and Orangefield. Improving connectivity across east Belfast, the Greenway includes around 16km of new pedestrian and cycle paths, and created or improved 26 crossing points to enable active travel through the city. As well as a movement corridor, the Greenway has become a recreation space in its own right, attracting many visitors because of the vibrant, safe and high quality landscape that has been created.

Benefits:

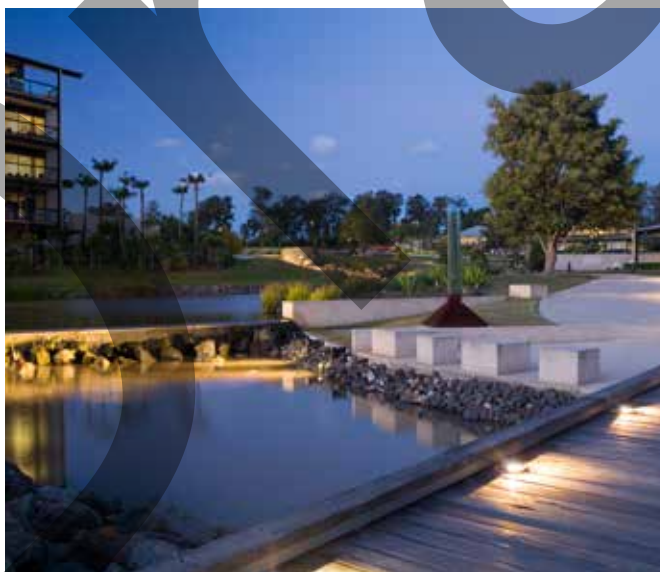
- Dedicated safe movement corridors through east Belfast
- Enhanced biodiversity providing wildlife corridor from Belfast Lough to the Castlereagh Hills
- A new leisure and recreation destination
- Over 5m of cleaned rivers and reduced flood risk
- Opportunities for education with community hubs, nature trails and interpretation points



Connswater Community Greenway - Victoria Park, Belfast
Source: Walk Northern Ireland

Principle 3: Integrated into the urban environment

Although it is important to enhance and improve connectivity between the strategic green spaces as set out by the strategic framework, significant benefits are also likely to be seen through the cumulative impact of smaller interventions in the urban environment. This section highlights some of the opportunities for integrating small scale green and blue infrastructure into the fabric of the city to provide a truly multifunctional urban environment.



Integrated green infrastructure

Source: AECOM

Multifunctional public realm

The public realm and streetscape is the single largest ‘open space’ in Belfast. Greening the public realm will therefore have the most visible benefits. There are many opportunities for greening the public realm, including enhancements to amenity space, greening the civic space within the city centre and providing more street trees.

Perhaps one of the greatest opportunities for integrating green and blue infrastructure into the urban environment, however, comes from the need for more effective management of surface water. In urban areas such as Belfast, where there the proportion of hard surfacing is increasing, surface water moves quickly; picking-up pollutants and is diverted into combined foul and surface water sewers. Belfast’s network of combined sewers is reaching capacity, meaning that in heavy rainfall events there is a risk that surface water cannot reach the sewer, the sewers overflow or foul water is released in the rivers.

Mimicking the natural water cycle using SuDS built into the public realm can help reduce the rate at which water flows into the network, creating more headroom in the sewer and reducing the amount of water that needs to be treated in the waste water treatment plant. This additional headroom can also be used to support the development of new homes as there is now greater capacity. Northern Ireland’s ‘Living with Water’ programme recognises the importance of using green infrastructure led SuDS to provide storm water attenuation, infiltration and cleaning. We are keen to work with them to explore this opportunity to create a greener environment across the city.

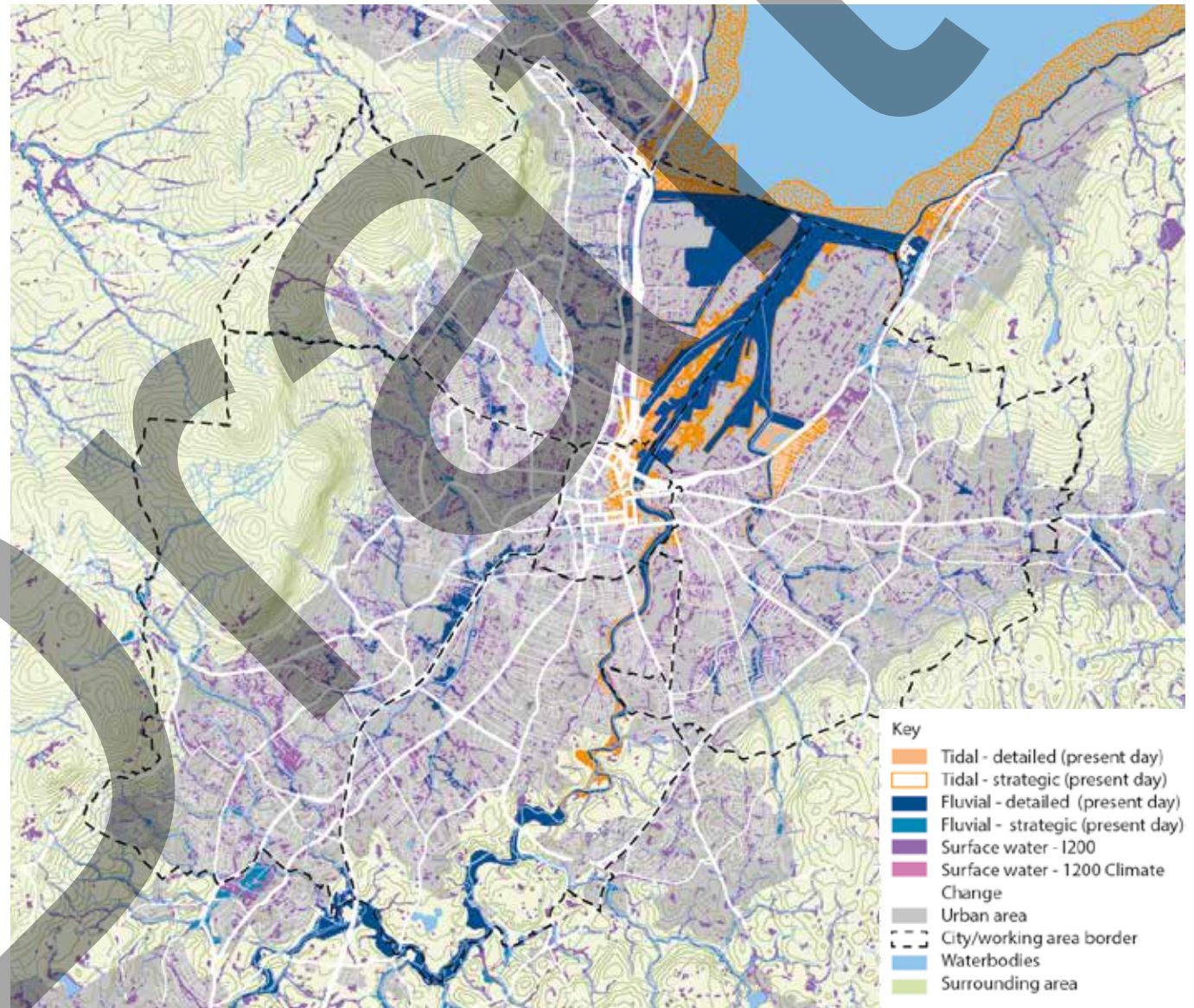


Figure 10. Flood risk, waterways and waterbodies

Multifunctional benefits of SuDS

There is a wide variety of different SuDS typologies, the table included in the appendix outlines the main interventions. Different types of SuDS should be used in combination with each other in a catchment to form a 'SuDS train' in order to maximise benefits. With the right design, they can be integrated into most urban environments, including steep or shallow slopes, in areas with land contamination and in areas of heavy vehicle use. This section sets out the benefits SuDS can deliver. Figure 11 highlights which types of SuDS are likely to provide the most benefits.

Increased water attenuation

The intention is to primarily slow runoff rates in urban areas and to increase the time it takes for water to enter the sewer system in storm events. Through the increase of vegetated areas which soak up water and the creation of voids that can capture water, it is slowly released through infiltration, plant up-take or controlled discharge. Runoff is prevented from flowing directly into sewers which in combined systems can result in polluted water backing up; causing damage to property and the environment. Water can be managed above ground; distributing and managing it on/near the surface.

Improved water quality

Capturing polluted runoff before it reaches waterways or sewers reduces damage to the environment and the level of treatment that is required. Filtration systems can be developed using plants or sands and gravel as natural filters to clean water so that it can be reused or safely returned to the environment.

Greater infiltration

Infiltration of runoff, after it has been cleaned, can be used to replenish groundwater levels, however this requires permeable surfaces which can be uncommon in urban areas.

Increased water reuse

Water can be captured and treated which can then be used for non-potable purposes, such as irrigation or toilet flushing. Water capture and reuse can be applied at many scales, from serving the individual home to site-wide treatment train approaches. This reduces water demand overall and also supports several sustainability certifications and targets.

Improved biodiversity and habitats

Integrating plants and trees as part of the design of the SuDS can support the slowing, filtration and storage of water. Using a range of native plant species will provide habitats for a variety of local biodiversity. Thinking about approaches as a network can create green corridors to support wildlife movement. It is important that water management approaches protect and enhance local ecology, and do not prevent existing habitats from functioning.

Improved amenity value

SuDS can improve the aesthetics of an area, increasing views to green space and contributing to high quality public realm and as such are attributed to increased property prices. In urban areas this is particularly true due to a scarcity of access to greenery and open spaces.

Provision of education opportunities

Consideration for the integration of SuDS into schools or providing information boards, provides creative and engaging educational resources for the community. Above ground management approaches can be effective ways to demonstrate the value of water management and the importance of protecting our water sources.

Increased open space provision

As SuDS can be designed to only be wet during rainfall events, they can be used to increase open space provision for recreation when they are not being used to manage surface water. This multifunctional approach can help meet development open space targets whilst also meeting surface water drainage requirements.

Improved character

Well designed and multifunctional spaces change people's perception of a development or area and help to enhance its character. Not all interventions are appropriate in every context, it is important to respond to each unique character, its opportunities and constraints. For example, city centre developments may not suit the more natural approaches and likewise, hardscape rills would look out of place in more rural areas.

Better regulated microclimate

Plants, vegetation and the retention of water in SuDS support microclimate regulation; mitigating the negative impacts of the urban heat island effect as well as improving air quality. Water stored in SuDS could also be used to help meet wider irrigation requirements and reduce drought risks.

The table opposite links the possible types of integrated water management approaches with the potential benefits. Further detail about typologies is given on the following pages.

	Green Roof	Rainwater Harvesting	Soakaway	Permeable Paving	Filtration Strip	Bioretention Area	Swale	Hardscape Storage	Pond/basin	Wetland	Underground Storage	Street Trees	Raingardens
Attenuation	●	●	●	●	●	●	●	●	●	●	●	●	●
Water Treatment	●	●	●	●	●	●	●	●	●	●	●	●	●
Infiltration	●	●	●	●	●	●	●	●	●	●	●	●	●
Water reuse	●	●	●	●	●	●	●	●	●	●	●	●	●
Biodiversity Habitat	●	●	●	●	●	●	●	●	●	●	●	●	●
Education	●	●	●	●	●	●	●	●	●	●	●	●	●
Amenity	●	●	●	●	●	●	●	●	●	●	●	●	●
Open Space	●	●	●	●	●	●	●	●	●	●	●	●	●
Character	●	●	●	●	●	●	●	●	●	●	●	●	●
Microclimate	●	●	●	●	●	●	●	●	●	●	●	●	●

Legend: ● Likely Benefit: ● Benefit could be achieved: ● Unlikely Benefit: ●

Figure 11. SuDS benefits matrix

Opportunities for integrating green and blue infrastructure into the public realm

Streetscape and Greenways

Greening streets can have an immediate visual impact, helping to improve amenity, local air quality and biodiversity. This could be done through the introduction of street trees or through the enhancement of amenity space. Many of these opportunities can also be combined with surface water management SuDS, such as bio-retention tree pits for street trees and raingardens.

Greening the city centre

Although the Streets Ahead scheme has improved the pedestrian environment in the city centre, the Belfast City Centre Regeneration and Investment Strategy (2015) highlights the lack of publically accessible green space. It promotes the development of a transformative landscape vision for the river corridor through the city centre and extending to the Titanic Quarter, would enabling active travel and provide animation along the river. There are also opportunities for increased tree planting, including along the Southern Link Ring Road, recreating it as a tree-lined urban boulevard where possible, particularly along Great Victoria Street and the Dunbar Link.

Opening up waterways

As highlighted above, there are opportunities to work with Northern Ireland Water and landowners across the city to rejuvenate Belfast's waterways; both larger scale rivers and streams but also on plot drainage channels. Promote the benefits of de-culverted waterways and drainage channels and providing guidance for BCC expectations.

Parks, playing fields and golf courses

We aim to manage our larger open spaces, such as the public parks and playing fields, to provide a range of functions. We will work with partners including those managing golf courses and school/university playing fields to also diversify their land cover. One opportunity is to work with partners such as Northern Ireland Water to identify areas of open green space that can be used for water attenuation in times of heavy rainfall. Northern Ireland Water have a project called 'Living with Water' which investigates the potential for increasing the capacity of the drainage network through a variety of measures. It forms part of the long term water management strategy 'Sustainable Water'.

Car parking

Opportunities will be sought to work with operators of car parks, such as those connected to supermarkets, as well as our own parking provision, to reduce the expanse of hard surfacing by introducing areas of planting and use of permeable paving. This will help clean runoff as well as providing a more attractive environment and potentially help improve air quality.

Planning policy in new developments

Planning policy requires developers to provide open green spaces within their development. Developers will be encouraged to use these spaces as part of an integrated approach to meet greenfield runoff rates for surface water. Where new development cannot meet greenfield runoff rates we will seek to use Section 76 contributions to offset costs resulting from additional strain on drainage infrastructure; this would give preference to offsite provision of green and blue infrastructure over hard infrastructure solutions.

To support this, integrated water management design guidance for new development areas can set out council expectations and also offer support and advice to developers.

Management of the Uplands

Although not within the urban area, the management of upland areas around Belfast can have a direct impact on reducing surface water management risk in the city. Working with partners, including the National Trust and the Belfast Hills Partnership we will help identify alternative management regimes for the Belfast Hills and other areas on the urban periphery to increase local water storage in times of heavy rainfall. This will help increase the capacity of the storm water drainage network downstream.



Example of a green roof on Victoria Square, Belfast

Source: XX

An example of integrated Green and Blue Infrastructure

The following diagrams illustrate the potential for integrating green and blue infrastructure into a common terrace street typology in Belfast. It shows that, in theory, it is possible to increase the overall green cover in the streetscape through relatively low cost interventions.



Figure 12. SuDS integrated into a typical Victorian terrace example
- Street view, Belfast

Source: Google Street View

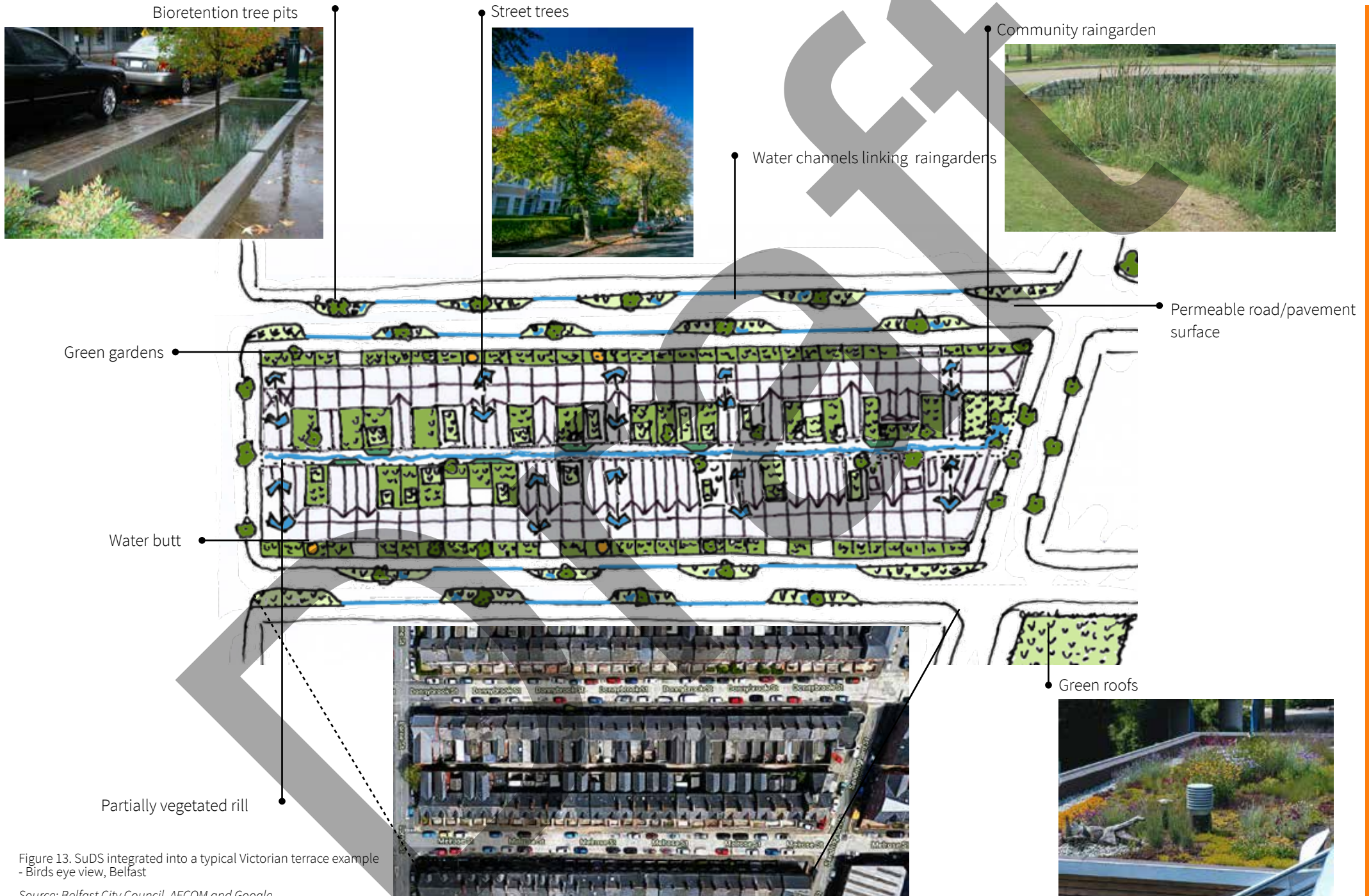


Figure 13. SuDS integrated into a typical Victorian terrace example - Birds eye view, Belfast

Source: Belfast City Council, AECOM and Google

Building integrated Green and Blue Infrastructure

As urban densities increase, there is increasing interest in integrating green infrastructure into buildings. This can have great benefits including providing outdoor space for residents, enhanced biodiversity, improved insulation and surface water management (and potentially non-potable water reuse). There are a number of different types of building integrated Green infrastructure:

- Intensive green roofs – These spaces are more akin to roof gardens. They include substrate of a depth between 150 and 450mm to support a range of lawns, perennials, shrubs and trees. As the most intensive areas, they are heavy at around 180-500kg/m² and will require the most irrigation, however they are also likely to provide the greatest community and environmental benefit
- Semi-intensive green roofs – These roofs have less substrate, up to around 200mm and are really designed as ecological green roofs rather than for people. With grasses, herbs and shrubs they still require some access and maintenance with periodic irrigation.
- Extensive green roofs – The lowest cost green roofs have as little as 60mm of substrate and generally support mosses, sedum and grasses. They require little maintenance or irrigation.
- Brown roofs – another low cost option, brown roof are predominantly designed for invertebrates these are stony / rock covered areas. They are useful in attracting a number of bird species.

- Blue roofs – These are green roofs that are specifically designed to hold back surface water. Water can be held in the roof structure itself or channelled to tanks where it could be treated for reuse to flush toilets or for irrigation.
- Green / living walls – These incorporate either modular soil or hydroponic systems to create vertical gardens with a rich variety of plants.

There are also a number of other smaller devices, such as bird/bat boxes and insect hotels that can increase the opportunities for biodiversity within developments.



Case Study: East Belfast Mission - Green roof and wall

The East Belfast Mission is a mixed use development that has been designed as a key community asset. The scheme brings together a range of services to meet the needs of all members of the community. It was specifically designed to be an example of sustainable and environmentally conscious building to be replicated elsewhere Belfast. The site was constrained by space availability and is located near to a main road so required any greenery to be integrated into the building design.

The building includes an extensive green roof as well as a 500m² green wall covered in over 6,500 plants.

Benefits:

- Attractive community assets
- Supports local biodiversity
- Helps to improve air quality as the site is by a main road
- Integrates solar heating, which often work better with green roofs as they regulate the temperature

East Belfast Mission Green Wall

Source: Belfast Telegraph

Opportunities for building integrated green infrastructure

New development

Integrating green infrastructure into existing buildings can be costly. As such, the main opportunity for green roofs and walls is in new builds. If considered early in the design process the uplift in costs can be relatively minimal as they can be substitutes for other materials. In developments that cannot meet their open space requirements we will require developers to investigate the potential for increasing biodiversity through integrated measures or through Section 76 agreements for off-site green and blue infrastructure. All new developments should deliver a net gain in biodiversity.

Air Quality Management Areas (AQMAs)

The map opposite highlights the AQMAs in Belfast, which are those areas which have been affected by pollution from road transport. In these areas, along some of Belfast's most congested roads, there are likely to be considerable space constraints. There may be opportunities for integration of green walls into buildings, bridges and supporting walls in these areas. There may also be opportunity for increased planting of street trees along or in the surrounding areas of the AQMAs. Improved air quality will be supported through the promotion of more active modes of transport such as walking and cycling, as is outlined under Principle 2.

Greening gardens

Many front gardens are being paved over. This can have a significant impact on green cover across the city. We will encourage homeowners and landlords to limit hard surfacing and introduce permeable surfacing where hard cover is required. We will seek to develop planning policy to limit impermeable surfacing in new development.

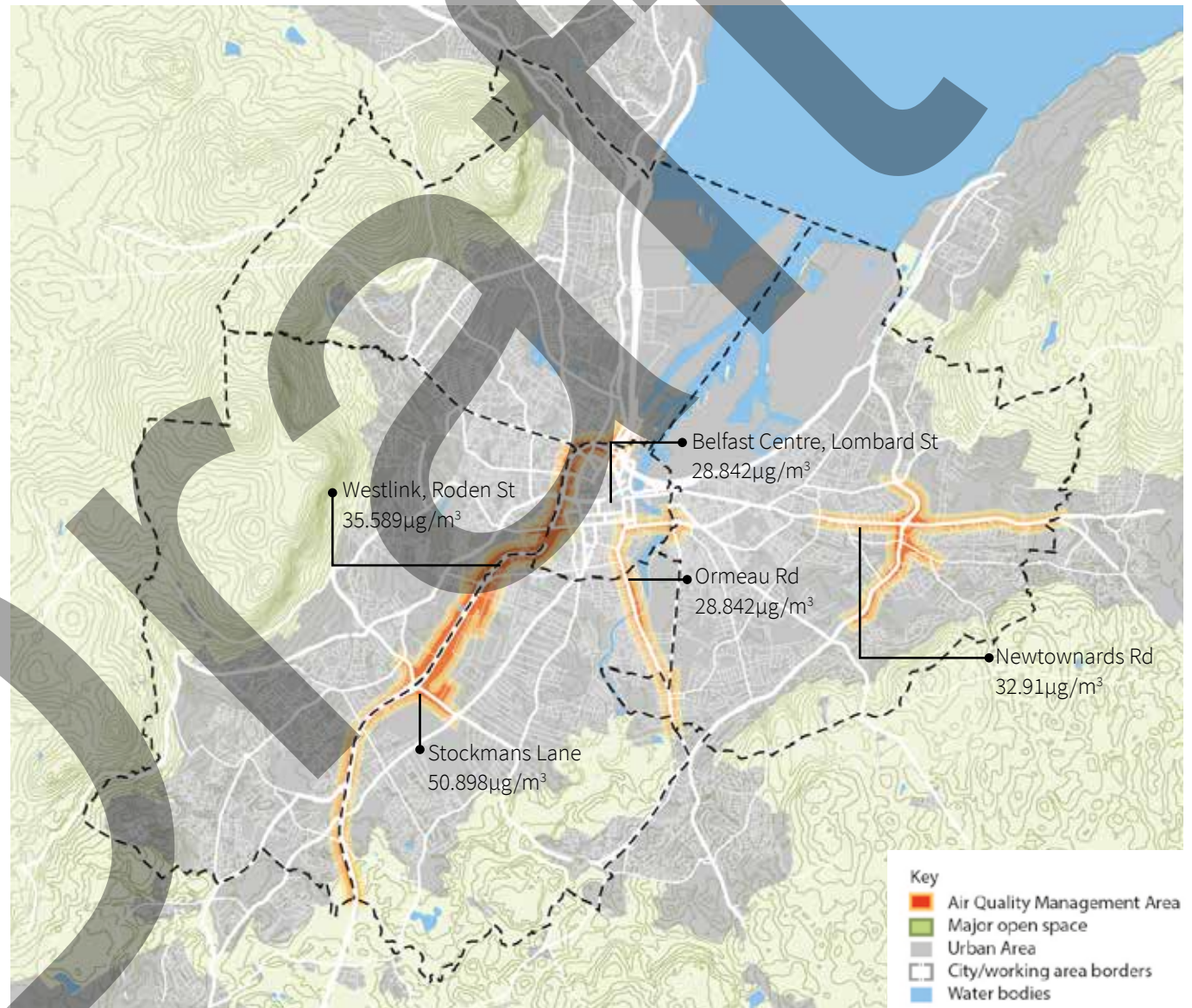


Figure 14. Air Quality Management Areas (AQMAs) in Belfast

Principle 4: Well designed and managed

All infrastructure should be designed to meet desired needs and will require effective ongoing management to ensure that it functions effectively. Green and blue infrastructure is no exception. As highlighted previously, it is recognised that all green and blue infrastructure should be delivered with biodiversity in mind, but if designed and managed effectively it can also deliver multiple societal benefits.

Place making

Making Belfast 'welcoming, safe, fair and inclusive for all' is particularly important in the city's publicly accessible open spaces. Well designed and managed green and blue infrastructure reinforces and enhances local character, and can create a strong identity with interest and distinctiveness.

Social cohesion and safety

The perception of place and its quality can be tied to how people feel about their local open space and how safe they feel using it, how satisfied they are by it and how active they are likely to be. Through the encouragement of activity and passive surveillance of open spaces, a sense of place is reinforced improving social cohesion and helping to reduce anti-social behaviour and crime. As has been demonstrated with the removal of the Peace Line along Crumlin Road which has been replaced with a 300m landscaped path and space for community uses, positive responses are already being shown. Through, Together: Building a United Community, targets have been set to remove these barriers in recognition of the social cohesion and shared space benefits.

Attracting investment

Creating a high quality, attractive environment across the city is also vital for attracting inward investment. Although the value of water front development has been recognised for a long time, research by Eftec and Sheffield Hallam University found that 95% of real estate development consults surveyed believed that green open space also adds a premium to development of around 3% (although estimates vary from 1-9%).

Health and wellbeing

In addition to providing places for formal sport and informal recreation with improved cardio, respiratory and mental health benefits, green and blue infrastructure has been shown to increase workforce productivity, reduce the number of sick days and improve recovery times.

Tourism and visitor spending

In addition to commercial investment, the quality of green and blue spaces helps attract visitors, both locally and internationally. Attracting people in their own right, such as the botanic gardens, or providing spaces to stop, reflect or play within the city help to retain people for longer and increase visitor spend.



Cherryvale Playing Fields, Belfast

Source: Belfast City Council



Ormeau Park, Belfast
Source: Belfast City Council

Principles of good design and management

Although every space should be planned, designed and managed to take into consideration the local context, there are a number of overarching principles that contribute to the success of green and blue infrastructure. These principles embed sustainability into our open space design, considering the social, environmental and economic longevity of our green and blue infrastructure.

Welcoming, accessible and inclusive

Belfast's spaces are enjoyed by residents and visitors alike. Spaces should be welcoming with clear access points that cater for different abilities and ages. It is important, however, to balance the needs of people with biodiversity. As highlighted throughout this GBIP, biodiversity is key to delivering many of the benefits and in some places access to space by people might need to be restricted to support sensitive and vulnerable species.

Native and species rich

Green spaces can become 'green deserts' with limited ecological value. In supporting biodiversity we encourage the use of species rich meadow grassland and planting focusing on native species. Where appropriate, gang mowing should be restricted to support biodiversity. Through the implementation of the GBIP the council seeks to achieve net gain in biodiversity.

Readable

As well as being accessible, it should be clear how to move around and between spaces. This does not necessarily mean signage, but can also be done with landforms and paying attention to desire lines. It is as important to guide people away from more sensitive areas as it is to show them where to go.

Reflective

Green and blue infrastructure should enhance our spaces and support them to reflect the local context - its built, natural and cultural heritage. Carefully considered design, the use of local materials and where possible crafts and skills will ensure our strong heritage is woven into the fabric of our city.

Safety by design

Spaces that are accessible to the public should be designed to be safe, and feel safe. Again this does not need to be done through intrusive features, but can be done through the design including consideration of sight lines, particularly around entrances, and avoiding places where people can hide. Fencing can be derisive, although it may be appropriate in some instances, they can also make spaces feel trapped and restrict movement. We recognise the importance and encourage natural play, but risks need to be minimised and common sense must be applied.

Easily managed

Open spaces should be designed with consideration given to their long term management; ensuring this is not onerous with heavy resource requirements. Develop a management plan that is agreed with the council. This should outline the appropriate approaches and who has responsibility to ensure these spaces remain of a high quality.

Resource efficient

Spaces should be efficiently managed and where possible make use of natural processes. For example, using livestock to keep grass levels low and using vegetated areas to remove pollutants from waterways. Sustainable, local and low embodied carbon building materials should be used where needed.

Integrate play and health

Play does not have to be formal play areas. There are opportunities to integrate play across many of our green and blue spaces. This should also extend to adults, encouraging active movement and interest in the outdoors.

Multifunctional and Adaptable

Spaces can and should be designed to respond to change. Community needs will shift and alter over time, as such our spaces should be flexible enough to continue providing benefits. There are degrees of change that should be considered, over the course of a day, a week, the seasons or total change. Spaces should be usable throughout the year. For example: one-off events, temporary uses, regular events such as weekly markets or seasonal changes. Climate change is already having an impact on our green spaces with longer drier spells requiring more park management and the threat of invasive and alien species needing to be monitored. We need to ensure that our green and blue spaces are adaptable to climate change.



Falls Park, Falls Road, Belfast

Source: Belfast City Council

Principle 5: Appropriately funded

As we have seen throughout this GBIP, our vegetated areas and waterways/waterbodies are valuable assets that provide a wide range of benefits. As such, they are increasingly recognised as essential infrastructure and need to be appropriately funded to ensure that they continue to function effectively. There are a number of approaches to funding that will be used to create and enhance our green and blue infrastructure:

- Physical Investment Programme – The Physical Investment Programme is the primary source for capital funding for improvements in leisure provision including our parks. This programme draws on a range of funding pots including the Belfast Investment Fund and the Local Investment Fund. The Department will also be responsible for delivering over 20 projects on behalf of the Executive Office under the Social Investment Fund and the Urban Villages initiatives.
- Developer contributions – Under Section 76 of the Planning Act (Northern Ireland) 2011, the council may require developer contributions as a means of policy compliance in order to make a development permissible. Where a developer increases the demand for a particular infrastructure asset, such as green space or drainage, they can be expected to contribute to the delivery of measures to enhance the existing network in order for it to accommodate the growing population. Where developers are unable to deliver sufficient green space on site or where it is preferable to, the council will use developer contributions to create spaces off site, enhance existing spaces or improve the connection to/between existing spaces across the city.
- Commercial Arrangements – There are a range of potential commercial arrangements that we can enter into to help sustain our spaces. These could be large, one off events or temporary events such as concerts or smaller concessions or pop-up initiatives. We are however conscious that our spaces are for everyone and we would not like to see them effectively become ‘privatised’. As such, although we will encourage commercial activities within our green spaces, we will only do so where they demonstrate community benefits and limit long term disruption to the general use of the space.
- Independent funding bodies – There are a wide range of independent funding bodies for green and blue spaces, including major funders such as the Heritage Lottery Fund which helped fund the formation of the Belfast Hills Partnership. The PEACE IV programme also includes a shared spaces theme which may contribute where appropriate. There are also a wide range of smaller natural environment and recreation charities that provide funding opportunities.
- Cross-departmental funding - In some instances, there may be opportunity for joint ventures between departments with a shared interest in projects. Possible opportunities for partnerships with DAERA exist, linking into their River Basin Management Plan. Northern Ireland Water funded the flood alleviation works that formed part of the Connswater Community Greenway Project.
- Payment for ecosystem services – in delivering some of our integrated green and blue infrastructure we will be looking to our utility providers to support initiatives. In particular we are keen to work with Northern Ireland Water to investigate opportunities for creating SuDS across the city to reduce the pressure on their networks and enable new development to be unlocked.



*Barnetts Demesne Recreation Centre, Belfast
Source: Bradley, M - Belfast City Council provided*

Making it happen

This is the first Green and Blue Infrastructure Plan for Belfast; and it is just the beginning. This plan will provide a long term framework with guidance setting out how we will work hard to create and enhance green and blue infrastructure that benefits everyone in our city. This is a cross cutting plan that will need support from across the public sector and will need to directly involve developers and local communities and will continue to develop. In implementing the plan, the priorities will be:

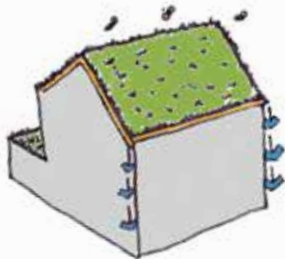
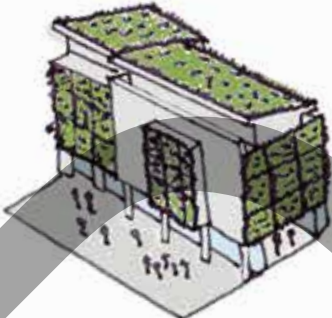
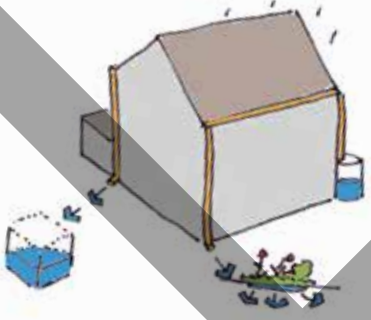
- Review and create supporting policy and strategies - To support this GBIP will be a number of companion strategies that will provide more details for specific elements of the network. This includes Belfast's Open Spaces Strategy, which focuses on planning for recreational spaces in the city and the Local Biodiversity Action Plan which sets out the need for the creation and management of priority habitats and species across the city. This structure is illustrated in Figure 4.
- Planning – This GBIP sets out the strategic framework for the future development of the green and blue infrastructure network. This is reinforced by the Local Development Plan and will be a material consideration in determining planning applications and in planning strategic investment. Planning also offers the opportunity for development contribution funding as highlighted above.
- Considering local context – We are working to create local plans for each of the working group areas. These will be led by Local Area Management Groups who will work with stakeholders to make decisions on the creation, enhancement and management of open spaces in each of the areas. These groups will also have the responsibility for ensuring that the quality of spaces and services within these spaces meet community expectations. For specific sites we will develop Site Regeneration Plans and in creating high quality spaces we will continue to develop and deliver our Green Flag Management Plans.
- Work closely with communities - As highlighted throughout this strategy, successful spaces need strong community input. We are keen to work closely with community representatives, groups and volunteers in shaping the future of local spaces.
- Preparing for the long term - this plan puts in place the priorities to adapt to long term changes that will impact our city including the expected population growth and climate change.



Sir Thomas and Lady Dixon Park, Belfast
 Source: Arrebola, P - Belfast City Council provided

Appendix

Green Infrastructure SuDS Typologies and Design Ideas

Typology	Description	Required area
Green/Blue Roofs	 <p>Where it is structurally possible, replacing conventional roof coverings on sheds or building roofs will not only provide temporary water capture; slowing down how quickly rainwater reaches sewers, it also provides habitats to encourage biodiversity and is aesthetically pleasing. Green roofs also reduce energy costs throughout the year providing insulation in the winter and cooling in the summer.</p>	Building integrated
Green Walls	 <p>Also known as living walls, can either be retrofitted onto existing façades, or for new builds actually form part of the external structure. The wall structure usually provides a substrate with an integrated irrigation system. Green walls often have high water demand, so for efficiency are often connected to rain water collection tanks. Some interlinked systems can use gravity fed irrigation. For longevity it is crucial that the plant species selection takes into consideration the location of the wall, but can be used in numerous situation both externally and internally.</p>	Building integrated
Rainwater Harvesting	 <p>Water storage tanks such as water butts can be connected to downpipes to collect roof runoff during storm events which can then be used for non-potable purposes such as watering gardens or cleaning cars at a later time. Water bills are reduced through water savings made.</p>	Water storage (underground or above ground).

Soakaways



A soakaway is designed to allow water to quickly soak into permeable layers of soil. Constructed like a dry well, an underground pit is dug filled with gravel or rubble. Water can be piped to a soakaway where it will be stored and allowed to gradually seep into the ground.

Dependant on runoff volumes and soils.

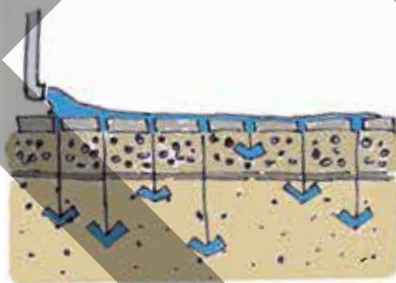
Filtration strips



Filtration strips are grassed or planted areas that runoff is allowed to run across to promote infiltration and cleansing.

Minimum length 5 metres.

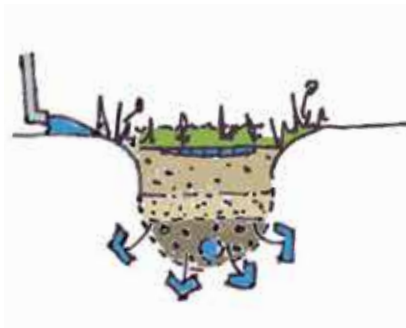
Permeable paving



Replacing previously concreted or impermeable public spaces with paving which allows water to soak through gaps between solid blocks or through the use of porous paving materials which filter and slow down water as it passes through to the ground or to drains, Water can be stored beneath the surface and be allowed to slowly infiltrate the ground or into storage systems.

Can typically drain double its area.

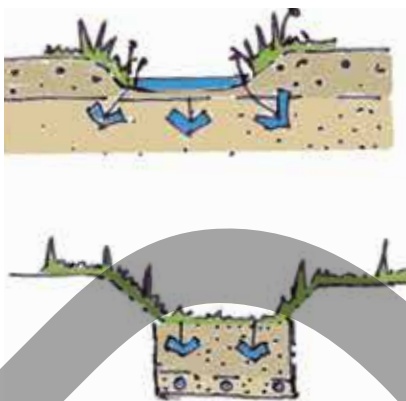
Bioretention area



Vegetated areas with permeable layers such as sand or gravel which have been designed to channel, filter and clean water. Water is collected and passes down through these layers into the ground or drain below or can drain into a perforated pipe to be conveyed elsewhere. These can be connected to onstreet raingardens as part of a network resulting in the collection of less polluted water which otherwise impacts waterways and waterbodies.

Typically surface area is 5-10% of drained area with storage below.

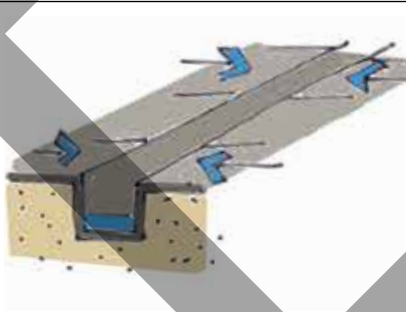
Swale



Shallow channels or depressions in the ground which have been specifically designed to convey and filter water. Swales can be designed to be either wet, where water is temporarily stored above surface or dry, where water is allowed to infiltrate down to a gravel layer under the surface. Swales support biodiversity as well as provide attractive areas that bring multiple ecosystem benefits as well as flood risk reduction.

Account for width to allow safe maintenance typically 2-3 metres wide.

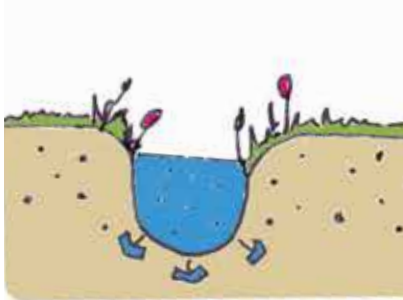
Hardscape storage



The use of rills in hard landscapes adds interest and design features as well as allowing for the conveyance of water. Includes hard edged channels designed to allow water to flow down them which can be connected to areas of planting or to other SuDS features.

Could be above or below ground and sized to storage need.

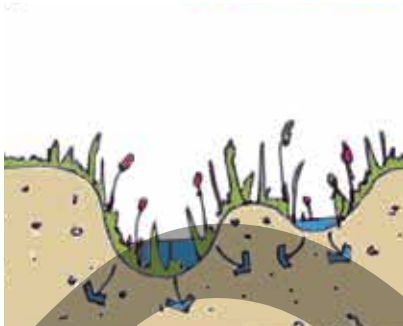
Pond/basin



Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.

Dependant on runoff volumes and soils.

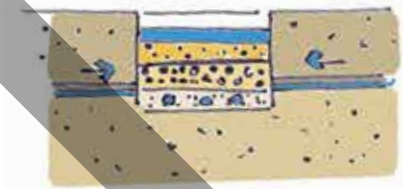
Wetland



Shallow vegetated water bodies which can, depending on where they are implemented, have different water levels. It is important to plant the wetlands with plant species that are capable of water filtration as this is an important opportunity presented by a wetland. Water flows through the wetland, being treated as it passes through the vegetation until it is discharged. There are opportunities to integrate wetlands at varying scales into both natural and hard landscapes.

Typically 5-15% of drainage area to provide good treatment.

Underground storage



Water can be stored in tanks, gravel or plastic crates beneath the ground to provide attenuation. This feature, however, does not provide the wider benefits that other green SuDS do, and should be viewed as a secondary option.

Dependant on runoff volumes and soils.

Street trees (with bioretention areas)



Planting of more street trees will not only contribute to improved air quality, improved flood risk management but also make the street more aesthetically attractive. It will be important to ensure that new street trees planted have low VOCs and are not planted in a way that traps pollution.

Can be designed to fit the width and pavement.

Raingardens



Small temporary water storage tanks and ponds which support aquatic flora and fauna can be connected to disconnected downpipes or incorporated into onstreet tree pits. Raingardens collect and temporarily store water during storm events. Creating a network of raingardens allows for greater collection, filtration and redistribution opportunities. They are attractive features which can transform the look of a garden or entire street. In some cases, they can even be used as traffic calming measures.

Can be designed to fit the space available.

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