BATH CITY RIVERSIDE ENTERPRISE AREA MASTERPLAN

NATURAL ENVIRONMENT EVIDENCE BASE

On behalf of Feilden Clegg Bradley for Bath and North East Somerset

06 NOVEMBER 2015

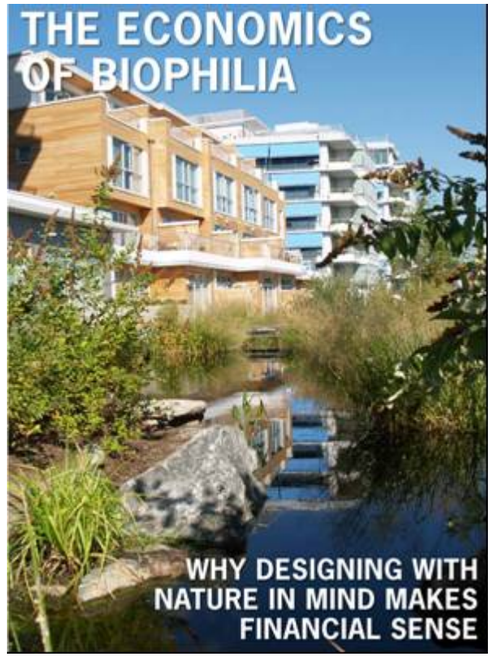
Rev 2 Final

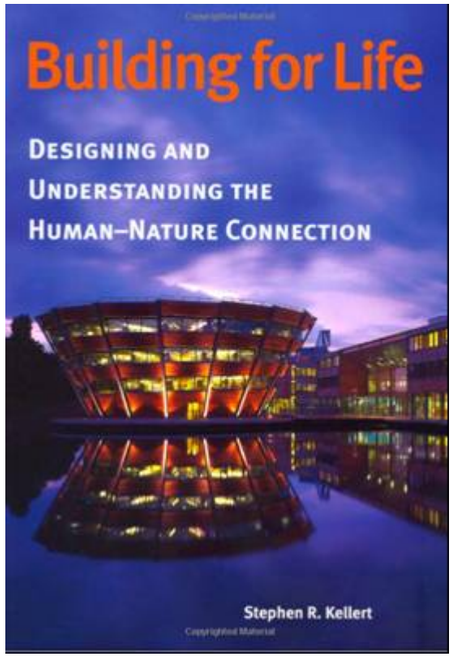
BIODIVERSITY BY DESIGN

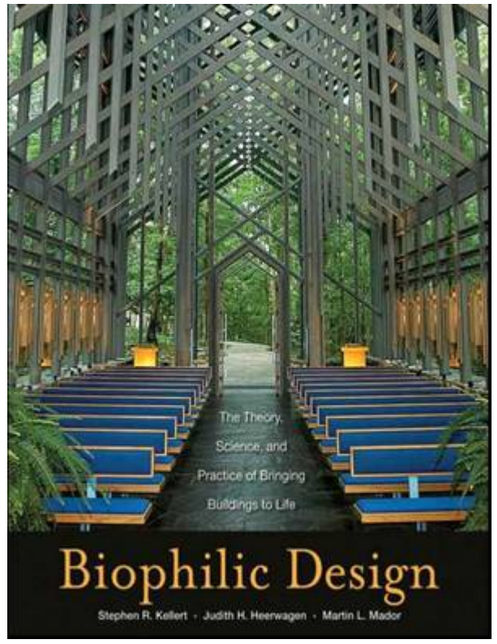
EXECUTIVE SUMMARY

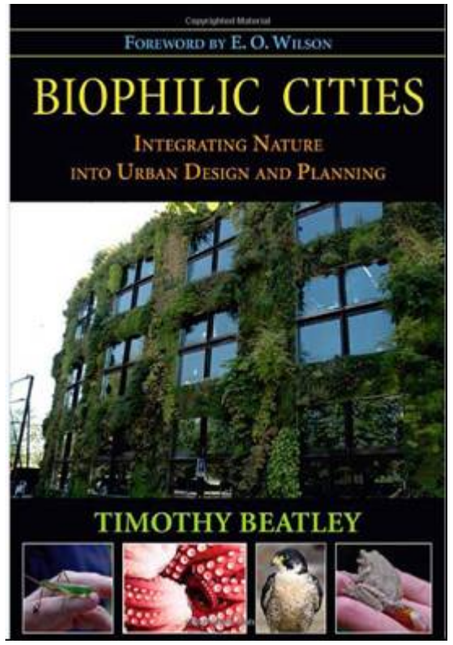
The present document constitutes a synopsis of the ecological baseline for the Bath Riverside Enterprise Area. The synopsis goes beyond summarising current ecological resources within the BCREA and its relevant vicinity; the key potential for the enhancement of ecological resources and ecosystem services is also indicated and illustrated. At this stage the document is a working draft for B&NES review and comment. As such certain sections relating to potential and enhancement are not fully complete. Also, whilst generic and representative fauna of the key habitats could have been listed, it is preferred to inform such a listing with the actual records from the Bristol Biological Records Centre, work that is still in progress. The key conclusions of the review work undertaken to this point in terms of biodiversity and ecosystem services are as follows:

1. There are some very significant ecological resources in their own right given the urban context of the BCREA that need to be protected and where possible conservation status enhanced: primary amongst these are bats, Otters, Kingfishers, Peregrines and fish.
2. Whilst there are remarkably vegetated and reasonably dark (given the wider urban context) sections of river bank at the western end of the BCREA, 50% of the banks are hard structure with limited value in terms of hinterland vegetation.
3. Accordingly there is considerable scope for enhancement both of the biodiversity habitat and corridor value of the BCREA and the associated ecosystem services that this can furnish to the residents of and visitors to Bath.
4. The work has identified key ‘nodes’ along the BCREA where wildlife corridors intersect and/or there are features of particular ecological value in the river channel.
5. Enhancement works should in the first instance consolidate and enhance resources at these key nodes.
6. Between the nodes, a variety of possible techniques for installation and retrofit of biodiverse green infrastructure would appear to be both viable and desirable. Some of these techniques should be the subject of pilot applications before implementing at large scale.
7. Key drivers for net enhancement of the BCREA should be the concept of what has come to be known as ‘Biophilic Design’, whereby incorporation of biodiversity, clean water and variations in aspect and view can contribute focally to the wellbeing and productivity of citizens, thereby also resulting in a general increase in the perceived quality of place. Front covers of recently published works that explain the theory behind this approach to urbanism are shown opposite.









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APPENDIX 1:BRERC RECORDS RELEVANT TO STUDY AREA

1.0 SCOPE

The Natural England biodiversity webpage describes biodiversity as:

> *'the variety of life on Earth [encompassing] the whole of the natural world and all living things with which we share the planet'.*

The Resolutions made by the 2010 Convention of Parties at the Convention on Biological Diversity at Nagoya, Japan, centred around reversing the global and catastrophic loss of global biodiversity by 2020. The long-term protection, restoration and stewardship of biodiversity, now a matter of global concern and crisis, will no longer be achieved purely by focusing on networks of statutory nature reserves. The habitat value of the landscape 'matrix' between these areas is becoming increasingly important to permit movement of fauna between reserves, to buffer the reserves from outside influences and to provide additional habitat for some of the less specialized species This includes the urban landscape with its cliff-like buildings and savannah-like parks and gardens.

Biodiversity in the urban realm also has important value to man in the provision of what are now called 'urban ecosystem services'. Ecosystem services can be defined as benefits people obtain from ecosystems. These benefits are not always apparent to the casual observer other than the contribution of living things to an aesthetic appreciation of colour and form in the landscape within the urban realm.

The key ecosystem services that are being considered within the context of BCREAM are:

- Contributions towards psychological well-being through providing opportunities for interaction with flora and fauna, the provision of birdsong, floral bouquet etc. Around the world there are commonalities of response across many cultures and types of people to nature. Positive responses to nature have been termed biophilic responses (Kellert & Wilson 1993). The key landscape elements that appear to contribute most to positive psychological responses based on studies worldwide are:
  - o A semi-forested biodiverse landscape
  - o A landscape with clean fresh and ideally flowing water
  - o A landscape with significant topographic refuges (these can be provided by buildings).
- Increases in property value, attributed indirectly to the above responses.
- Contributions to environmental cleansing systems e.g. filtration and neutralisation of airborne pollution and purification of rainwater runoff.
- Local thermal benefits: through direct shading and evapotranspirative cooling.

There is an intimate relationship between biodiversity and quality of provision of ecosystem services. The stability of ecosystems tends to increase with biodiversity which in turn leads to an increase in the number and quality of services provided.

The present document addresses biodiversity and ecological services as they feed in to topic areas as identified in the Creative Brief (B&NES 2013); see Box 1.1

Box 1.1: Extracts from the Creative Brief Relevant to Ecology and Ecosystem Services

Reference	Relevance to Ecological Brief
Bath will be internationally renowned as a beautifully inventive...city	Much can be done in ecological design to promote this reputation. A river corridor-wide living roof incentive policy could be one example, following the examples of the European mainland.
A place that connects people to the natural environment	Much of the river corridor disconnects people from nature and regeneration projects and river management have removed much of what nature there is.
Minimising of risks to delivery of the masterplan	Protected species issues may be relevant especially relating to Horseshoe Bats as impacts on these can be considered in breach of the Habitats Regulations as they may ultimately affect the integrity of the Bath Stone Mines SAC.
Testing of the principles which B&NES have already produced	The main ones ecologically are the Green Infrastructure Strategy and the Emerging River Strategy.
Essence is often the biophilic properties of place that can either heal or harm psychologically or physically. Ecosystem services are much less commonly addressed, including psychological wellbeing; broad estimates of their net economic value to society would be made.	
Compliance with NPPF framework	Critical here is the concept of sustainable development and what that means in terms of urban green infrastructure provision and contributions to the ongoing losses of native biodiversity.
Specialist Marketing to Investors and Business	Proposals to contribute to the Delivery Strategy in helping to prepare elements of the marketing pitch through selling the concept of ecosystem service provision throughout the entire zone.
.... how a sensitive and beautiful World Heritage City expands and renews itself as a relevant, living and contemporary place...	Many parts of the riverside at present, despite some recent regeneration works, strongly detracts from this goal. Biodiverse design can truly help to remedy this and respond to the very popular movement towards interest in biodiversity conservation and restoration in the UK, especially in urban areas.
A visitor destination of international renown	Biodiversity, especially in relation to the tremendous resources that can colonise post-industrial land, can become a design resource of international appeal.
The EA should consider..... the future climate e.g. to ensure resilience to heatwaves, storm and flooding	Green infrastructure can deliver the ecosystem services necessary for climate change adaptation.

2.0 POLICY FRAMEWORK

2.1 OVERVIEW OF KEY POLICY DOCUMENTS RELATING TO BIODIVERSITY AND ECOSYSTEM SERVICES

2.1.1 NATIONAL PLANNING POLICY FRAMEWORK

The National Planning Policy Framework (NPPF issued in March 2012) sets out the Government's planning policies for England and how these are expected to be applied. It introduces a presumption in favour of development, but qualifies this with the word 'sustainable' – and that includes environmental, social and economic aspects of sustainability. It provides a framework within which local people and their accountable councils can produce their own distinctive locale and neighbourhood. The two main sections of the NPPF relating to the brief are Section 10: Meeting the challenge of climate change, flooding and coastal change & Section 11: Conserving and enhancing the natural environment. As regards climate change the NPPF charges Local Authorities to take a proactive approach to mitigation and adaptation to such change and to long-term effects on biodiversity. It expects new development to 'take account of ...landscaping to minimise energy consumption'. As regards the Natural Environment, policy focuses on preservation of key ecological assets and avoiding adverse effects on the, seeking net gains where possible; and recognising the wider benefits of ecosystem services. Emphasis is placed on seeking opportunities to remediate degraded or derelict land. Emphasis is also placed on landscape-scale planning for biodiversity across administrative boundaries and promotion of the preservation, restoration and re-creation of priority habitats and the protection and recovery of populations of priority species; and to permit development proposals where the primary objective is to conserve or enhance biodiversity. The policy aims to minimise ground, aquatic, noise or light pollution.

2.1.2 UNEP-WCMC (2011) UK NATIONAL ECOSYSTEM ASSESSMENT: UNDERSTANDING NATURE'S VALUE TO SOCIETY

The UK National Ecosystem Assessment (UK NEA 2011) was the first analysis of the UK's natural environment in terms of societal economic and other benefits. The study found that around a third of the ecosystem services provided by terrestrial and aquatic ecosystems in the UK are declining and many others are degraded due to loss of habitat extent and condition. Some 40% of Priority Habitats and 30% of Priority Species were reported to be in decline. The assessment concludes that pressures will increase with climate change and population increase, that we cannot leave the solution to market forces and that a change to trans-sectoral governance and societal change will be needed to move towards sustainable development.

2.1.3 HM GOVERNMENT (2011) ENVIRONMENT WHITE PAPER: THE NATURAL CHOICE: SECURING THE VALUE OF NATURE (ENGLAND)

The first White Paper on the natural environment in England in 20 years was published in 2011 and was directly linked to the UK NEA and Lawton report. The White Paper (Defra 2011a) recognises that the natural environment is sometimes taken for granted and undervalued, but that people cannot flourish without the benefits and services it provides, asserting that: *'A healthy, properly functioning natural environment is the foundation of sustained economic growth, prospering communities and personal wellbeing.'* Key proposals relevant to development include the promotion of better urban green spaces for the benefit of cities and towns and allowing local communities to give formal protection to areas that are important to them for recreation, the view or their importance for wildlife. Ecosystem services are now also for the first time included within in the national treasury accounts.

2.1.4 ENGLAND BIODIVERSITY STRATEGY (2011): BIODIVERSITY 2020: A STRATEGY FOR ENGLAND'S WILDLIFE AND ECOSYSTEM SERVICES

Building on the NEA and White Paper and other documents the England Biodiversity Strategy (Defra 2011b) sets out a Vision for England's biodiversity as follows:

'By 2050 our land and seas will be rich in wildlife, our biodiversity will be valued, conserved, restored, managed sustainably and be more resilient and able to adapt to change, providing essential services and delivering benefits for everyone.'

It also states a government mission up to 2020 to:

> *'halt overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks, with more and better places for nature for the benefit of wildlife and people.'*

Key initiatives include the establishment of Nature Improvement Areas and biodiversity offsetting. There is, however, a potential threat that biodiversity offsetting could result in urban areas relatively denuded of nature; offsetting is only being considered at present on a trial basis.

2.1.5 THE 'UK POST-2010 BIODIVERSITY FRAMEWORK' (JULY 2012)

The 'UK Post-2010 Biodiversity Framework' (JNCC July 2012) succeeded the UK BAP 1994 and 'Conserving Biodiversity – the UK Approach' 2007 after Nagoya and the Aichi targets. The framework demonstrates how the work of the UK and each of its component countries contributes to achieving the 'Aichi targets'. It also identifies the activities required to complement the country biodiversity strategies in achieving the targets.

The new Biodiversity Action Reporting System is a new tool for measuring the progress towards meeting the goals of this framework.

2.1.6 PLANNING FOR A HEALTHY ENVIRONMENT – GOOD PRACTICE GUIDANCE FOR GREEN INFRASTRUCTURE AND BIODIVERSITY

This guidance document (Town & Country Planning Association & The Wildlife Trusts issued in July 2012), prepared by a wide range of organisations, recognises the importance of the planning system in delivering sustainable development, protecting and enhancing biodiversity, and delivering well-planned green infrastructure (GI), within the context of the Localism Act 2011 and the NPPF. The guidance sets out a list of key principles to follow when planning and creating climate-resilient GI for biodiversity and people.

2.1.7 BATH AND NORTHEAST SOMERSET: DRAFT CORE STRATEGY

The Core Strategy document (B&NES 2010) provides the strategic framework for how B&NES will manage the development and use of land up to 2026. It identifies the broad locations for new homes and offices, provides direction for response to climatic change and ensures the protection of key environmental assets in order to achieve a sustainable future.

2.1.8 VALUING PEOPLE, PLACE AND NATURE: A GREEN INFRASTRUCTURE STRATEGY FOR BATH AND NORTHEAST SOMERSET

This document (B&NES 2013) sets out the strategy to provide a framework for realising and sustaining the full benefits of the

natural environment to support people, place and nature. Policy priorities for the strategy are:

- Put the value of nature at the heart of decision making
- Deliver through the planning process by integrating green infrastructure principles into the Placemaking Plan and other Local Plan documents
- Influence related Council strategies and work streams
- Deliver the biodiversity requirements set out in the National Planning Policy Framework.

2.1.9 BATH & NORTHEAST SOMERSET LOCAL STRATEGIC PARTNERSHIP: SUSTAINABLE COMMUNITY STRATEGY 2009 – 2026

The Sustainable Community Strategy (BANES 2009) sets out a vision for Bath & Northeast Somerset in 2026. The Partnership is a group bringing together stakeholders in Bath's business, utilities and community sectors with a common understanding that sustainability can be defined as being about delivering improvements to quality of life now without compromising the quality of life of future generations.

Two of the key issues to be addressed were:

- Leading B&NES to an environmentally sustainable, low carbon future resilient to climate change;
- Helping individuals to achieve their potential by improving health and wellbeing.

2.2 BIODIVERSITY POLICY: SPECIFICS

2.2.1 NATIONAL PLANNING POLICY FRAMEWORK

The Government's key planning policies relating to biodiversity are set out as excerpts from the NPPF in Box 2.1:

Box 2.1: NPPF Key Policies on Biodiversity

Para.	Policy
109 (in part)	*The planning system should contribute to and enhance the natural and local environment by:* • *minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures*
	• *protecting and enhancing valued landscapes, geological conservation interests and soils;* • *minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures;*
111 (in part)	*Planning policies and decisions should encourage the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value*
113	*LPAs should set criteria based policies against which proposals for any development on or affecting protected wildlife or geodiversity sites or landscape areas will be judged. Distinctions should be made between the hierarchy of international, national and locally designated sites, so that protection is commensurate with their status and gives appropriate weight to their importance and the contribution that they make to wider ecological networks.*
114 (in part)	*LPAs should set out a strategic approach in their Local Plans, planning positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure;*
117 (in part)	*To minimise impacts on biodiversity and geodiversity, planning policies should:* • *identify and map components of the local ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity, wildlife corridors and stepping stones that connect them and areas identified by local partnerships for habitat restoration or creation;* • *promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations, linked to national and local targets, and identify suitable indicators for monitoring biodiversity in the plan;* • *where Nature Improvement Areas are identified in Local Plans, consider specifying the types of development that may be appropriate in these Areas.*
118 (in part)	*When determining planning applications, local planning authorities should aim to conserve and enhance biodiversity by applying the following principles:* • *if significant harm resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts),adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused;* • *development proposals where the primary objective is to conserve or enhance biodiversity should be permitted;* • *opportunities to incorporate biodiversity in and around developments should be encouraged;* • *planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss;*
125	*By encouraging good design, planning policies and decisions should limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

2.2.2 PLANNING FOR A HEALTHY ENVIRONMENT – GOOD PRACTICE GUIDANCE FOR GREEN INFRASTRUCTURE AND BIODIVERSITY

Key principles relating to biodiversity are summarised from this document in Box 2.2.

Box 2.2: Key Principles relating to Biodiversity in Green Infrastructure from the Planning for a Healthy Environment Guide (2012).

Number	Principle
1	*GI needs to be strategically planned to provide a comprehensive and integrated network:*
2	GI requires wide partnership buy-in, Local authorities are advised to work in consultation with Local Nature Partnerships and communities to achieve this
3	GI needs to be planned using sound evidence: The planning and implementation of GI should be based on up-to date ecological evidence on and information about GI assets.
5	GI creation and maintenance need to be properly resourced
7	*GI should contribute to biodiversity gain by safeguarding, enhancing, restoring, and creating wildlife habitat and by integrating biodiversity into the built environment*
8	*GI should achieve physical and functional connectivity between sites at strategic and local levels: Although a physically joined-up network is desirable, simple proximity can be enough to functionally integrate an individual green space such as a private garden into a wider network*

2.2.3 BATH AND NORTHEAST SOMERSET DRAFT CORE STRATEGY

Key policies on biodiversity from the B&NES Draft Core Strategy are summarised in Box 2.3.

Box 2.3: Key policies on biodiversity from the B&NES Draft Core Strategy (2010)

Number	Policy
DW1: District-wide Spatial Strategy (in part)	*The overarching strategy for B&NES is to promote sustainable development by:* *prioritising the use of brownfield opportunities for new development in order to limit the need for development on greenfield sites* *protecting the district's biodiversity resource including sites, habitats and species of European importance*
B1: Bath Spatial Strategy (in part)	*The strategy for Bath is to protect, conserve, and where possible, enhance:* *The network of green spaces and wildlife corridors including the River Avon and Kennet and Avon Canal, Local Nature Reserves, formal and informal parks and recreational areas, trees and woodlands.* *protecting the district's biodiversity resource including sites, habitats and species of European importance.*
B2: Central Area Strategic Policy (in [part)	*The following characteristics combine to provide an exceptional urban environment. Development proposals must demonstrate that they have been inspired and shaped by these characteristics:* *The River Avon and its banks are of nature conservation value and provide opportunities to connect people to the natural environment.*
B3: *Twerton and Newbridge Riverside Strategic Policy (in part)*	*Assets of Newbridge and Twerton Riverside Development proposals must be informed and shaped by the following characteristics* *The river including its banks and open land at the western section of the area are an important wildlife resource*
CP6: Environmental Quality	*The quality, extent & robustness of protected sites and valued habitats will be enhanced, and networks of valued habitat will be restored or created, by measures which:* *Improve the quality and/or increase the size of current sites and valued habitat.* *Enhance connections between, or join up, sites and valued habitats.* *Create new sites and valued habitats.* *Reduce the pressures on wildlife by improving the wider environment* *New Development will, in particular, respect and enhance existing networks of priority habitat; facilitate migration and dispersal though the natural and built environment; and seek to reduce fragmentation of existing habitats.* *The Council will promote the management, conservation, enhancement or restoration of environmental assets. Sustainable opportunities for improved access to and enjoyment of these assets will be promoted where it does not compromise the integrity of the asset.*

2.2.4 VALUING PEOPLE, PLACE AND NATURE: A GREEN INFRASTRUCTURE STRATEGY FOR BATH AND NORTHEAST SOMERSET

Delivery aims and objectives relating to biodiversity from the Bath Green Infrastructure for Bath (2013) are summarised in Box 2.4.

Box 2.4: Delivery aims and objectives relating to biodiversity from the Bath Green Infrastructure for Bath (2013)

Aim	Objectives
Maintain and create robust ecological networks by reducing fragmentation and delivering habitat restoration, re-creation and biodiversity enhancements	• Deliver habitat restoration targets, enhance biodiversity and improve habitat connectivity through new GI • Deliver net biodiversity gains through well planned green infrastructure and beneficial design features in both new or restored buildings • Identify the full potential of Council owned land for delivering biodiversity benefits • Achieve robust ecological networks, prioritising links between ...the river and canal corridors • Explore ways to improve urban ecology • Work with partners to support on-going and new landscape scale projects • Develop a robust biodiversity monitoring system to tie in with national targets.

2.3 ECOSYSTEM SERVICES

2.3.1 NATIONAL PLANNING POLICY FRAMEWORK

The Government's key planning policies relating to ecosystem services provision are set out as excerpts from the NPPF in Box 2.5:

Box 2.5: NPPF Key Policies on Ecosystem Service Provision

Para.	Policy
94	LPAs '*should adopt proactive strategies to mitigate and adapt to climate change, taking full account of flood risk...*'
96 (in part)	*To support the move to a low carbon future,* LPAs *should... actively support energy efficiency improvements to existing buildings*
109 (in part)	*The planning system should contribute to and enhance the natural and local environment by:* • *recognising the wider benefits of ecosystem services;* • *preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air,* • *remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate water or noise pollution or land instability*

2.3.2 PLANNING FOR A HEALTHY ENVIRONMENT – GOOD PRACTICE GUIDANCE FOR GREEN INFRASTRUCTURE AND BIODIVERSITY

Key principles relating to ecosystem service provision by green infrastructure set out in the Planning for a Healthy Environment guidance (2012) are set out in Box 2.6.

Box 2.6: Key Principles on Ecosystem Service Provision set out in Planning for a Healthy Environment guidance (2012)

Number	Principle
4	*GI needs to demonstrate 'multi-functionality': The integration and interaction of different functions within a single site is sought where appropriate – and across a GI network as a whole. Within the network some spaces will have primary functions, such as biodiversity within nature reserves or amenity within local parks, but this does not necessarily exclude other functions. Multi-functional GI can also be viewed as the application of an 'ecosystem approach'*
6	*GI needs to be central to the development's design and must reflect and enhance the area's locally distinctive character: The GI network should be fully integrated within the design of a development, reaching into the built environment and incorporating gardens, open space, extensive corridors, and improvements that connect with the wider countryside and reflect and enhance local distinctiveness and landscape character.*
7	*..... The built environment should aim to be permeable to wildlife, incorporating design features aimed at sustaining and increasing the population of particular species and facilitating climate change adaptation.*
9	*GI needs to include accessible spaces and facilitate physically active travel: GI within a development should include attractive, engaging and safe outdoor spaces which meet a variety of social, health and well-being needs for local people*

2.3.3 BATH AND NORTHEAST SOMERSET DRAFT CORE DOCUMENT

Key policies on ecosystem services from the B&NES Draft Core Strategy are set out Box 2.7:

Box 2.7: Key Policies on Ecosystem Services from the B&NES Draft Core Strategy

Number	Policy
DW1: District-wide Spatial Strategy (in part)	*The overarching strategy for B&NES is to promote sustainable development by requiring development to be designed in a way that is resilient to the impacts of climate change*
B1: Bath Spatial Strategy (in part)	*The strategy for Bath is to:* • *protect, conserve, and where possible, enhance, regenerate and repair a number of areas within the Central Area and Western Corridor to create new areas of attractive and productive townscape and a much improved relationship between the city and its river* • *Implement the Air Quality Management Plan for Bath* • *Improve the energy efficiency of the built environment.*

2.3.4 VALUING PEOPLE, PLACE AND NATURE: A GREEN INFRASTRUCTURE STRATEGY FOR BATH AND NORTHEAST SOMERSET

The key aims relating to green infrastructure provision form the Bath Green Infrastructure Strategy are summarised in Box 2.8.

Box 2.8: Key Objectives on Ecosystem Services from the B&NES Green Infrastructure Strategy

Aim	Objectives
Recognise the importance of healthy ecosystems and protect and enhance the natural services they provide	• *Work with key partners to agree an ecosystem position statement and high level management plan for the district* • *Work with partners to deliver landscape scale habitat restoration* • *Prioritise green solutions for development infrastructure*

Plate 3.1: Bath Green Infrastructure Strategy Front Cover

3.0 ECOSYSTEM SERVICES AND THE BIOPHYSICAL ENVIRONMENTAL BASELINE

3.1 BIOPHILIC BENEFITS

'Biophilic Design', is a term that describes the incorporation of biodiversity, clean water and variations in aspect and view into design goals and approaches. It has been argued cogently by several authors (see images in the Executive Summary) that biophilic design can significantly improve human health along, social behaviour and development -improvements which in turn could be argued to have positive economic consequences both locally and nationally.

The potential economic importance of appropriately designed green infrastructure can be equated, e.g. through reductions in medical expenses. Comparisons of people in urban and forest atmospheres highlight the benefit of exposure to nature, demonstrating 13.4 -15.8% lower cortisol (stress hormone) levels, and 3.9-6% lower systolic blood pressure levels (Park *et al* 2010). Stress is known to cause cardiovascular disease as well as mental health disorders, and accounts for $1 of every $6 spent on healthcare in America (CDC 2011).

Biophilic design has been linked to improved behavioural symptoms in children suffering with ADHD (Taylor *et al*. 2009) and reduced costs in medication linked to physical inactivity. Furthermore over 50 studies have been published linking biophilic design with improved recovery times for patients in hospital (Wilson, 2012). A study in Sacramento, California (Wilson 2012,) estimated an annual saving in medical costs of $19.8 million as a result of access to park space.

The effects of green and blue infrastructure can also be linked to reduced absenteeism from work, decreasing potential lost earnings for the employee and increasing employer profit margins (Karaswek 1992, Biodiversity by Design and Ken Yeang 2011).

One of the proposed aims of BCREA is to encourage a 'creative hub' within the development. Creativity is stifled in a sterile environment. With this in mind William McDonough and Partners applied a biophilic approach to the design of the Herman Miller Furniture in Michigan. The design of a new office led to a 20% gain in worker productivity in 9 months. Although attribution of the positive response could not be broken down into different elements of the green design, office workers stated that they positively responded to the opportunities for contact with nature, the improved views and the presence of restored prairie and wetland habitats next to the office (Heerwagen, 2000).

Moreover, social benefits on housing developments that incorporate blue and green infrastructure have been investigated. It could be argued that green design encourages people outdoors, which in turn results in stronger social cohesion between neighbours (Heerwagen 2006). It is not, therefore, surprising that a reduced level of hostile behaviour is apparent in people benefiting from interactions with nature. A study of 145 urban public housing residents in Illonois, USA, in varying proximity to green space, showed higher scores of attention span and reliability in residents living in closer proximity to green environments, with a 25% reduction in some types of domestic violence (Kuo & Sullivan 2001). Biophilic design has also been linked to reduced crime rates: a study in Chicago comparing buildings surrounded by greenery to buildings barren of nature, showed 52% fewer felonies in the greener area, 7-8% of which linked to increased access to nature (Kuo & Sullivan 2001).

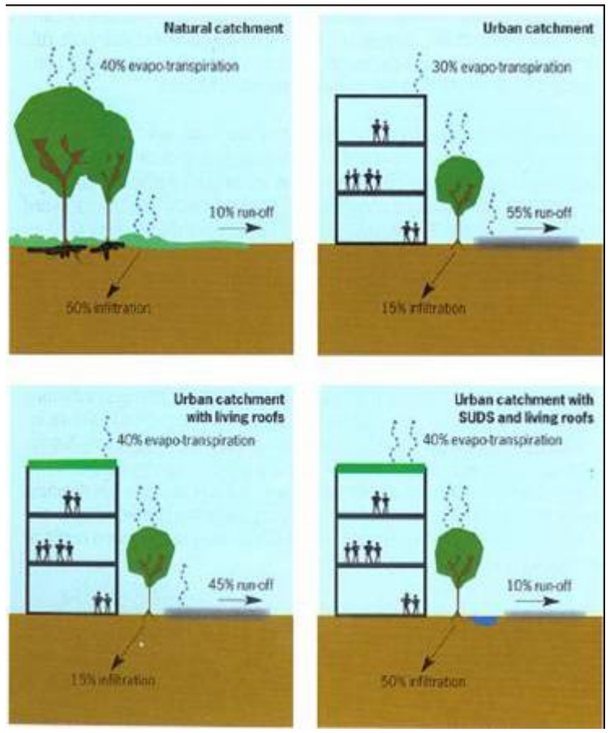
Biophilic design can be seen to improve the ability for children to focus, retain information and build social bonds (Wells & Evans 2003). This could also have long term wider benefits for the local and regional economy.

3.2 FLOOD RISK MANAGEMENT AND RUN-OFF WATER TREATMENT

The flood risk plans for the area are shown in the review by Buro Happold. In summary the plans show that nearly the entire BCREA is at risk of flooding in the most extreme 1:100 year flood events and that there are areas of particular risk including: the recreation ground, north keys (north bank), just upstream and downstream of Victoria Bridge (south bank) and just downstream of the Windsor Bridge on the north bank

Slowing down the discharge rate of rainwater to receiving waters can have multiple benefits including the reduction in flood risk and the protection of riparian ecosystems. The benefits of biophilic design depend on providing water that is clean and stays clean. Polluted waters engender significant negative responses. Achieving this benefit long-term entails a maintenance cost.

Figure 3.1: Effects of vegetation on urban rainwater runoff (from Grant, G. (2012). *Green Roofs*; with kind permission of the author



Creating new wetlands and living roofs and facades can greatly reduce runoff to match green-field runoff rates (see Figure 3.1). Research at the University of Manchester (2011) has shown that the creation of green infrastructure significantly offsets the risk of flooding. Increasing green space cover in urban areas by 10%, reduced surface run-off by almost 5%. Increasing tree cover in urban areas by 10% reduced surface water run-off by almost 6%. Perhaps the most significant finding was that adding green roofs to all the buildings in town centres could potentially reduce surface water run-off by almost 20% (Architecture and the Built Environment, 2011).

Grant (2012) suggests that a typical UK living roof with 100 mm of substrate absorbs 50% of the rain water that falls upon it each year.

By installing wetland systems that treat water, clean water can be obtained long-term largely using the power of the sun rather than

requiring, for example, treatment with chemicals that are both expensive and which have a high associated carbon cost in their production. The value of such systems can be measured in terms of maintenance-saved equations:

- Cost of mechanical cleaning and treatment of water to maintain quality per square metre of wetland;
- Multiplied by size of wetland in square metres;
- Less cost of SuDS maintenance (vegetation trimming, occasional flushing and de-silting).

Savings can be substantial if SuDS are well-designed.

SuDS are often proposed based on planting monocultures. However, in recent years it has been shown that more biodiverse SuDS can be more efficient in removal of pollutants and more robust in the long term (e.g. Millet 1997). The more robust a system is in relation to environmental change, the less frequently the system will need to be renewed.

3.3 AIR QUALITY AMELIORATION

3.3.1 Air Quality Parameters Relating to Bath

The Bath Air Quality Action Plan (B&NES, 2011) was developed in recognition of legal requirements under Part IV of the Environment Act (1995). Present and likely future air quality of the air is compared to National Air Quality Objectives including PM10, ozone, Nitrogen Dioxide (NO_2), sulphur dioxide (SO_2), and carbon monoxide (CO), all being health-threatening pollutants. Of these only NO_2 failed to meet the Objectives. However, there is a growing body of evidence that there is no safe threshold for exposure to air pollutants, especially PM (e.g. Brunekreef *et al*., 2002).

Concentrations of these pollutants can be reduced by controlling emissions, an approach addressed by the Air Quality Action Plan. However the Plan does not acknowledge the role that increasing deposition rates can play in reducing street-level emissions. The current report therefore assesses role deposition on plants can play in the amelioration of air quality with regard to PM10s and NO_2.

3.3.2 Particulates

Greenspaces within the urban environment can aid the regulation of air quality (biogenic regulation). Vegetation can act as an enhanced deposition sink for gaseous and particulate pollution (Freer-Smith *et al.* 1997). Tree canopies capture particles more effectively than any other vegetation type due to their greater surface roughness (Manning & Feder, 1980) which increases turbulent deposition and impaction processes. Within the urban environment, the interception of particles by vegetation is typically far greater for street trees than for more distant vegetation due to their proximity to high intensities of road traffic (Impens & Delcarte, 1979). Dispersion modelling has predicted significant potential PM10 reduction by increasing tree cover in the UK in several UK cities e.g. London (Tiwary *et al.*, 2009). A number of epidemiological studies have shown that a rise in PM10 concentrations of 10 µg m-3 (as a 24 hour average) is associated with an increase in mortality of 1% (University of Lancaster & Centre for Ecology and Hydrology, Undated).

Local effects of vegetation can be very important. Screening by a single tree alone has been estimated to reduce PM concentration by 15-20 % immediately behind the tree (Mitchell and Maher, 2009). However, it is important to get planting arrangements just right or they can limit air circulation and wind dispersal of pollutants so that air quality decreases again. The cost saving of this effect to the user could be reflected in the decrease of the incidence of sickness and absenteeism in workers. A high proportion of sick leave incidents are related to respiratory complaints and sick leave represents an enormous cost to industry.

3.3.3 Nitrogen Dioxide and other pollutants

A graphical representation of base case NO_2 values through and around the BCREA for 2016 is provided in Figure 3.2.

NO_2 is taken up by the stomata of certain plants and metabolised into organic nitrogenous compounds (Hill, 1971).

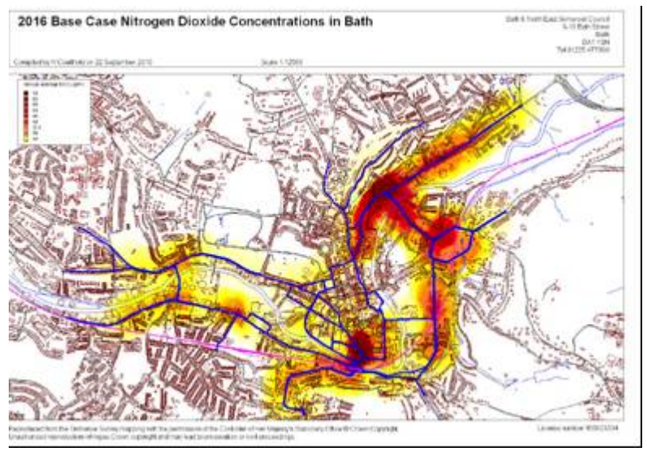
Not all tree species have a net positive effect in reducing urban air pollution. Some trees emit volatile organic compounds (VOCs). Donovan *et al.* (2005) have developed a model to develop an urban tree air quality score (UTAQS) ranking trees in order of their potential to improve air quality. Of 30 species studied the UTAQS are given in Table 3.1.

Table 3.1: Potential of Trees in the UK to improve urban air quality following Donovan *et al.* (2005)

Best (High UTAQS)	Medium	Worst (Low UTAQS)
Alder	Apple	Aspen
Field Maple	Ash	Crack Willow
Hawthorn	Cherry	English Oak
Larch	Common Lime	Goat Willow
Laurel	Elder	Red Oak
Lawson Cypress	English Elm	Sessile Oak
Norway Maple	Grey Alder	White Willow
Pine	Hazel	
Silver Birch	Holly	
	Italian Alder	
	Leyland Cypress	
	Lilac	
	Rowan	
	Sycamore	

Perhaps the most important implication of the study is that mass plantings of native oaks and willows could be detrimental to air quality during stagnant summertime conditions. These species, however, have high year-round ecological value.

Figures 3.2: Nitrogen Dioxide, Predicted concentrations in and around the BCREA - base case 2016(Source: B&NES, The Bath Air Quality Action Plan, 2011)



3.4 LOCAL HEAT ISLAND REDUCTION

Whilst Bath is a relatively green city, thinking e.g. of the extraordinarily hot summer of 2003, heat island effects can occur and within the BCREA the areas at greatest risk of overheating might include:

- The main urban stretch between the railway station and Green Park
- Bath Western Riverside (if appropriately abundant green infrastructure were not to be included in the design)
- The industrial estate around Locksbrook Road.

3.5 THE PHENOMENON OF THE URBAN HEAT ISLAND

A well-known effect of urbanisation is the warming of the local climate relative to surrounding rural areas, creating a phenomenon known as the 'urban heat island' (UHI: Doick *et al* 2013) whereby dark, solid surfaces absorb solar radiation during the day and re-radiate it at night, maintaining local temperatures much higher than in surrounding suburbs/greener areas (see Figures 3.3 and 3.4).

Global temperatures are set to rise during the foreseeable future as a consequence of human activities (Stern, 2006). The Department of Health has identified that temperatures in excess of 23 °C are associated with heat-related stress and excess summer deaths (Department of Health, 2008). Although the risks to health are greater in large metropolitan areas there are significant implications for the thermal comfort and health of city dwellers across much of the UK, including the South West (Health Protection Agency 2012).UHI extent can vary across a city. Heat islands can develop in 'pockets' around single buildings and temperature differences of 4 °C have been reported along a single street (Taha *et al*., 1990).

Planners of urban design should be aware of two factors that can significantly contribute to UHI. Two urban design factors further contribute to the UHI. Firstly, the height and spacing of buildings and their orientation relative to the prevailing wind restrict airflow and mixing and thus limit cooling. Secondly, in urban areas with deep street canyons (high building height to street width ratio) and high building densities there is a dense input of waste heat from human activities. Buildings are the dominant emitter of waste heat energy, contributing some 60% of the total, followed by road traffic (32%) and human metabolic heat emissions (8%) (Smith *et al.*, 2009).

3.5.1 The Impact of Vegetation on UHI

The urban climate can be effectively modified by altering the amounts of heat energy absorbed, stored and transferred, and by adopting cooling strategies. Vegetation can be very effective as it delivers several mechanisms of cooling simultaneously and in a complementary manner.

Through evaporation, incoming energy is used to convert water into water vapour. Energy is being used to drive the evaporation process rather than being transferred to the sensible heat that we feel, thus air temperatures are lower. Where the water is within a plant, on its surfaces or in the soil, the process is termed evapotranspiration. Vegetation is sparser in cities than in the countryside, reducing cooling through evapotranspiration and much of the surface is sealed, reducing cooling through evaporation. This is a primary contributor to the UHI.

Living roofs and facades can significantly reduce the temperature of the air envelope around a building by evapotranspiration. This increases the efficiency of air conditioners resulting in significant energy savings. Where photo-voltaic cells are sited on roofs as a source of renewable energy they are 20% more efficient if cooled by the evapotranspiration of a green roof.

By limiting solar penetration shading by trees lowers the heating of the local environment and shelters people from direct exposure to the sun.

Figure 3.3: London's Heat Island in summer 2003, which killed many citizens (source: http://climatelondon.org.uk/)

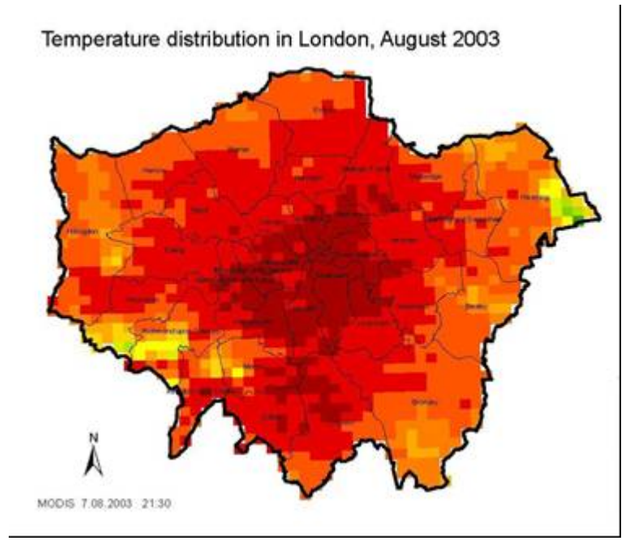


Figure 3.4: Infra-red technology reveals heat island effects in Melbourne, Australia

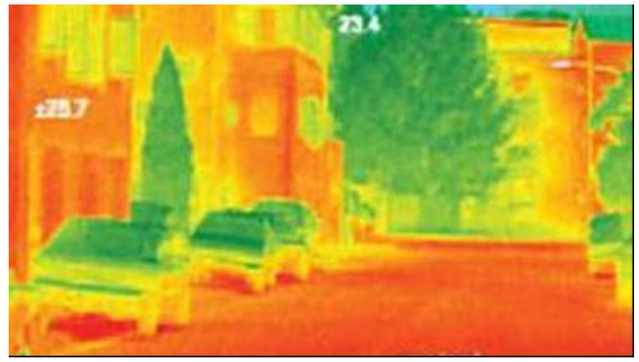


Plate 3.2: Flowering Rush – Sustainable Drainage Systems can also be colourful and biodiverse

3.6 MAINTAINING & ENHANCING PROPERTY VALUES

Several studies have identified the added value associated with the proximity of premises to open clean water areas. The resulting values range between 2% and 19%. HR Wallingford suggests that land values and house prices located adjacent to attractive SuDS water features (see Plate 3.2) may attract a 10% premium on resale. Other estimates suggest that a stormwater wetland "waterfront" location on a business park/commercial estate can increase rental rates by 3-13% (Ellis *et al*. 2003).

The UK government think-tank CABE Space showed that values of properties close to well-designed parks were elevated over the values of more or less identical properties in the same market area but outside of the influence of the park averaged 5% to7% but with a range from 3% to 34% (CABE Space 2005).

4.0 DESIGNATIONS

4.1 STRATEGIC NATURE AREAS

Figure 4.1 shows that Strategic Nature Areas frame Bath to the northwest and southeast giving it a strong ecological context and source of wildlife migration into, out of and across the urban fabric.

4.2 EUROPEAN SITES

Combe Down and Bathampton Down Mines lie approximately 2km SSE of The Site. The mines are designated as a Site of Special Scientific Interest (SSSI) which forms part of the Bath and Bradford on Avon's Special Area of Conservation (SAC).

4.3 LOCAL NATURE RESERVES

Three Local Nature Reserves of particular relevance to the BCREA:

- Carr's Wood LNR - abuts the river at the western end of the river corridor with the BCREA area occupying approximately 22ha. It is an area of diverse broadleaved woodland containing Sycamore and Beech/Ash regeneration. A diverse ground flora id dominated by Dog's Mercury, Ramsons and Ivy. It also contains Bath Asparagus (a regional BAP species), Wood Anemone, ferns, Enchanter's Nightshade. Pignut and Pendulous Sedge.
- Newton Brook Grasslands LNR– a series of west-facing fields some of which support very high quality unimproved limestone grassland which is very herb rich. Others support more improved grassland or dense scrub/woodland.
- Field by Redland Park LNR – large field of grazing pasture with a strip along the western edge which supports a more herb rich sward including Tufted Hair-grass and Woolly Thistle.

4.4 SITES OF NATURE CONSERVATION IMPORTANCE

Key SNCIs in or adjacent to the Bath City Riverside Enterprise Area are:

4.4.1 River Avon

Banks and river contain important rare wetland plants and aquatic species in places e.g. Loddon Pondweed. Important wildlife corridor and aquatic habitat.

4.4.2 Kennet and Avon Canal

Natural vegetation along the banks and edges. A good wildlife corridor between the countryside and the city centre.

4.4.3 Locksbrook Cemetery (East Side)

An east facing slope supporting unimproved limestone grassland species.

4.4.4 Locksbrook Cemetery (West Side)

Limestone grassland flora that has been improved but nevertheless still supports some of the original herb species.

4.4.5 Linear Park

Long park following part of the line of the disused Somerset and Dorset railway line. Lined by shrubs, hedges and trees. Some banks of long mown grassland some of which support a few species of limestone grassland. Has supported Slow-worm.

4.4.6 Site Adjacent to Linear Park

Short mown area of turf with a south facing bank which supports some of the original herb species.

4.4.7 Newbridge Slopes

Three fields of south facing steep terraced slopes of unimproved limestone grassland. The central field has been planted with trees; the other two are being invaded by scrub. Very rich herb grassland.

4.4.8 Twerton Farm

Series of north facing meadows grazed by cattle. Fairly herb rich. Also some wet flushes present which support small areas of wetland vegetation.

4.4.9 Beacon Hill

Very steep cliff covered in broadleaved woodland, densely shaded, ground flora not very diverse.

4.4.10 Beechen Cliff

Very steep north facing slope with broadleaved woodland. Ground flora is very densely shaded.

4.4.11 Gainsborough Gardens Woodlands

Narrow strip of broadleaved woodland with a thick canopy and understorey. Fairly diverse ground flora.

4.4.12 St James' Cemetery

East half of this cemetery is open and supports a number of species of limestone grassland. West half is more shaded by mature Beech trees and is less herb-rich.

4.4.13 Bitton to Bath Railway Track

Semi-natural broadleaved woodland, unimproved calcareous and neutral grassland, tall ruderal and scrub. Good range of semi-natural habitats and plants. Common Lizard, Bath Asparagus and Glow-worms present.

Figure 4.1: Strategic Nature Areas around Bath (source: BRERC 2013)

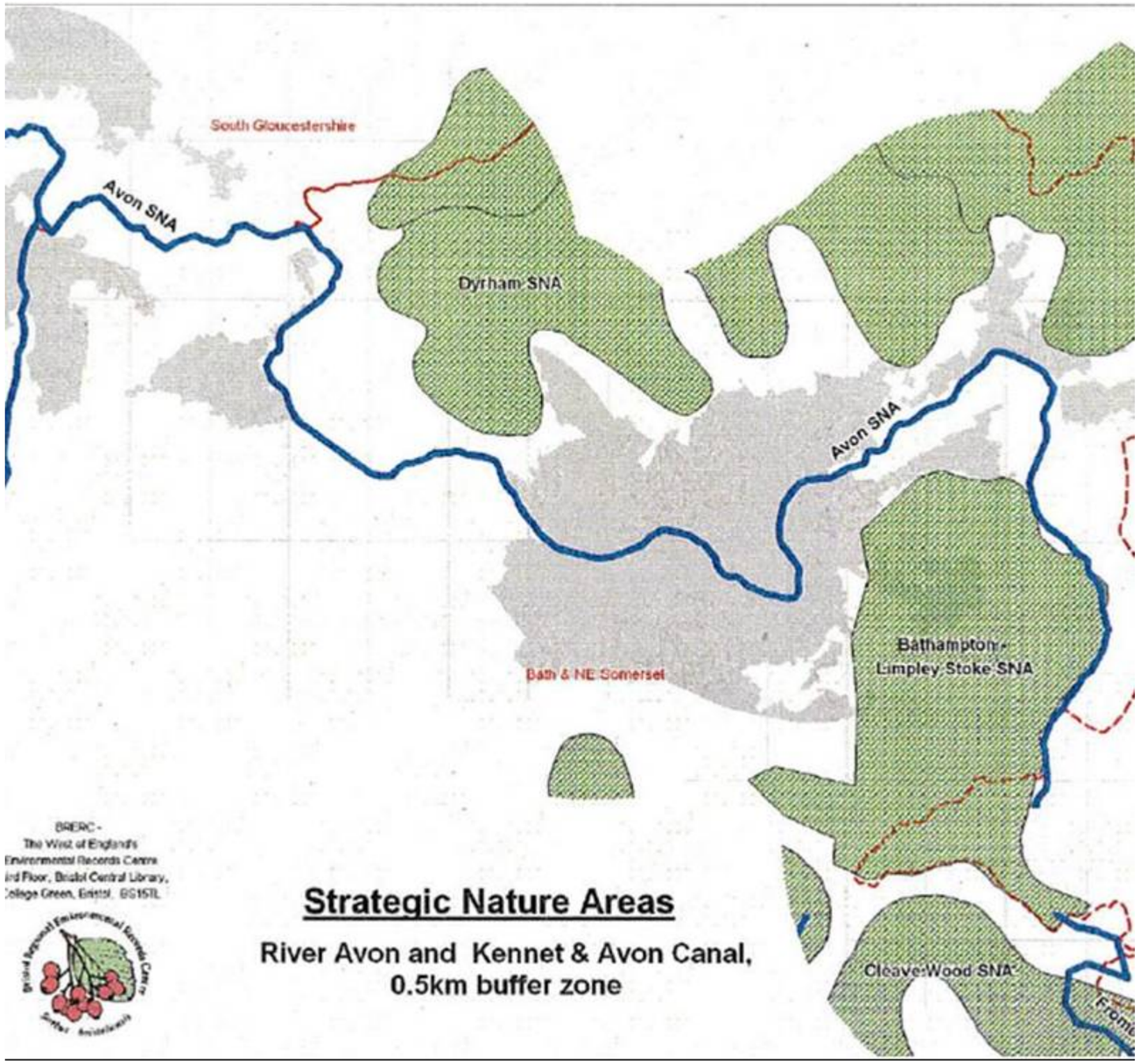
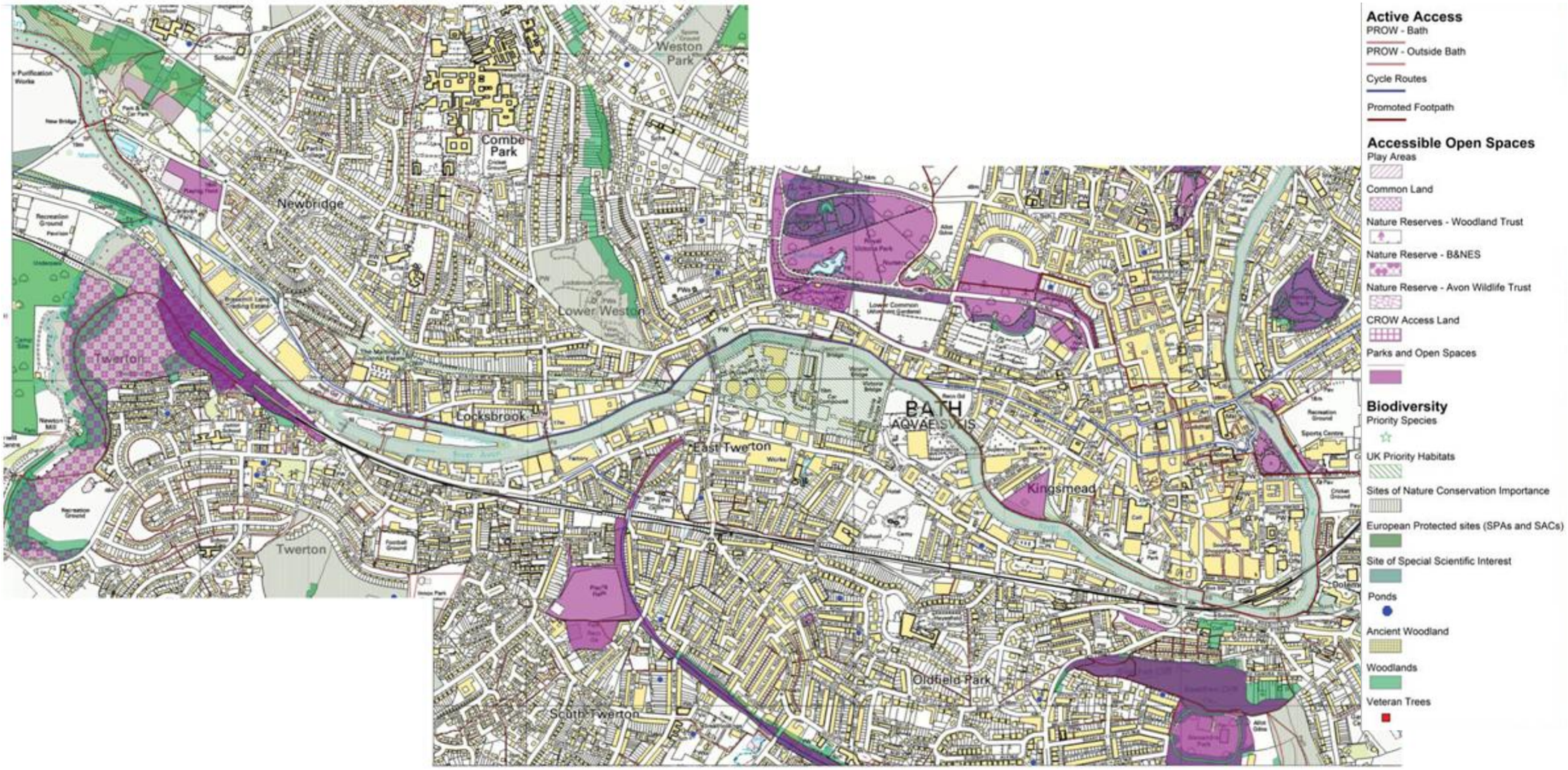


Figure 4.2: Ecological Designations relevant to the BCREA (source: B&NES 2013)



5.0 BROAD HABITATS

The broad habitat types within and relevant to the BCREA site are shown in Figure 5.1. An extract from the Avon Phase 1 survey was published in '*Nature in the City: A Report of the Bath Wildlife Survey* (Bath City Council, 1990, see Plate 5.1). This extract summarised the amount of semi-natural vegetation which can be found within the Bath District. Table 5.1 summarises these data.

Table 5.1: Broad Habitat Types in Bath (from BCC, 1990)

Habitat	Area in Bath District (ha)	% of District	% Total of Semi-natural Habitat
Broad-leaved Woodland	83.7	2.91	41.07
Calcareous Grassland	52.0	2.15	25.52
Scattered Scrub	22.3	0.77	10.94
Dense Scrub	18.5	0.64	9.08
Mixed Woodland	10.6	0.36	5.20
Marshy Grassland	2.0	0.06	0.98
Neutral Grassland	1.7	0.05	0.83
Eutrophic Standing Water	1.6	0.05	0.79
Tall Ruderal	0.7	0.02	0.34
Short Perennial	0.7	0.02	0.34
TOTAL	203.8	7.08	

The habitats shown in Figure 5.1 show these habitats in a simplified representation and not to a high degree of accuracy. The aim is to show broad functional cover types e.g. all woody habitats are treated together to determine patterns of connectivity through the river corridor, Non semi-natural habitats, such as gardens and amenity grasslands, make a significant contribution to Bath's biodiversity and the ecosystem services it provides,

Plate 5.1: Nature in the City. Bath Wildlife Survey from 1990

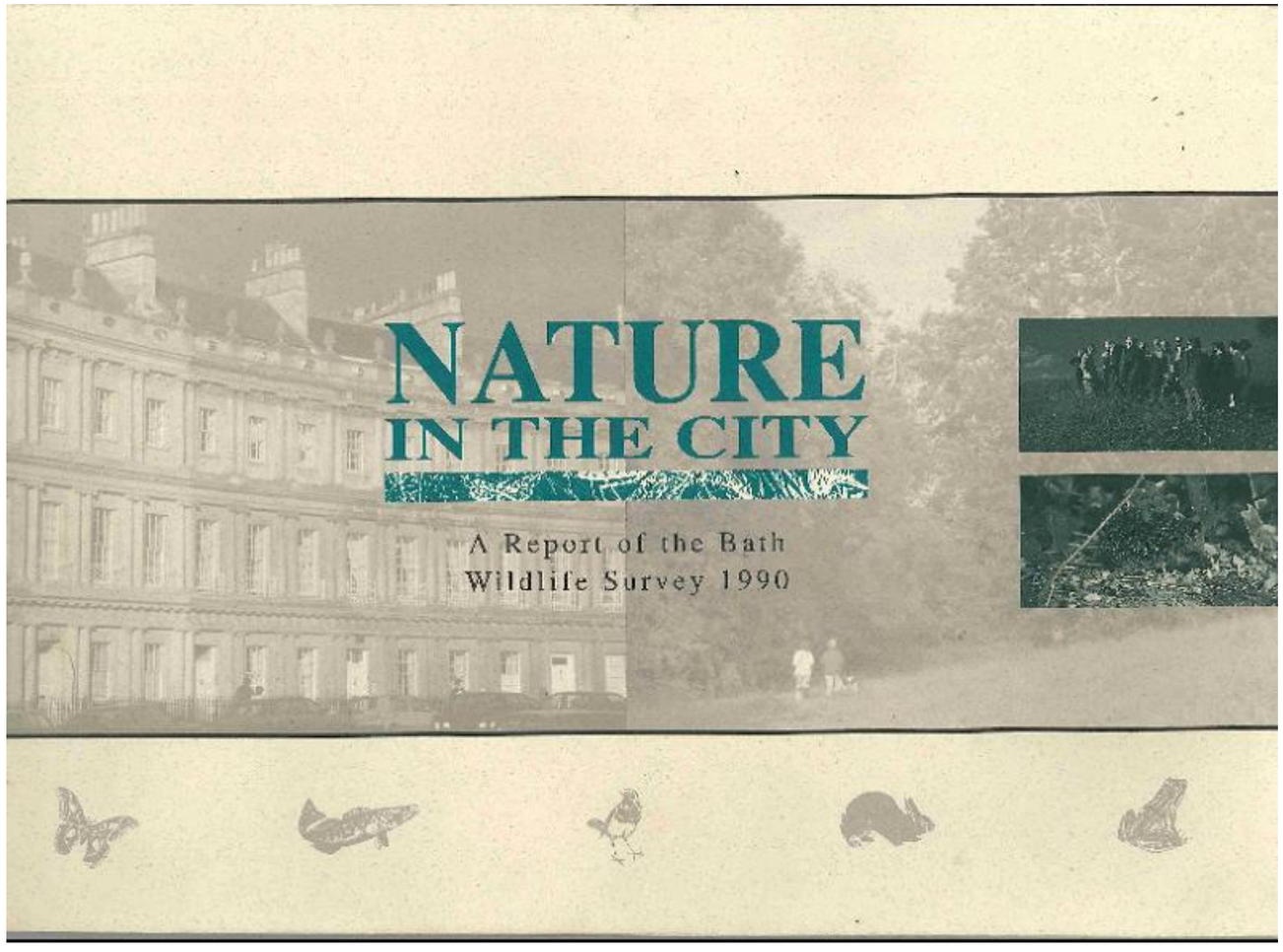
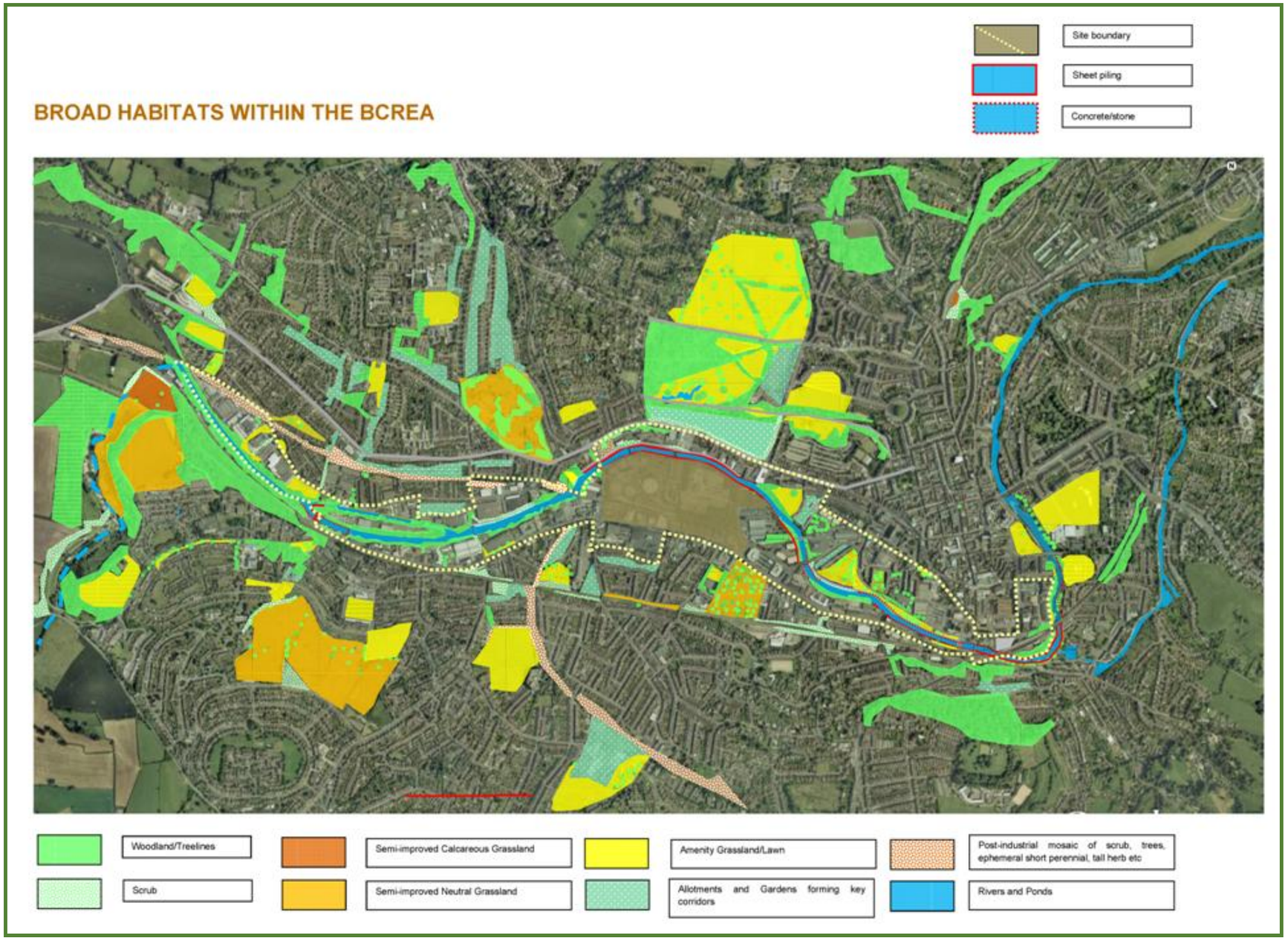


Figure 5.1: Broad Habitats within and relevant to the BCREA



6.0 WILDLIFE CORRIDORS

Wildlife corridors in Bath can be described as natural or man-made elongated habitat features running through or penetrating the built-up area. They provide particularly strong linkages between different wildlife sites and to the open countryside beyond. For example they can provide routes along which fauna (particularly pollinators) can travel relatively safely and aid dispersal of flora.

The strategic and potential wildlife corridors relevant to the BCREA are shown diagrammatically in Figure 6.1.

1. The primary connection to the surrounding countryside are the central west – east River Avon corridor
2. Almost as important is the corridor of the Kennet and Avon Canal joining the eastern end of the BCREA.
3. The Newton Brook and its surrounding complex of woodland and grassland to the west,
4. The Old Somerset and Dorset (S & D) railway joining the central part of the BCREA. The junction of the railway corridor and the river is currently not continuous. This deficit will be partly corrected by the proposed park to be constructed on the western portion of the Bath Western River side development, but further effort should be made to complete the connection with green infrastructure.
5. The Bitton to Bath disused railway line crosses the river, From the north the Locksbrook Cemetery SNCI and the Gainsborough Gardens SNCI form connections to the wider countryside in the Weston/Upper Weston area. The southern end of this northwards corridor needs to be reinforced with green infrastructure to complete the connection with the river.
6. Another potential corridor runs through Victoria Park and the Botanic Gardens but stops short of the river with the significant barrier of the Upper Bristol Road However, there is a proposed green connection on the north bank of the river running inland as part of the Bath Western Riverside north bank development. This could establish a connection to Victoria Park via private gardens and perhaps other new green infrastructure as well.

Figure 6.1: Strategic and Potential Strategic Wildlife Corridors in Bath connecting to the BCREA. The numbers refer to known or putative corridors – see text

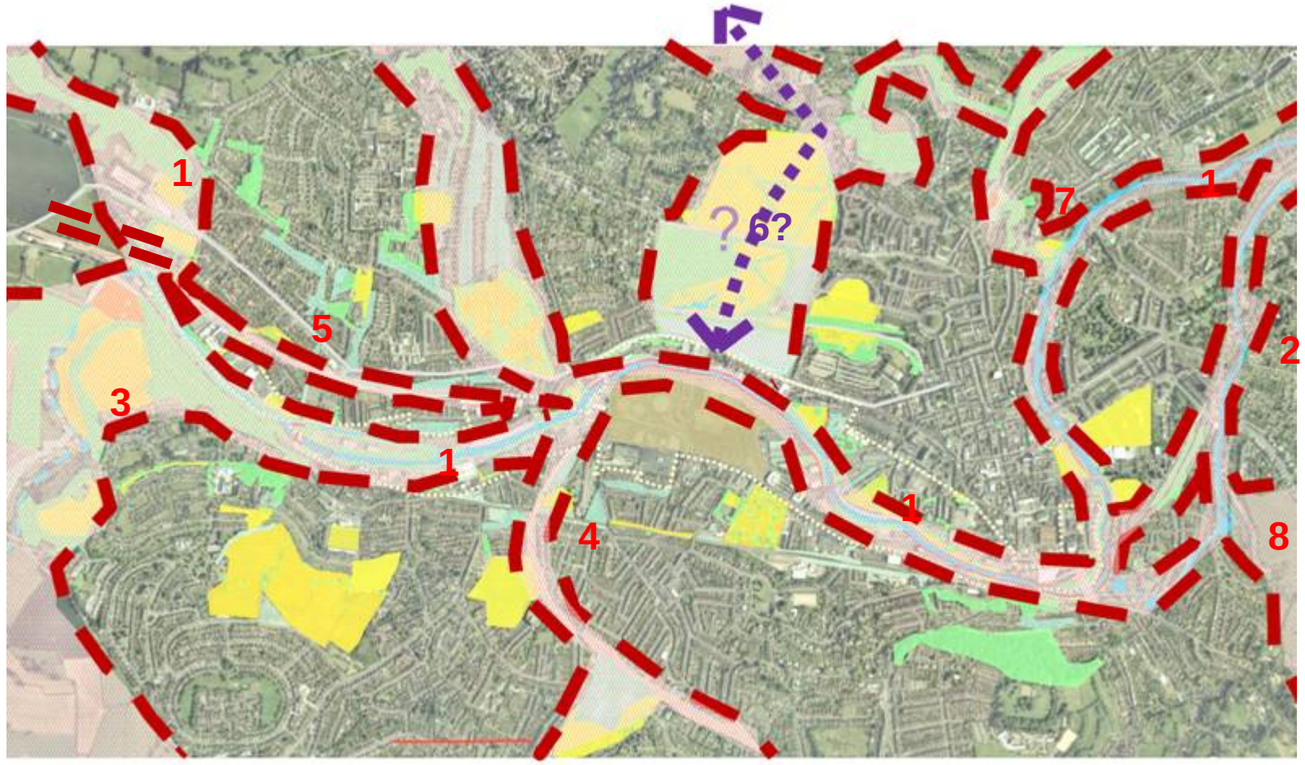
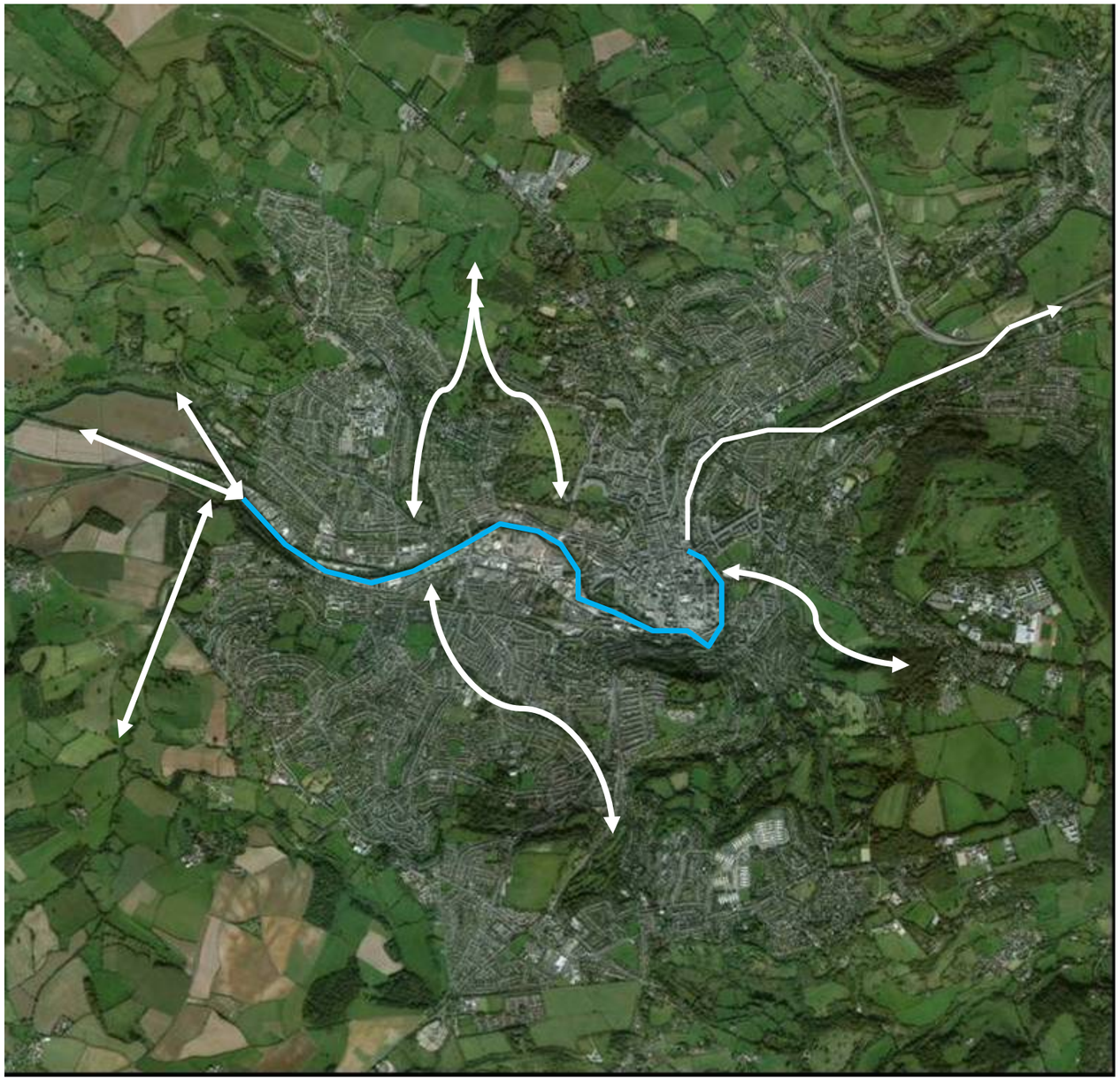


Figure 6.2: Aerial view of Bath showing the intrusion of green wedges of countryside towards the urban core and possible wildlife corridors



7. Another corridor joins the river corridor beyond the northern end of the BCREA area. This is formed by a line of woodlands running southwards from Beacon Hill. This corridor is perhaps an important route for foraging Lesser Horseshoe Bats commuting between their roosts in Beacon Hill and Parade Gardens.

8. Another potential corridor extends southeast from the River Avon via the Bath Recreation Grounds. The potential for this can clearly be clearly seen in Figure 6.2.

In the sections to follow, the various broad habitat types relevant to the BCREA are each described in turn, both in terms of existing conditions and potential.

7.0 RIVERS, CANALS, WATER BODIES & MARSH

7.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

This habitat category has been created to cover closely associated habitats that are intimately connected with flowing water and include the habitats of river bed, emergent fringe, swamp and damp margins. Clearly there may be various degrees of overlap with the community composition of standing waters; but there will also be many species uniquely associated with water flows. Wet woodland fringes to watercourses have been considered under the 'woodland' habitat type.

Fish and fisheries have been addressed under this heading.

Both the River Avon and the Kennet and Avon Canal are designated as SNCIs.

Although no significant water bodies or SuDS systems where these are vegetation-based are currently present in the BCREA area, this category also covers such features if eventually created.

7.2 BCREA BASELINE

7.2.1 General Distribution, Condition and Trends

Six nodes of valued habitat /species hot-spots have been identified along the course of the Bristol Avon in the BCREA (Figure 7.1). Moving upstream these are:

1. The confluence with the Newton Brook (Plate 7.1)
2. Weston Island (Plate 7.2)
3. The intersection of wildlife corridors near Locksbrook (Plate 7.3)
4. The riffle opposite Norfolk Terrace
5. The confluence with the Kennet and Avon Canal (Plate 7.4)
6. Pulteney Weir

Figure 7.1: Key Riverine Habitat Nodes/Species Hot-spots within the BCREA

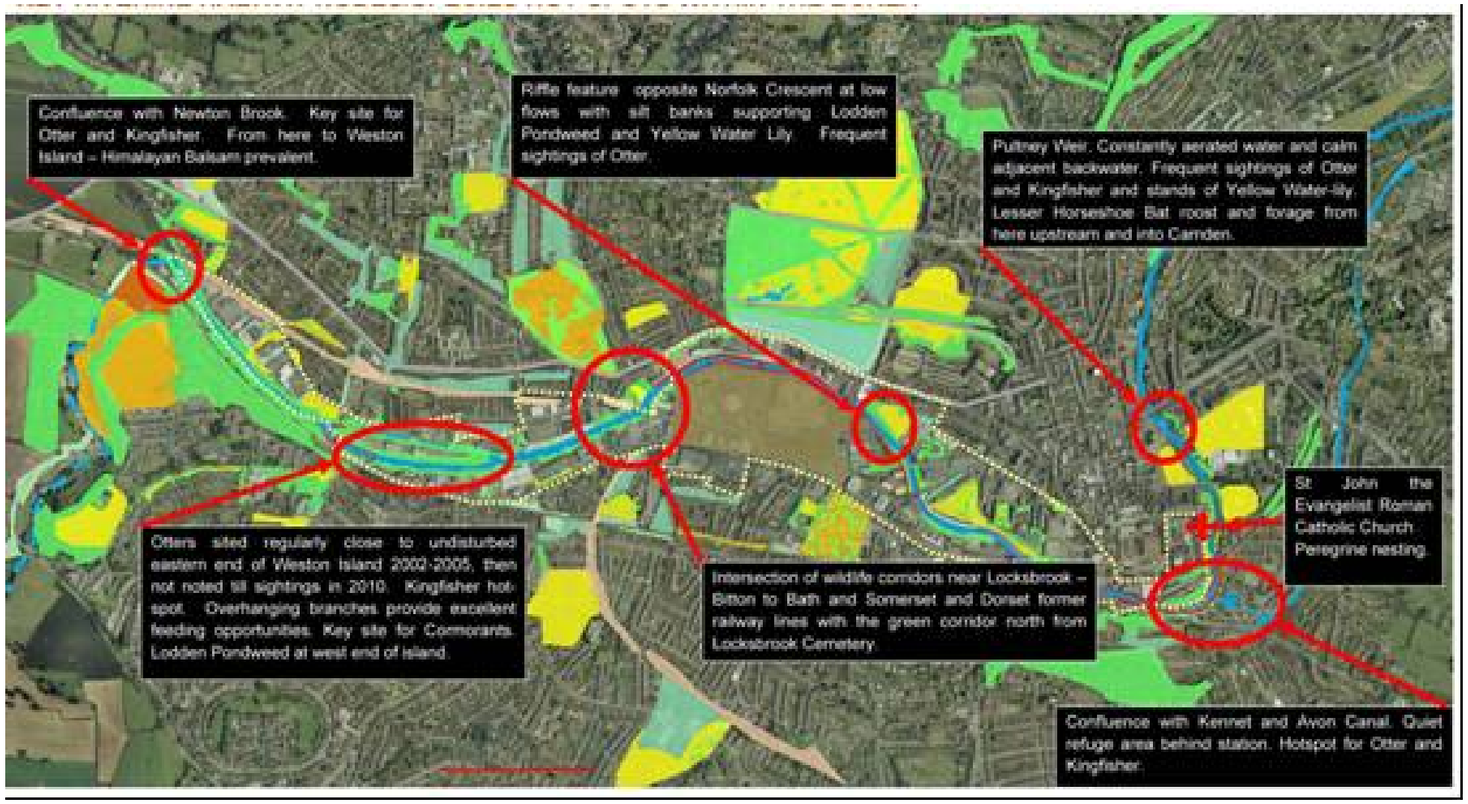


Plate 7.1: Confluence between Newton Brook and the River Avon

Plate 7.2: River Avon looking downstream towards Weston Island

Plate 7.3: Old Railway Bridge at Locksbrook

Plate 7.4: River Avon looking upstream towards confluence with Kennet and Avon Canal

7.2.2 Associated Plant Species of Importance

Plants species of importance/interest recorded in the BCREA river corridor are recorded in Table 7.1.

Table 7.1: Plant species of local interest or importance within the BCREA river corridor

Species	Status and requirements
Arrowhead	Scarce locally. Ponds, canals, rivers. Intolerant of medium – high pollution.
Common Alder	Locally frequent. Associated with wetlands. Cones are important food source for birds.
Black Poplar	Tall tree with high wildlife value associated with riparian sites. The native subspecies is increasingly rare
Common Club-rush	Scarce locally. Emergent. Tolerant of continuous mid-flow velocities, exposure & submersing. Perennial.
Common Reed	Frequent. Long-lived. Emergent. Good habitat for Reed & Sedge Warblers.
Crack Willow	Common on riverbanks. High wildlife value. Holes provide nesting sites for birds. Often pollarded.
Fennel Pondweed	Ponds. Uncommon locally. Aquatic. Pollution tolerant.
Greater Dodder	Nationally & locally uncommon. Bristol Avon catchment is a hot-spot. Parasitises Common Nettle on riverbanks.
Himalayan Balsam	**This invasive alien grows on riverbanks downstream of Twerton. A programme to eliminate this species is recommended.**
Lesser Pond Sedge	Uncommon locally. Emergent. Good wildlife value for invertebrates. Seed for birds.
Lodden Pondweed	Nationally rare Although relatively scarce locally Bristol Avon is a hot-spot. Found at western end of Weston Island and in shallows near Norfolk Crescent.
Yellow Water-lily	Uncommon locally. Grows in shallows by Norfolk Crescent and Pulteney weir.

7.2.3 Associated Invertebrate Species of Importance

Dragonflies and damselflies regarded as being of conservation importance in the BRERC area have been recorded in the BCREA river corridor are listed in Table 7.2

Table 7.2: Key Odonata recorded in the BCREA area

Species	Status and requirements
Beautiful Demoiselle	Nationally notable. Moderate flow streams.
Brown Hawker	Local in BRERC area. Slow-flowing rivers.
Golden-ringed Dragonfly	Rare in BRERC area. Possibly breeding in North Somerset.
Red-eyed Damselfly	Rare in BRERC area. Sluggish rivers with floating vegetation.
Scarce Chaser	Rare in BRERC area. Slow flowing rivers.
White-legged Damselfly	Rare in BRERC area. Sluggish rivers.

7.2.4 Associated Fish Species of Importance

At least 12 species of fish have been recorded within the BCREA river corridor. These include the key species listed in Table 7.3.

Table 7.3: Some of the key fish species recorded in the BCREA river corridor

Species	Status and requirements
Brown Trout	NERC Act 2006: Section 41: Species of Principle Importance in England. UK BAP listed. The River Avon is predominantly a coarse fishery. Increase in the populations of this species in the main river is an indication of stable good quality water.
Bullhead	Species of Conservation Concern in BRERC. Requires highly oxygenated rivers so if present possibly below weirs.
Eel	NERC Act 2006: Section 41: Species of Principle Importance in England. In severe decline nationally especially in the Bristol Channel.

The fish passes at Twerton and Pulteney weir have been identified by the Environment Agency as nearing the end of their working life; replacements of these features should cater for the needs of migratory fish and enable upstream and downstream recruitment of fish species.

7.2.5 Biodiversity Valuation

Following IEEEM (2004) river corridor through the city is assessed as of ecological value in a Local / Parish context only given the lack of extent and condition; though the larger patches of Lodden Pondweed could be considered of City Value. There is considerable scope for enhancement.

7.2.6 Ecosystem Services

The river has a City-wide importance as its key drainage corridor.

In terms of visual and aesthetic amenity the corridor is assessed as broadly of City Value in the western half of the BCREA to Bath Western Riverside, closer to Parish Value from here to the Canal and rising again to City Value at Pultney weir. The river is likely to serve a significant local and perhaps wider cooling function in the hot summer months. There is a certain amount of value as a coarse fishery, but perhaps no more than Parish level at present.

7.3 ENHANCEMENT OPPORTUNITIES

7.3.1 General

It is proposed that in the first instance, ecological and landscape enhancements be effected at key ‘nodes’ along the river where they can achieve maximum multifunctional benefits. Between these nodes (the internodes) more generic enhancement interventions could be made. These outline suggestions are summarised in Figure. 7.2.

Key locations where there would appear to be scope for enhanced fluvial or urban runoff storage, combined with habitat creation are shown in Figure 7.3.

7.3.2 Proposed enhancement of nodes

The confluence with the Newton Brook

- The bridge carrying the former Bitton to Bath railway line could be retro-fitted as a ‘green bridge’.
- A Kingfisher bank could be installed on the left bank of the Bristol Avon.
- An Otter holt, surrounded on the landward side by a thorn buffer, could be installed on the left bank.

Weston Island

- As much as possible of the wooded fringe around the island should be retained.
- An Otter holt, surrounded on the landward side by a thorn buffer, could be installed on the eastern end of the island.
- A Kingfisher bank could be installed on the southern bank of the island.

The intersection of wildlife corridors near Locksbrook

- The bridge carrying the former Bitton to Bath railway line to could retro-fitted as a 'green bridge'.
- The following green corridors could be extended to meet the River Avon, either by tree and shrub planting, green roofs or green facades:

    - The corridor along the Bitton to Bath railway line;
    - The corridor running through Locksbrook Cemetery
    - The corridor running through the Somerset and Dorset railway line.

The riffle opposite Norfolk Terrace

- The right bank could be re-profiled as a cascading public terrace to the water's edge.
- The left bank could be re-profiled as a stepped terrace leading to wall/ledge planters at the river margin;
- The covered footbridge to be green retro-fitted.

The confluence with the Kennet and Avon Canal

- Right bank could be re-profiled as a terrace to the river;
- An Otter holt, surrounded on the landward side by a thorn buffer, could be installed on the right bank.

Figure 7.2: Potential interventions along the BCREA river corridor to enhance biodiversity and ecosystem services at key nodes and between nodes

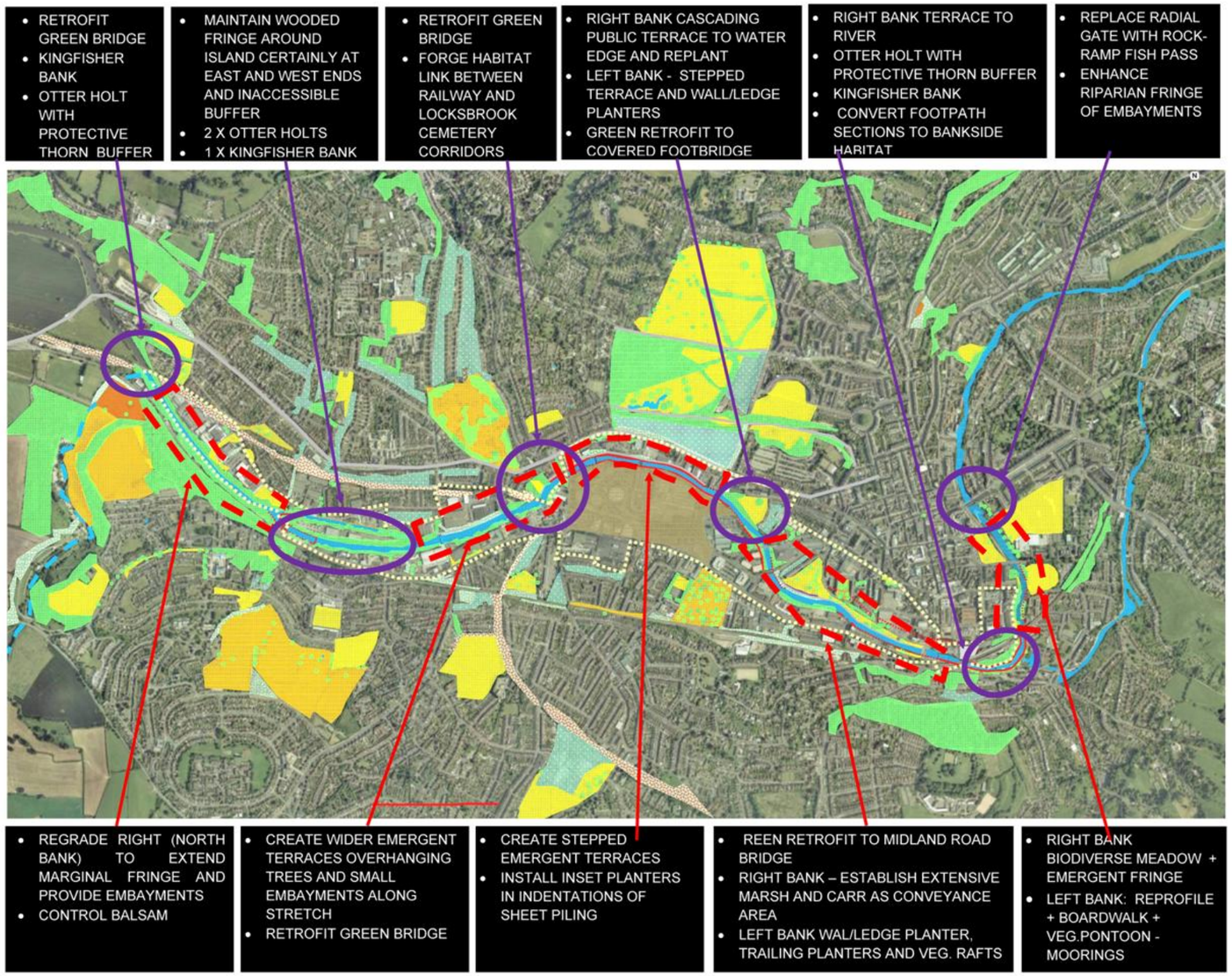
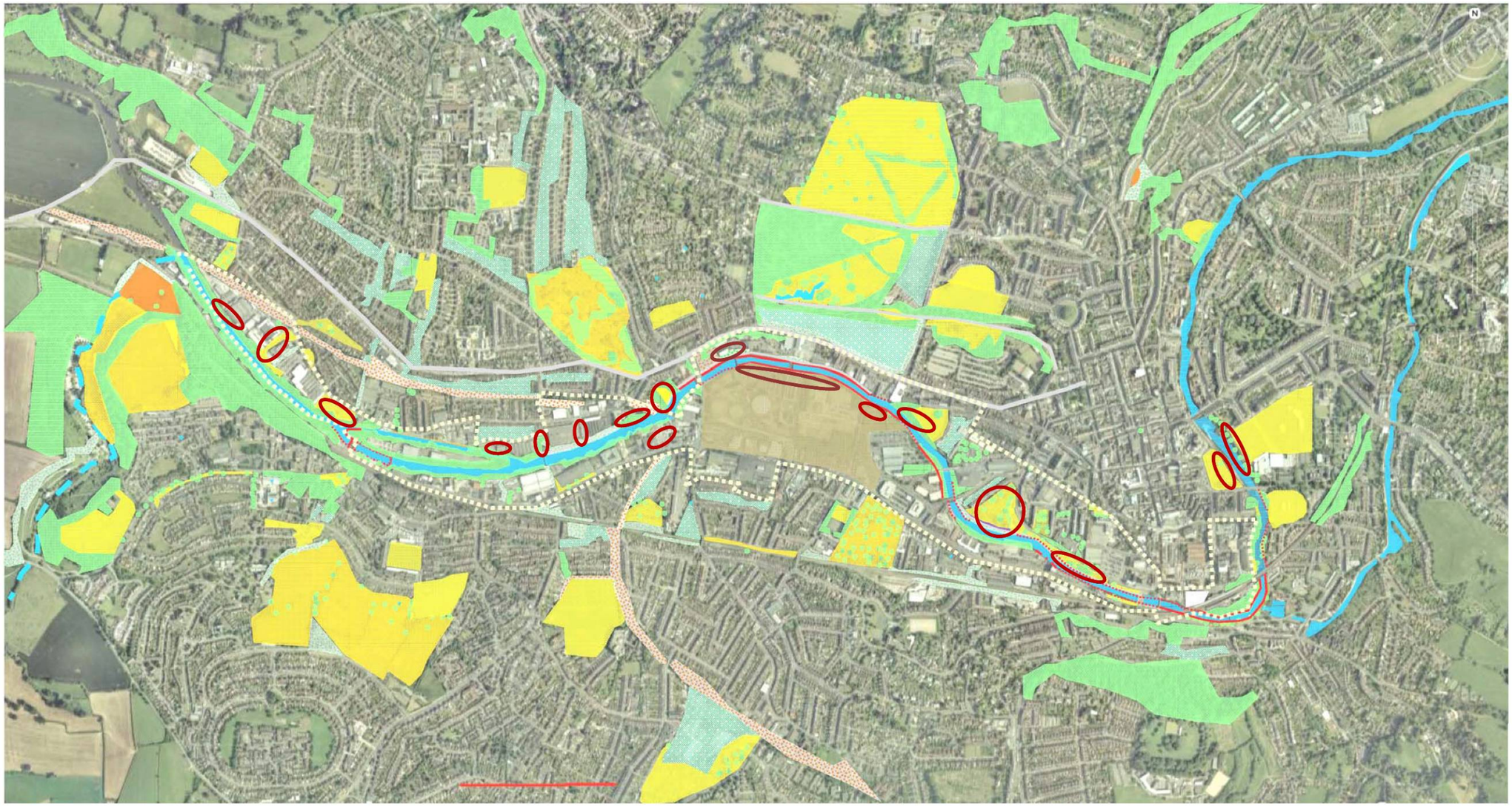


Figure 7.3: Key locations where there would appear to be scope for enhanced fluvial or urban runoff storage, combined with habitat creation



- A Kingfisher bank could be installed on the right bank of the river, or else on the Kennet and Avon Canal upstream of the confluence;
- On the left bank footpath sections could be converted to bankside habitat.

Pulteney Weir

- The radial gate should be replaced by a rock-ramp fish pass
- The riparian fringe could be enhanced with embayments

7.3.3 Proposed enhancement of internodes

Internode 1

- The right bank could be regraded to extend the marginal fringe and provide embayments
- Himalayan Balsam should be controlled/eradicated

Internode 2

- A wider emergent terrace, overhanging trees and small embayments could be created

Internode 3

- Stepped emergent terraces could be created
- Bespoke planters could be installed in indentations of sheet piling

Internode 4

- The Midland Road Bridge could be subject to a green bridge retrofit
- Extensive marsh and carr as conveyance area could be established on the right bank
- On left bank wall/ledge planters, trailing planters and vegetated rafts could be installed

Internode 5

- On the right bank a biodiverse meadow and emergent fringe could be created
- The left bank could be reprofiled with a boardwalk over embayments and vegetated pontoons. Banks could be regraded to more natural profiles

7.3.4 Natural Reprofiling of Banks

Even in highly built-up urban locations with high land values bioengineered bank profiles can be created particularly where there are existing steep banks (Environment Agency 2008). Hard elements in the design may be included initially to allow the plants to establish but thereafter marginal and bankside vegetation can thrive even when subject to rigorous hydrological forces. Plates 7.5 to 7.7 illustrate a mixture of hard engineering and bioengineering techniques to permit 'stepping back' from the river's edge in a site subject to Thames Estuary flows.

Various locations shown in Figure 7.3 could benefit from such an approach.

7.3.5 Embayments & Backwaters

The consequence of a lack of shallows and emergent plants is that the age range of fish is skewed towards semi-mature and mature. To reverse this trend, in addition to marginal planting (Section 7.3.1), embayments would provide nurseries for the variety of fish species found in the river. They would also provide habitat for spawning amphibians and places where the life-cycles of dragonflies and damselflies could be played out.

These shallow areas would also provide habitat for important rooted aquatics such as Yellow Water-lily and Loddon Pondweed.

The illustration (Figure 7.8) shows how a riverside footpath and an embayment are not necessarily mutually exclusive features. Grey Wagtail breeding refuges would add to their biodiverse attractions.

Trash baffles can be added to permit the collection and redirection of flotsam.

Plate 7.5: Vertical river wall terraced at confluence between Rivers Wandle and Thames, London

Plate 7.6: Stabilisation of substrate on new terraces with coir matting and rolls, River Wandle, London

Plate7.7: Newly terraced wall of River Wandle with substrate graded to a natural slope and then planted with native emergents

Plate 7.8: Embayment crossed by footpath pedestrian bridge

7.3.6 Marginal and emergent aquatics strategy

Much of the BCREA river edge is sterile with banks composed of steel piling or concrete/stone. It is estimated that 4.8km of bank (out of a total of ca. 10km of bank) from Pulteney Bridge to Twerton weir is without any vegetation as set out in Table 7.1.

Left Bank		**Right Bank**	
Concrete/Stone	Sheet Piling	Concrete/Stone	Sheet Piling
1.6km	1.1km	1.2km	0.9km

Interventions to enhance these sterile banks could be done in several possible ways e.g.:

- Wall/ledge planters (Plates 7.96a and b)
- Vegetated rafts on fixed guide rails (Plates 7.10 a&b)
- Inset planters on sheet piling
- Vegetated Fenders (Figures 7.5 & 7.6)
- Vertical beaches (Figure 7.7)
- Trailing planters (Plate 7.11)

Species choice of marginal and emergent aquatics is critical. Native planting is essential for all the above interventions intimately associated with the river. Attention must be paid to the appearance of all the above-mentioned interventions throughout the year, with some perennial species included to provide structure and form, havens for over-wintering invertebrates and food for birds.

Many emergent species are potentially invasive. To prevent rafts and planters from being dominated by a one or two species root barriers would limit their spread.

The use of native species for trailing species is not so critical provided that they are not invasive and have proven value to native fauna, in particular pollinators.

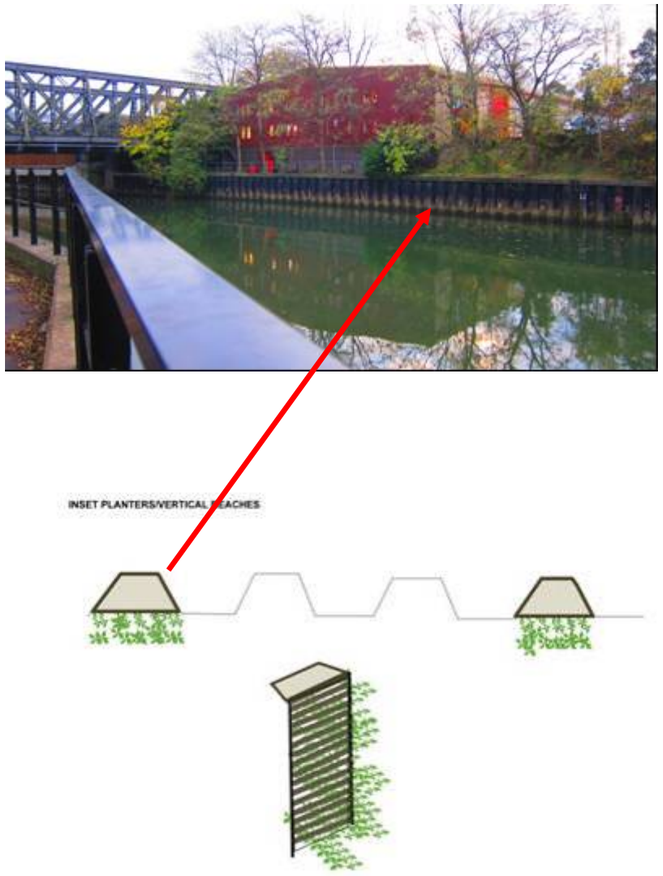
These installations would be ring-mounted at either end to metal corrosion-proof poles embedded in the riverbed allowing the pontoon/rafts to move freely up and down with changing river levels.

Plates 7.9a & b: Wall/ledge planters at Charter Quay on the Thames at Kingston

Plates 7.9a & b: Planted ledge at Battersea Reach, London (from Estuary Edges)

Plate 7.10a & b: Vegetated rafts on fixed guide rails, Charter Key, Hogsmill River

Figure 7.4: Inset planters/vertical beaches on sheet piling



Figures 7.5a & b: Fender designs including options for natural colonisation by plants (source EA – Estuary Edges 2008)

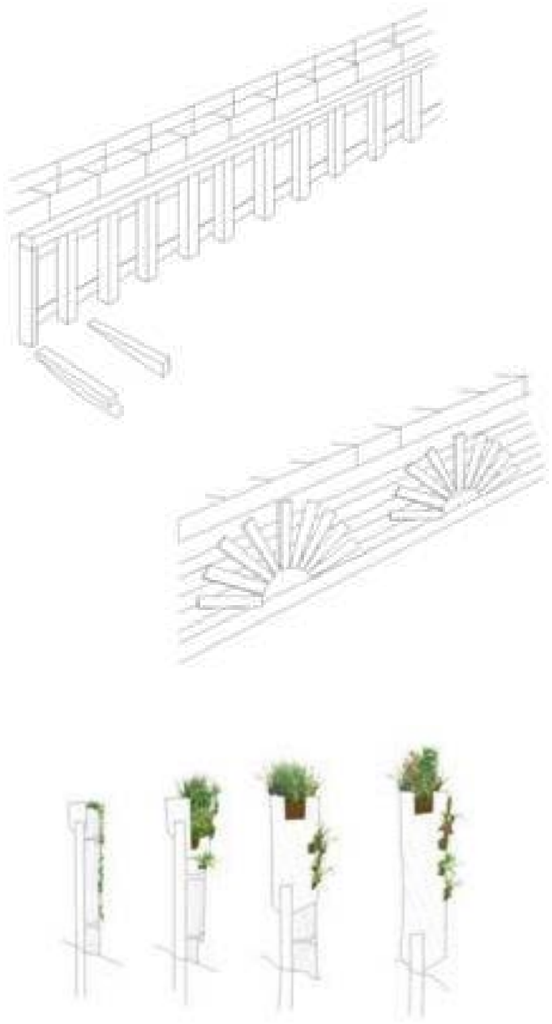


Figure 7.6: Fender and underwater planter designs including artificial egg laying strips for fish (source EA – Estuary Edges 2008)

Figure 7.7: Full vertical beach design (source EA – Estuary Edges 2008)

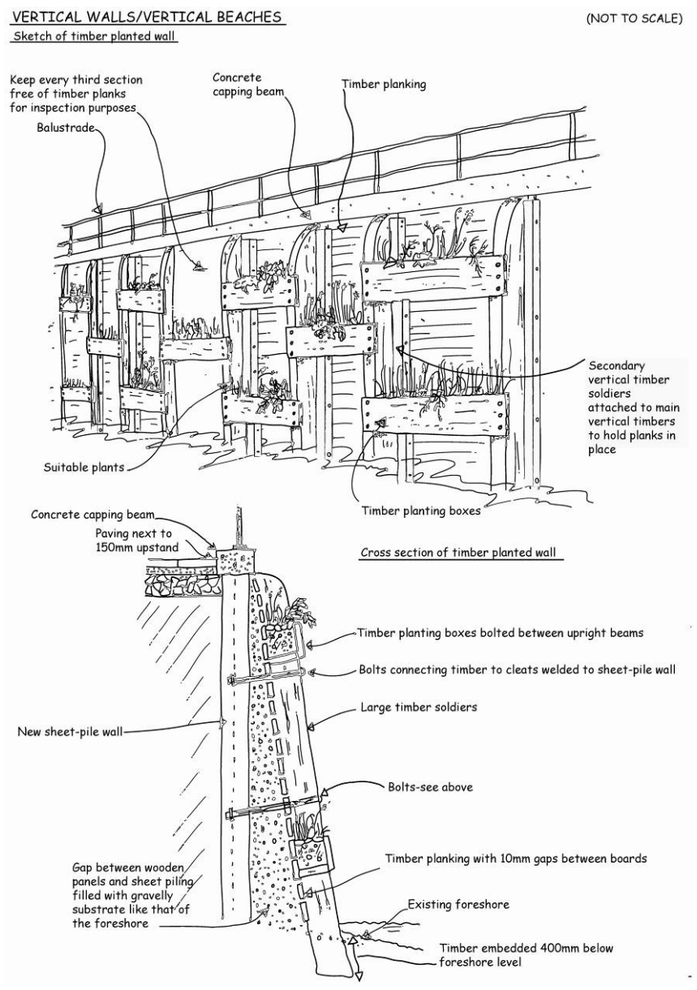


Plate 7.11: Tailing plants from planters can give year-round cover and wildlife value if carefully selected e.g. trailing Rosemary below (excellent for bees)

7.3.7 Ponds and Vegetated Sustainable Drainage Systems

Ponds are some of the most important habitats for biodiversity and can be created fairly readily (see Plate 7.12, a pond created in the south Cotswolds). At present the only such waterbodies exist as small lakes in Victoria Park and ponds in back gardens. Concerns about health and safety reduce the occurrence of these vitally important habitats. They can be purely for biodiversity, or parts of SuDS systems and can be profiled with extensive marsh fringes and drawdown zones to minimise public hazard.

At present there are no obvious areas of installed vegetated Sustainable Urban Drainage systems in the BCREA.

There is, however, considerable scope for their incorporation in redesigned soft landscape and excellent precedent in Bath for such systems (Bath University).

The SuDS installation at Bath University, designed by Grant Associates, show variety in style and formality, from relatively 'wild' to more domestic and urban. Both have biodiversity value, but the more semi-natural swale habitats do appear to be of exceptional value, especially to pollinators. Recent images are show in Plates 7.13 to 7.16.

Plate 7.12: Created biodiverse pond near Bath

Plate 7.13: Biodiverse vegetated SuDS at the University of Bath: native biodiverse design, early in the season

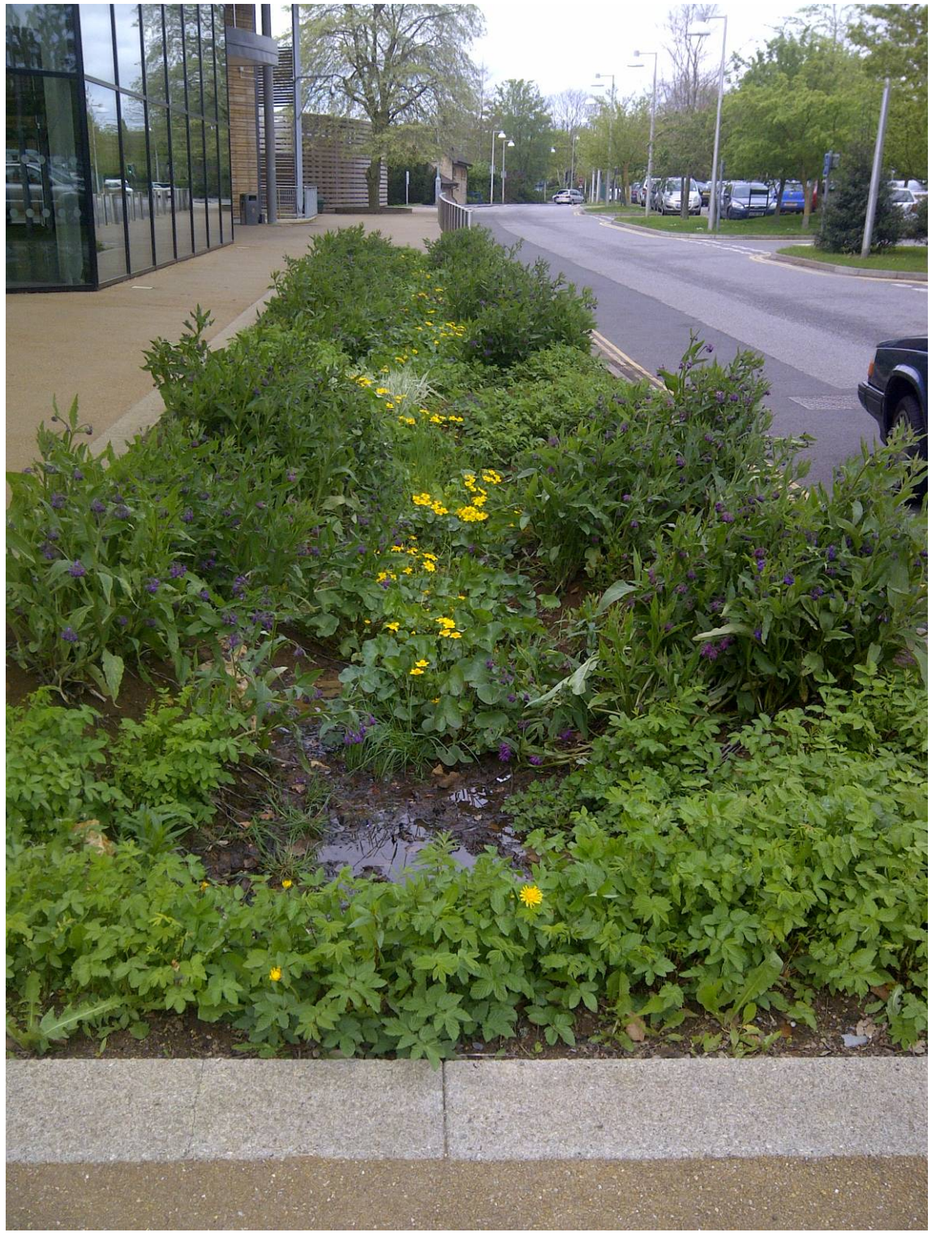


Plate 7.14: Biodiverse vegetated SuDS at the University of Bath: more formal, partly non-native evergreen design

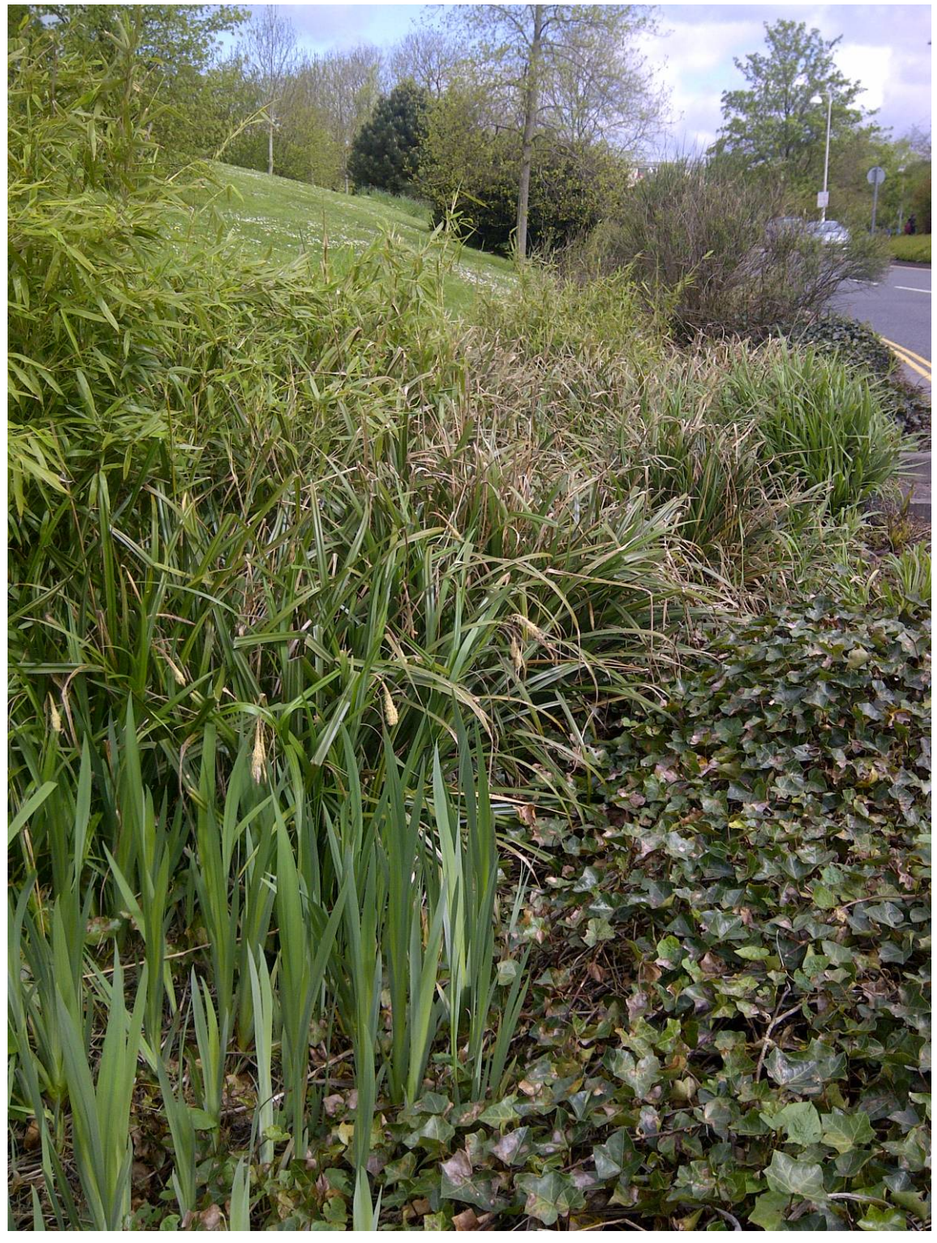


Plate 7.15: Biodiverse vegetated SuDS at the University of Bath: peak flowering season; excellent for pollinators

Plate 7.16: Biodiverse vegetated SuDS at the University of Bath: Tree planting in rain sink supporting native Field Woodrush

8.0 WOODLAND, TREELINE, HEDGEROW, SCRUB

8.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

This category covers woodlands of varying biodiversity and ecological amenity values and includes in approximate order of increasing ecological value.

1. Wet Woodland (National Priority Habitat)
2. Broadleaved Woodland
3. Broadleaved Plantation
4. Mixed Plantation
5. Treelines
6. Scattered Trees (generally in parkland)

Types 1 to 4 may qualify as the National Priority Habitat Lowland (Mixed) Deciduous Woodland (the B&NES Priority Habitat type is Broadleaved Woodland).

Hedges and scrub are also included here given their value in forming corridors (along with trees) for dispersal and safe movement of various faunal species (though there are no significant hedges within the BCREA at present)

Japanese Knotweed, an invasive alien, is recorded in several areas of scrub particularly in the western end of the BCREA corridor.

8.2 BIODIVERSITY BASELINE IN THE BCREA

8.2.1 Distribution, Condition *and* Trends

Most of the data relating to woodland species within the BCREA area was supplied by BRERC (2011). These data described species of recognised conservation status within 1km squares along the river corridor without precise definition of the habitat with which they were associated. Bath City Council (1990) provided an overview of woodland within Bath City limits but only in a general sense. Two surveys (BRERC 2012 & BRERC 2013), described species found within the Newbridge Slopes SNCI and the Linear Park SNCI, both of which contained woodland components.

The National Vegetation Classification (NVC) communities identified within these SNCIs included:

- W4: *Betula pubescens – Molinia caerulea* woodland;
- W5: *Alnus glutinosa – Carex paniculata* wet woodland;
- W7: *Alnus glutinosa - Fraxinus excelsior – Lysimachia nemorum* wet woodland;
- W8: *Fraxinus excelsior – Acer campestre – Mercurialis perennis* plantation woodland;
- W10: *Quercus robor – Pteridium aquilinum – Rubus fructicosus* broadleaved woodland;
- W11: *Quercus petraea – Betula pubescens – Oxalis acetosella* broadleaved woodland;

8.2.2 Key Associated Flora

Key flora that characterise the riverine corridor in the BCREA are listed in Table 8.1 and of the drier woodlands in Table 8.2

Table 8.1: Some of the key Flora associated with wet woodland and river edge within the BCREA

Species	Status and requirements
Trees & Shrubs	
Common Alder *Alnus glutinosa*	Native. Locally frequent. Associated with wetlands. Cones are important food source for birds.
Black Poplar *Populus nigra betulifolia*	Native. Tall tree with high wildlife value associated with riparian sites. The native subspecies is increasingly rare
Crack Willow *Salix fragilis*	Native. Common on riverbanks. High wildlife value. Holes provide nesting sites for birds. Often pollarded.
Weeping Willow *Salix x sepulcralis*	Introduced. Fairly frequent along river. Probably low value for native wildlife.
White Willow *Salix alba*	Native. Frequent along river.
Aspen *Populus tremula*	Native. Uncommon in BRERC area.
Purple Willow *Salix purpurea*	Native. Infrequent on riverbank.
Hawthorn *Crataegus monogyna*	Native. Frequent on riverbank.
Blackthorn *Prunus spinosa*	Native. Frequent on riverbank.
Grey Willow *Salix cinerea*	Native. Occurs towards downstream end of the river corridor.
Sycamore *Acer pseudoplatanus*	Non-native. Common along riverbank & in broadleaved woodland and plantation.
Species	**Status and requirements**
Groundflora	
Small Teasel Dipsacus pilosus	Uncommon, BRERC area
Greater Dodder *Cuscuta europaea*	Native. Adjacent to streams associated with Nettle *Urtica dioica*. Rare in B&NES
Meadowsweet *Filipendula ulmaria*	Native. W5 & W7 wet woodland.
Yellow Pimpernel *Lysimachia nemorum*	Native. Uncommon in BRERC area. W7 wet woodland.
Creeping Buttercup *Ranunculus repens*	Native. W5 & W7 wet woodland.
Wild Angelica *Angelica sylvestris*	Native. W5 & W7 wet woodland.
Lady-fern *Athyrium flilix-femina*	Native. W5 & W7 wet woodland.
Marsh Marigold *Caltha palustris*	Native. W5 & W7 wet woodland.
Marsh Pennywort *Hydrocotyle vulgaris*	Native. Rare in B&NES.
Soft-rush *Juncus effusus*	Native. W5 & W7 wet woodland.
Bittersweet *Solanum dulcamara*	Native. W5 wet woodland.
Common Comfrey *Symphytum officinale*	Native. W5 wet woodland.
Hemp-agrimony *Eupatorium cannabinum*	Native. W5 & W7 wet woodland.
Hoary Willowherb *Epilobium parviflorum*	Native. W5 wet woodland.
Lesser Celandine *Ranunculus ficaria*	Native. W7 wet woodland.
Purple-loosestrife *Lythrum salicaria*	Native. W5 wet woodland.
Water Mint *Mentha aquatica*	Native. W5 & W7 wet woodland.

Table 8.2: Some of the key flora associated with dry woodland and hedgerow recorded within or near the BCREA area

Species	Status and requirements
Sycamore *Acer pseudoplatanus*	Non-native. Common in broadleaved woodland and plantation.
Hawthorn *Crataegus monogyna*	Native. Frequent on in broadleaved woodland and plantation.

Species	Status and requirements
Blackthorn *Prunus spinosa*	Native. Frequent on in broadleaved woodland and plantation.
Alder Buckthorn *Frangula alnus*	Uncommon BRERC region
Wild Cherry *Prunus avium*	Native. Frequent on in broadleaved woodland and plantation.
Beech *Fagus sylvatica*	Native. Frequent on in broadleaved woodland and plantation.
Field Maple *Acer campestre*	Native. Frequent on in broadleaved woodland and plantation.
Pedunculate Oak *Quercus robor*	Native. Frequent on in broadleaved woodland and plantation.
Silver Birch *Betula pendula*	Native. Frequent on in broadleaved woodland and plantation.
Hazel *Corylus avellana*	Native. Frequent on in broadleaved woodland and plantation.
Dog-rose *Rosa canina*	Native. Frequent on in broadleaved woodland and plantation.
Ash *Fraxinus excelsior*	Native. Frequent on in broadleaved woodland and plantation.
Elder *Sambucus nigra*	Native. Frequent on in broadleaved woodland and plantation.
Holly *Ilex aquifolium*	Native. Frequent on in broadleaved woodland and plantation.
Sea-buckthorn *Hippophae rhamnoides*	Not locally native. Occasional in broadleaved woodland and plantation.
Bath Asparagus *Ornithogallum pyrenaicum*	Uncommon BRERC Area
Lords-and-ladies *Arum maculatum*	Native. Typical of broadleaved woodland in the the BRERC area.
Maidenhair-fern *Adiantum-capillus-veneris*	Proposed BRERC notable 2004 as nationally notable.
Spurge-laurel *Daphne laureola*	Uncommon understorey plant, BRERC area
Stinking Hellebore *Helleborus foetidus*	Scarce in the BRERC area
Bluebell *Hyacinthoides non-scripta*	Common but iconic species of the woodlands of the area, often outcompeted by escaped Spanish Bluebell
Toothwort *Lathraea squamaria*	Parasite on Hazel and Elm. Uncommon BRERC region
Hard Shield-fern *Polystichum aculeatum*	Uncommon BRERC area
Black Currant *Ribes nigrum*	Uncommon BRERC Area
Wild Garlic *Alium ursinum*	Common but iconic and distinctive species of the woods of the area of huge cultural (and culinary) importance.

8.2.3 Key Fauna

Key Fauna associated with Woodland, Hedgerow and Scrub that have been recorded from the BCREA area are listed in Table 8.3.

Table 8.3: Key fauna associated with woody habitats recorded within or near the BCREA area

Common Name	Species	Status and requirements
Hedgehog	*Erinaceus europaeus*	NERC Act 2006: Section 41: Species of Principal Importance in England. Common but declining. Benefits from woodland, hedgerow and grassland habitats
Badger	*Meles meles*	Protection of Badger Act 1992. Widespread even in urban areas. Woodland, parkland and gardens
Common Pipistrelle	*Pipistrellus pipistrellus*	WCA 1981: Sch. 5. Bats in general have declined. Can be successful in urban areas where there are sufficient trees and hedges
Noctule	*Nyctalus noctula*	WCA 1981: Sch. 5. NERC Act 2006: Section 41: Species of Principal Importance in England.
Greater Horseshoe Bat	*Rhinolophus ferrumequinum*	NERC Act 2006: Section 41: Species of Principal Importance in England. WCA 1981: Sch. 5. Annex IV Habitats Directive. A stronghold in Bath. Trees and grassland areas including parks
Lesser Horseshoe Bat	*Rhinolophus hipposideros*	NERC Act 2006: Section 41: Species of Principal Importance in England. WCA 1981: Sch. 5. Annex IV Habitats Directive. A stronghold in Bath. Trees and grassland areas including parks
Green Woodpecker	*Picus viridis*	Birds of Conservation Concern: Amber list. Common. Feed in urban grasslands but also require mature trees for nesting
Bullfinch	*Pyrrhula pyrrhula*	Birds of Conservation Concern: Amber list. A species in decline. Feed on berries on trees and shrubs. Some potential for foraging beyond park areas
Yellowhammer	*Emberiza citrinella*	Birds of Conservation Concern: Red list. Uncommon, has declined. Scrub or dense shrubs are required
Redwing	*Turdus iliacus*	Winter visitor. Feeds on berries from trees & shrubs.
Small Emerald Moth	*Hemistola chrysoprasaria*	NERC Act 2006: Section 41: Species of Principal Importance in England.
Stag Beetle	*Lucanus cervus*	UKBAP; AvonBAP; BNESBAP; rare. Dependent on reasonably sized vertical deadwood (does use horizontal deadwood, but not extensively)

8.2.4 Ecological Valuation

Most of the woodland and scrub areas within the BCREA are fairly small and of a value within the immediate zone of their influence only. At the western end of the BCREA the riparian tree belts are more continuous and are assessed as of City Value.

8.2.5 Ecosystem Services

The level of ecosystem service provision of woody plants within the BCREA at present is spatially variable, but generally below Parish to Parish level in terms of air quality improvement or amenity. Again the more continuous wooded corridors from Weston Island west have a landscape and visual amenity value at the City level.

8.3 ENHANCEMENT OPPORTUNITIES

A phased replacement of non-native riparian species with native species would make a significant contribution to creating sustainable biodiverse habitat along the river corridor.

Enhancement of groundflora within existing woodland areas and establishment of a species-rich ground flora layer at the time of any new woodland planting would be key positive interventions that could be successfully made. Recent examples of where this has been achieved are illustrated in Plate 8.1 and 8.2. Flowering fringes to hedges are illustrated in Plate 8.3.

A very important component of the woodland and woody habitat type relates to organisms that are dependent on dead or decaying wood. Different organisms utilise lying deadwood and standing deadwood, and/or mosaics of the two. It is therefore suggested that a deadwood strategy be developed for the entire BCREA so that elements of this habitat can be found throughout. Many species of invertebrate whose larvae use deadwood habitats are also predators of many pest species e.g. defoliating moths and hence a deadwood strategy can assist with natural biological control. An example of a deadwood installation in the UK is provided in Plate

Establishing continuity of canopy is particularly important for foraging bats; if continuity along one bank cannot be achieved then a continuous canopy on the opposite bank should be planted where possible. Canopies can be natural, but also more urbanised and sculptural, but still very functional for people and wildlife (see Plate 8.5).

Most species of breeding birds do not rely on trees for nesting; most prefer dense scrub species. Planting riparian scrub belts where human disturbance is lowest (significant stretches of the south bank are suitable), either as replacement for sections where scrub has been removed as part of the proposed developments, would enhance the river corridor for breeding birds. Also a strategy for provision of artificial refuges for birds and bats on trees should be developed for the whole BCREA. Note that such installations can be made even on recently planted semi-mature specimens (see Plate 8.6)

As well as providing habitat and refuges for breeding birds, consideration must be given to providing food and cover for birds outside of the breeding season, such as giving preference to berry-bearing shrubs to provide food for resident species and winter migrants such as Redwing and Fieldfare.

Plate 8.1: Created Carr woodland with species-rich groundflora, London

Plate 8.2: Impressive understorey of Cow Parsley growing en masse under pine trees, Camden, Bath

Plate 8.3: Primrose fringe to hedge with non-native Grape Hyacinth, adjacent to non-native hedge, Bath.

Plate 8.4: Deadwood ‘planted’ vertically adjacent to horizontal installations as important habitat mosaic for saproxylic invertebrates and birds

Plate 8.5: Trees sculpted as bower to create shade for footpath

Plate 8.6 Recently planted semi-mature tree in a London park supporting substantial artificial refuge for birds

9.0 GRASSLANDS

9.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

This category covers grasslands of varying conservation and amenity values and includes in order of increasing ecological value:

1. Improved (amenity grassland)
2. Poor semi-improved grassland
3. Semi-improved neutral grassland
4. Semi-improved calcareous grassland
5. Unimproved neutral grassland

Types 2 to 5 would qualify as the England Section 41 National Priority Habitat Lowland Meadow. In B&NES there is a Species-rich grassland Biodiversity Action Plan which promotes the restoration and res-establishment of this habitat.

It is considered that many living roofs could reasonably be categorised under the habitat type 'grassland' as they share most of the characteristics of this habitat'; though most living roofs currently installed in the UK might better be described as ephemeral short-perennial sub-habitat of the broad post-industrial habitat category (see section 10.0).

9.2 BIODIVERSITY BASELINE IN THE BCREA

9.2.1 Distribution, Condition and Trends

Other than amenity grassland, the grassland habitat within or adjacent to the BCREA corridor is of two basic types; neutral and calcareous. However, recent descriptive information for the various grasslands throughout the BCREA area, most of them being within SNCIs, is very limited and to some extent contradictory. Most SNCI grasslands are described as limestone or calcareous grasslands (Bath City Council (1990) but more recent survey (e.g. BRERC 2012: Newbridge Slopes SNCI) describes the grassland as being neutral in character rather than calcareous.

Most of the grasslands in the area have been subject to degrees of neglect or management regimes designed to keep the grasslands tidy rather than specifically designed to promote biodiversity. It is therefore difficult to assign the grasslands to a definite National Vegetation Classification (NVC) community. Much of the grassland in Newbridge slopes is assigned to the NVC MG1 community (neutral *Arrhenatherum elatius* grassland) but this often includes a strong calcareous component.

As well as MG1, calcareous grasslands in the BCREA area likely to include the following NVC communities:

- CG1: *Festuca ovina – Carlina vulgaris* grassland;
- CG2: *Festuca ovina – Avenula pratensis* grassland;
- CG3: *Bromus erectus* grassland.

BRERC holds species lists of plant species found within the BCREA area paying particular attention to those of conservation value; these data are listed as being in individual 1km squares without being assigned to any particular habitat type. Overall the more uncommon floral species found in the area that are represented in grassland communities are listed in Table 9.1; examples of key fauna found in these communities are shown in Table 9.2.

9.2.2 Key Associated Flora

Some of the key flora associated with grasslands in the BCREA area and its immediate surroundings.

Table 9.1: Some of the key flora associated with grassland communities recorded within or near the BCREA area

Species	Associated NVC Communities	BRERC Status
Pyramidal Orchid *Anacamptis pyramadalis*	CG1; CG3	Uncommon
Small Thyme-leaved Sandwort *Arenaria serpyllifolia*	CG1; CG2	Uncommon
Yellow-wort *Blackstonia perfoliata*	CG1; CG2; CG3	Uncommon
Carnation Sedge *Carex panacea*	MG4; MG5; MG8; MG9	Scarce
Crosswort *Cruciata laevioes*	MG1	Uncommon
Viper's Bugloss *Echium vulgare*	CG1	Scarce
Fritillary *Fritillaria meleagris*	MG4	Notable
Spiny Restharrow *Ononis spinosa*	CG2; CG3	Uncommon
Adder's-tongue *Ophioglossum vulgatum*	MG5	Scarce
Bee Orchid *Ophyris apifera*	CG2; CG3	Uncommon
Wild Parsnip *Pastinacea sativa*	MG1; CG3	Uncommon
Hawkweed Oxtongue *Picris hieraciodes*	CG2; CG3	Uncommon

9.2.3 Key Associated Fauna

Table 9.2: Key fauna associated with grassland communities recorded within or near the BCREA area

Common Name	Scientific Name	BRERC Status
Hedgehog	*Erinaceus europaeus*	NERC Act 2006: Section 41: Species of Principal Importance in England. Common but declining. Forages in semi-improved grassland as well as hedgerow
Common Pipistrelle	*Pipistrellus pipistrellus*	WCA 1981: Sch. 5. In decline. Forages in urban semi-improved grassland areas where there are also sufficient trees and hedges
Greater Horseshoe Bat	*Rhinolophus ferrumequinum*	NERC Act 2006: Section 41: Species of Principal Importance in England. WCA 1981: Sch. 5. Annex IV Habitats Directive. A stronghold in Bath. Potentially semi-improved grassland areas including parks
Green Woodpecker	*Picus viridis*	Birds of Conservation Concern: Amber list. Common. Feed on ants in urban grasslands
Mistle Thrush	*Turdus viscivorus*	Birds of Conservation Concern: Amber list. Feeds on grassland invertebrates
Slow-worm	*Anguis fragilis*	NERC Act 2006: Section 41: Common in semi-improved grasslands
Common Toad	*Bufo bufo*	NERC Act 2006: Section 41: Forage in semi-improved grasslands
Smooth Newt	*Lissotriton vulgaris*	Forage in semi-improved grasslands
Small Heath	*Coenonympha pamphilus*	NERC Act 2006: Section 41: Potential to occur in semi-improved grasslands
Garden Tiger	*Arctia caja*	NERC Act 2006: Section 41: Potential to occur in semi-improved grasslands

Common Name	Scientific Name	BRERC Status
Glow-worm	*Lampyris noctiluca*	Occur in semi-improved grasslands, (especially neutral and calcareous)

9.2.4 Ecological Valuation

Currently the value of grasslands in the BCREA for biodiversity can only be assigned within the immediate zone of influence of the habitat patches, nearly all of which are amenity lawn, with varying elements of floristic interest. There is clearly very significant potential for enhancement of value, see below.

9.2.5 Ecosystem Services

The grasslands with the BCREA have amenity value to local people but really are no more than of Parish value in this regard at present and represent and underutilised and undervalued resource.

9.3 HABITAT CREATION AND ENHANCEMENT OPPORTUNITIES

9.3.1 Overview

Opportunities for establishing significant areas of new grassland at ground level are limited. There is, however, potentially a significant scope for grassland creation on roof spaces, either installed on new build or else retro-fitted to existing buildings.

Different types of living roof could be installed to reflect the existing habitats within and adjacent to the city: calcareous grassland, neutral grassland and post-industrial habitat. The last of these is addressed separately in Section 10 as this category includes considerable areas of bare ground.

There are significant opportunities to enhance existing grasslands, either to biodiverse meadow, or at least to flowering lawns (see below).

9.3.2 Flowering Lawns

Flowering lawns are regularly mown grasslands that sustain a significant proportion of flowering forbs, whilst having sufficient hard-wearing grass component to withstand regular and sometimes intense footfall. Dwarf Rye-grass is a key component (to reduce the competition with the forbs, whilst providing the main wearing 'base') and the flowers adopt dwarf forms, persisting because the grasses are kept in check by regular mowing. Examples of naturally evolved flowering lawns in Bath are shown in Plates 9.1 and 9.2.

One key place where such habitat could be installed is at North Quay when this is redesigned. Here a fairly formal aesthetic is required and flowering lawns provide the means of achieving both this and value to biodiversity.

The design of the North Quay has yet to be finalised; several options are being considered. What these options have in common is provision of a biodiverse landscape including grasslands that will be sufficiently robust to receive a certain amount of wear from foot traffic whilst still providing a good visual amenity. It is suggested that rather than relying on seeding and plug planting that for flat or gently sloping substrates wildflower turf is used; for steeper slopes seed impregnated coir matting could be used.

There are several advantages of turfing over seeding grassland habitat establishment. Seeding, although initially cheaper than the alternatives, has the following drawbacks:

- Establishment of a continuous sward can take up to years – in the interim the grassland can look unsightly;
- Each patch will be subject to seed predation by common UK bird species;
- In the early stages of establishment invasive weed species can become rapidly established;
- Amelioration of the above-mentioned problems can entail daily management intervention so adding to costs.

Turfing and use of coir matting have the following advantages:

- It is immediately visually attractive;
- The continuous sward is not easily susceptible to weed invasion;
- It is ideally suited to establishment of small patch sizes;
- Swards designed to be walked on are wear resistant after only a few days.

Should augmentation of the sward be desired then plug plants can be introduced into the turf or coir rolls. Non-native species could be introduced provided that they can withstand regular mowing and wear and have a proven value for wildlife.

A typical flowering lawn turf contains native species of grasses (80% by volume) and wildflowers (20% by volume) which can withstand regular mowing and moderate use (e.g. walking, picnicking). The species mix found in an example of a commercial species-rich turf is indicated in Table 9.3.

Table 9.3: Plant species in a commercial species-rich turf

Species	Common Name
Grasses (7 species)	
Anthoxanthum odoratum	Sweet Vernal-grass
Festuca rubra commutata	Chewing's Fescue
Festuca rubra. litoralis	Slender Creeping Red Fescue
Festuca rubra trichophylla	Slender Creeping Red Fescue
Lolium perenne	Perennial Rye-grass (dwarf cultivar)
Phleum bertolonii	Smaller Cat's-tail
Poa pratensis	Smooth Meadow-grass
Wildflowers (20 species)	
Achillea millefolium	Yarrow
Bellis perennis	Daisy
Campanula rotundifolia	Harebell
Centaurea nigra	Common Knapweed
Clinopodium vulgare	Wild Basil
Conopodium majus	Pignut
Galium (mollugo) album	Hedge Bedstraw
Galium verum	Lady's Bedstraw
Lathyrus pratensis	Meadow Vetchling
Lotus corniculatus	Common Bird's-foot-trefoil
Medicago lupulina	Black Medick
Origanum vulgare	Wild Marjoram
Prunella vulgaris	Selfheal
Ranunculus acris	Meadow Buttercup
Rumex acetosa	Common Sorrel
Poterium (Sanguisorba) minor	Salad Burnet
Betonica (Stachys) officinalis	Betony
Trifolium dubium	Lesser Trefoil
Trifolium pratense	Red Clover
Trifolium repens	White Clover

Plate 9.1: Spontaneous flowering lawn, Snow Hill, Bath

Plates 9.2: Flowering lawn as habitat for a solitary bee, Bath

9.3.3

9.3.4 Meadows

There are at least two key areas where meadow habitat could be created within the BCREA.

Green Park is at present an unsatisfactory visual amenity offering little to please the eye. It is suggested that part of the Park is given over to wildflower meadow. Local people and visitors to the city could then walk amongst and sit within a landscape that gives an atmosphere of an old-fashioned country meadow, a habitat that has suffered catastrophic loss in the English landscape in the past few decades.

As with the North Quay development proposals it is suggested that a pre-grown meadow turf be used to ensure rapid and satisfactory habitat establishment in a public context.

The species listed in one wildflower meadow mix suitable for calcareous soils is provided in Table 9.4.

Plate

Table 9.4: Species-mix in a commercial turfed wildflower meadow

Species	Common Name
Grasses (3 species)	
Cynosurus cristatus	Crested Dog's-tail
Festuca ovina	Sheep's-fescue
Festuca rubra. litoralis	Slender Creeping Red Fescue
Wildflowers (29 species)	
Achillea millefolium	Yarrow
Centaurea nigra	Common Knapweed
Daucus carota	Wild Carrot
Filipendula ulmaria	Meadowsweet
Galium verum	Lady's Bedstraw
Geranium pratense	Meadow Crane's-bill
Hypericum perforatum	Perforate St John's-wort
Hypochoeris radicata	Cat's-ear
Knautia arvensis	Field Scabious
Leontodon hispidus	Rough Hawkbit
Leucanthemum vulgare	Oxeye Daisy
Linaria vulgaris	Common Toadflax
Lotus corniculatus	Common Bird's-foot-trefoil
Silene (Lychnis) flos-cuculi	Ragged-Robin
Malva moschata	Musk-mallow
Origanum vulgare	Wild Marjoram
Plantago lanceolata	Ribwort Plantain
Primula veris	Cowslip
Prunella vulgaris	Selfheal
Ranunculus acris	Meadow Buttercup
Rhinanthus minor	Yellow-rattle
Rumex acetosa	Common Sorrel
Poterium (Sanguisorba) minor	Salad Burnet
Scorzoneroides autumnalis	Autumn Hawkbit
Silene dioica	Red Campion
Silene latifolia	White Campion
Silene vulgaris	Bladder Campion
Betonica (Stachys) officinalis	Betony
Trifolium pratense	Red Clover

Plate 9.3: Wildflower meadow established on the River Channelsea in London.

This was established on a substrate stabilised by bioengineering, suitable to withstand occasional inundation by fast-moving river water.

Plates 9.4 to 9.7: Examples of meadow habitats integrated with more formal parkland, UK

9.3.5 Grasslands on Living Roofs and Facades

A key way of introducing new grassland habitats to the BCREA could be on living roofs and facades. Some ecologists argue that such installations are not 'fully functioning ecosystems'; but when it is considered that in Switzerland one may find a grassland nature reserve of regional biodiversity value on a roof, (see Plate 9.8) this does seem an ill-founded concern.

There is scope to set a serious strategy for habitat creation here, one that could compete with the best British examples, and which could achieve the accolade of a Biodiversity Benchmark (see Plate 9.9),

The GRO Green Roof Code (Plate 9.10) does provide a framework for an approach that allows flexibility in design; depending on management commitment.

Grasslands can exist, as in nature, on a variety of slopes. A calcareous meadow roof on the 'Diggers' Development in Brighton can be seen in Plate 9.11. Meadows can even be installed on vertical services where appropriately designed as may be seen in Plate 9.12, taken in Southampton, a modular substrate based living wall at Southampton City Council that is based on native and long-naturalised species.

Key intended functions of green infrastructure on built form in the BCREA include:

- to create an attractive and interesting (ideally varied) visual aesthetic;
- to provide a degree of bioclimatic cooling and contribution to the wider network of greenery in London that helps combat the urban heat island and increase adaptability to climate change;
- to function as part of a wider system of sustainable urban drainage;
- to attract desired biodiversity, especially species of importance in a Bath context for the benefit of wildlife and people alike;
- to be sustainable in light of the significant variations in the climate of Bath within and between years; and adaptable in relation to predicted climate change.

Plate 9.8: A biodiverse meadow on a roof in Switzerland

Plate 9.9: The Biodiversity Benchmark for Green Roofs – and award run by the Wildlife Trusts for biodiverse green roof installations

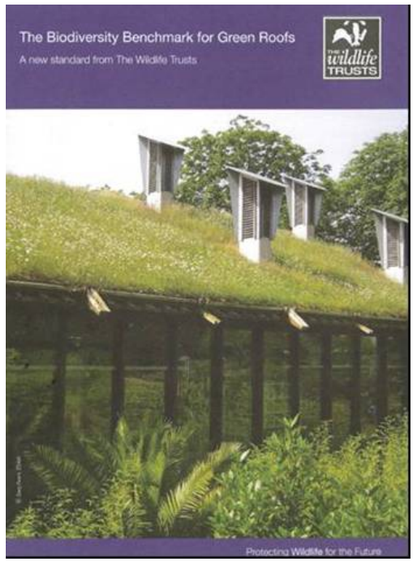


Plate 9.10: The GRO code for design and installation of living (green) roofs in the UK

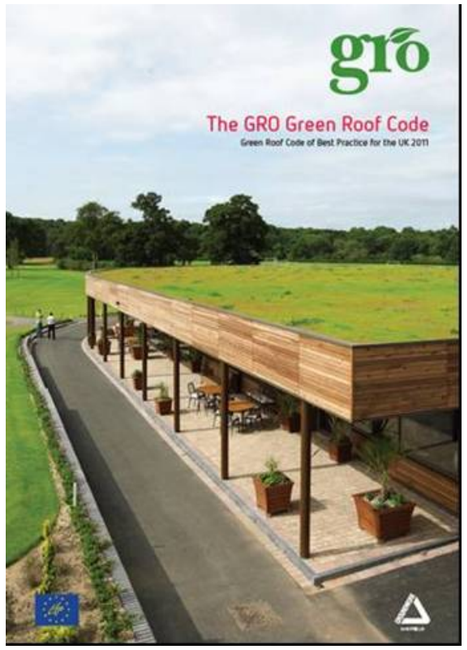


Plate 9.11: Calcareous meadow on living roof, Brighton, UK

Plate 9.12: Living wall of native and naturalised forbs, growing in an irrigated vertical soil module system, Southampton

10.0 EPHEMERAL SHORT PERENNIAL COMMUNTIES

10.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

These habitats occur on skeletal and/or nutrient-poor substrates provided by post-industrial sites, or on roof spaces. Tall herb at river of pond margins is considered under Fluvial Habitats. Generally the stand types are typical of derelict land or poorly maintained hard standings.

There is a B&NEs 'Wild Things' 10 year Habitat Action Plan (2006-2016) for post-industrial sites.

10.2 BIODIVERSITY BASELINE IN THE BCREA

10.2.1 General Status

The trend is for steady loss of this habitat type. When Bath Western Riverside was cleared for redevelopment, invertebrate communities of Regional importance that were associated with this habitat were lost.

There remains one key development site near to Bath Western Riverside on Upper Bristol Road that may support this habitat type currently, though no data are available at time of writing.

Elements of ephemeral short perennial communities exist along the disused railway lines, but these have largely succeeded to scrub and trees and hence meet the 'post industrial habitat classification, but are not ephemeral short perennial communities any more.

10.2.2 Key Associated Flora

Species often associated with post-industrial areas that occur in or near the BCREA and (BRERC 2011) are shown in Table 10.1.

Table 10.1: Typical flora of post-industrial areas (examples)

Species	Status
Yellow-wort *Blackstonia perfoliata*	Uncommon BRERC area
Many-seeded Goosefoot *Chenopodium polyspermum*	Uncommon BRERC area
Perennial Wall-rocket *Diplotaxis tenuifolia*	Uncommon BRERC area
Common Cudweed *Filago vulgaris*	Potentially occurs as a frequent plant of waste and brownfield sites, especially when disturbed
Fern-grass *Catapodium rigidum*	Uncommon BRERC area
Viper's Bugloss *Echium vulgare*	Scarce in the BRERC area
A Few-flowered Fumitory *Fumaria muralis boraei*	Rare in BCREA area but potential for dry calcareous areas
Blue Fleabane *Erigeron acer*	Uncommon BRERC area
Common Stork's-bill *Erodium cicutarium*	Uncommon BRERC area
Fennel *Foeniculum vulgare*	Uncommon BRERC area
Common Ramping Fumitory *Fumaria muralis boroei*	Rare BRERC area

10.2.3 Key Associated Fauna

Species often associated with post-industrial areas that occur in the BCREA (BRERC 2011) are shown in Table 10.1.

Table 10.2: Typical fauna of post-industrial areas

	Species	Status
Slow-worm	*Anguis fragilis*	UKBAP; Avon BAP; NERC Section 41 (were present on Bath Western Riverside before redevelopment)
Long-winged Conehead	*Conocephalus discolor*	Rare but underrecorded BRERC
Blue Mason Bee	*Osmia coerulescens*	Solitary bee utilising masonry material and other substrates
Butterflies		All those listed in Appendix 1 other than White-letter hairstreak could feed and indeed breed on this habitat
Sand-tailed Digger Wasp	*Cerceris arenaria*	Solitary wasp associated with sandy or fine gravel substrates.

10.2.4 Ecological Valuation

Currently not known what value this community type has, though clearly contributes to some extent to the value of Post-industrial habitats on the former railway SNCIs in and near the area.

10.2.5 Ecosystem Services

Good value to pollinators in extensive swards. Can have aesthetic value (e.g. Canvey Island SSSI in London).

10.3 ENHANCEMENT OPPORTUNITIES

The key opportunity for re-provision of this habitat type within BCREA is on roof spaces. A key location for this could be the industrial units in the western half of the area. Examples of this habitat on living roofs at home and abroad are illustrated in Plates 10.1 to 10.3. Note the opportunity for installation of Photovoltaics on this habitat type as shown on the Transport for London HQ in Plate 10.2.

Plate 10.1: Living Roofs with ephemeral short perennial communities

Plate 10.2: Ephemeral short perennial community and PVs on TFL HQ London

Plate 10.3: Ephemeral short perennial community – attractive rooftop, Basel

11.0 STONE WALL NICHE AND CLIMBER COMMUNITIES

11.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

Stone wall niche communities appear in mid-summer as lush displays of flowering forbs and lower plants on mortared bath stone walls, where sufficient weathering has allowed for the creation of niches where soil can accrete and plants draw water from deep in the supporting fabric. Such habitats currently have no protection status and are frequently lost when walls are re-furbished or repointed

Climber communities are frequently planted within courtyards etc in Bath, but also can arise spontaneously, usually as colonisation by Ivy or Virginia Creeper.

11.2 BIODIVERSITY BASELINE IN THE BCREA

11.2.1 General Status

Within the BCREA there appear to be relatively few good examples of this habitat type. However in Bath as a whole, such communities form distinctive, striking and ecologically valuable features in the landscape that lend a powerful sense of place.

11.2.2 Key Associated Flora

Some of the most common and regularly occurring plant species (other than mosses) found in stone wall niche communities in Bath are illustrated in Plates 11.1 to 11.7. However the community can include rarities, of which some key examples are listed in Table 11.1.

Table 11.1: Typical flora of stone wall niche and climber communities in or near the BCREA (examples)

Species	Status
Perennial Wall-rocket *Diplotaxis tenuifolia*	Uncommon BRERC area
White Stonecrop *Sedum album*	Uncommon BRERC area
Bats	Fully protected species – various species may forage around or roost under/amongst climber communities.

11.2.3 Key Associated Fauna

Species often associated with stone-wall niche communities that occur in the BCREA (BRERC 2011) are shown in Table 11.2.

Table 10.2: Typical fauna of post-industrial areas

	Species	Status
Tube Web Spider	*Segestria florentina*	Introduced but iconic spider.
Bees	*Various*	Various species of bee, including rarer species have been noted visiting flowers in these habitats

11.2.4 Ecological Valuation

Currently negligible in the BCREA.

11.2.5 Ecosystem Services

Can add very strong pleasing aesthetic to otherwise bland streetscapes. Provide good nectar and pollen source and will assist in filtering road pollution.

11.3 ENHANCEMENT OPPORTUNITIES

The intentional creation of these habitats could become a signature intervention in the BCREA. Moreover, intentionally created, with due care and attention paid to ensuring wall integrity, they would not be at risk of the sorts of losses described above.

There is considerable scope for facade enhancement with climber communities (see Plate 11.8). The palette of evergreen species of value to foraging native fauna is limited, but apart from Common Ivy, there are various non-native species that have such value and which can provide early or late nectaring opportunities.

Most climber communities on walls can provide day roosting cover for bats such as pipistrelles, if sufficiently dense and mature.

Plate 11.1: Ivy-leaved Toadflax: *Cymbalaria muralis*

Plate 11.2: Adria or Dalmatian Bellflower *Campanula portenschlagiana*

Plate 11.3: Trailing Bellflower *Campanula porscharskyana*

Plate 11.4: Mexican Fleabane *Erigeron karvinskianus*

Plate 11.5: Black Spleenwort *Asplenium trichomanes*

Plate 11.6: Wall Rue *Asplenium ruta-muraria*

Plate 11.7: Bath stone wall with abundant Yellow Corydalis *Pseudofumaria lutea* and Red Valerian *Centranthus ruber*

Plate 11.8: Climber community on wire trellis proud of building

12.0 ALLOTMENTS & GARDENS

12.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

Gardens and allotments cannot be overlooked in the context of urban ecological value as both can provide significant refuge or wildlife. It has been shown by the BUGS research undertaken by the University of Sheffield that the diversity of invertebrates in urban gardens depends on plant variety and is relatively insensitive to whether the plants are native of native. Most of the species in gardens are edge species and disperse well between stepping stones of habitat, rather than requiring continuous habitat corridors.

12.2 BASELINE IN THE BCREA

12.2.1 General Status

By comparison with the rest of Bath, in parts of which there are large gardens with large mature trees and other habitats, the garden habitats of the BCREA are quite limited in scale and diversity. There are no allotments in the area, though the BCREA is immediately adjacent to the large area of allotments in Victoria Park.

12.2.2 Key Associated Flora

Virtually any of the species listed in Appendix 1 could be found in gardens in theory, although most will not.

12.2.3 Key Associated Fauna

Again many of the species in Appendix 1 could at some point visit gardens. Perhaps one of the most notably is the Rose Chafer *Cetonia aurata* (local in the BRERC area) which can occur in Bath gardens as 'explosions' of adults e.g. foraging on *Ceanothis*.

12.2.4 Ecological Valuation

Currently of negligible value to value only within the zone of immediate ecological influence. Significant scope for enhancement.

12.2.5 Ecosystem Services

Of value to the residents of the houses involved.

12.3 ENHANCEMENT OPPORTUNITIES

One key mode of enhancement could be for B&NES to establish a best riverside garden award, which gave prizes for both aesthetic appeal and biodiversity. The constituency for this could be quite considerable. Examples of gardens in Bath showing the degree of drive to 'green' the immediate vicinity of dwellings, even in very challenging circumstances are shown in Plates 12.1 and 12.2. A Bath Enterprise Area in Bloom festival could also be established.

Extension of this to possible use of street areas for food growing through Council-Citizen partnerships could be considered.

There is also the possibility to consider use of roof spaces for good growing. Examples of this from the UK and USA are shown in Plates 12. 3 and 12.4. Such habitats can feature companion planting and/or large flowered exotic vegetables with high wildlife value as part of the overall design.

Plate 12.1: Private front garden packed with planting, providing a haven against the noisy and polluted London Road, Bath

Plate 12.2: Inventive approach to limited space for diverse garden creation, Bath

Plate 12.3: Rooftop Allotment: One Brighton

Plate 12.4: Brooklyn Grange, New York's biggest rooftop farm, Long Island City

13.0 BATS

13.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

There are 17 species of bat known to breed in the UK. Of these at least 8 species have recently been recorded in the Bristol Avon corridor through Bath (Simecology 2013). These were:

- Serotine *Eptesicus serotinus*
- Daubenton's Bat *Myotis daubentonii*
- Noctule *Nycatlus noctula*
- Common Pipistrelle *Pipistrellus pipistrellus*
- Soprano Pipistrelle *Pipistrellus pygmaeus*
- Brown Long-eared Bat *Plecotus auritus*
- Greater Horseshoe Bat *Rhinolophus ferrumequinum*
- Lesser Horseshoe bat *Rhinolophus hipposideros*

Other bats of the genus *Myotis* were also recorded; myotid bats are often difficult to differentiate even with the most sophisticated recording and sound analysis equipment. In a Bath and Bristol Avon context these were likely include Brandt's Bat *Myotis brandtii*, Whiskered Bat *M. mystacinus* and Natterer's Bat *M. nattereri.* Brown Long-eared Bats, known to be widespread in the area, were recorded in very low numbers but this is likely to reflect the 'whispered' nature of their calls.

The general consensus is that populations all species of bats in the UK, with the possible exception of Daubenton's, are in decline (Mitchell-Jones 2004).

All species of bat receive full protection under the Wildlife and Countryside Act 1981 (as amended). In view of their status across Europe, all species of bat have been listed on Annex IV of the EC 'Habitats and Species Directive', transposed into UK law by the Conservation of Habitats and Species Regulations (2010). Taken together UK legislation ensures that individual bats, their breeding sites and resting places are protected. Annex IV of the Habitats Directive relates to the designation of Special Areas of Conservation (SACs) and covers Greater and Lesser Horseshoe bats, One such SAC is the Bath and Bradford-on-Avon SAC; there are several roosts of this species within commuting distance of the Bath river corridor.

13.2 BCREA BASELINE

13.2.1 General Distribution, Condition and Trends

The Simecology (2013) survey, using both static and manual detection, took place at three sites; Weston Island towards the downstream end of the BCREA, Corn Market Vaults at the upstream end of the BCREA and Kensington Meadows upstream of the BCREA where the riparian habitat changes from urban to rural in character.

The high level of bat activity at the three sites was attributed to four common factors:

- All sites had significant cover, whether it was the trees, scrub or derelict riverside buildings;
- Light levels were recorded as 0 Lux at each of the sites;
- All sites were well connected to the surrounding rural areas by 'fingers' of green space reaching into Bath from the wider landscape;
- Compared to other sections of the river corridor, these sites had little disturbance from traffic, human activity and most importantly lighting.

The most common species recorded in the survey was Soprano Pipistrelle, followed by Common Pipistrelle and Daubenton's (see Plate 13.1); unidentified myotid species were recorded in significant numbers.

Although the most common activity type recorded was foraging, social calls from Soprano Pipistrelles, Common Pipistrelles and myotids (including Daubenton's) reflected breeding/mating behaviour typical of the time of year of the survey.

The Cornmarket Vaults supported a roost of at least three species; Daubenton's, Lesser Horseshoe (see Plate 13.2) and Greater Horseshoe.

A recent survey by Black & Veatch (unpublished) of the North & South Quays area showed the presence of Soprano and Common Pipistrelle, Daubenton's and Noctule Bats; the presence of the latter is mildly surprising considering that this species is normally associated with open country.

Previous surveys known to the present authors have revealed other roosts of horseshoe bats in Pultney Bridge.

In terms of species the BRERC (2011) data broadly reflected the findings of the 2013 survey but notably there are records of Whiskered Bat within a 1km square at the western end of the BCREA and Natterer's Bat in the 1km square covering the Kennet & Avon Canal confluence with the Avon.

13.2.2 Biodiversity Valuation

The level of cover at the three monitoring sites in the 2013 survey was noted as being excellent. However, this is not the case for much of the river corridor between the Corn Market Vaults and Weston Island where much of the riverbank has little or no vegetation. Survey for bat activity of this habitat-poor stretch of river was not part of the remit of the 2013 survey. Personal observation by BbD, anecdotal reports of others, the Black and Veatch survey and BRERC data do demonstrate that parts of the river do support pockets of bat foraging activity. Lack of continuous good foraging habitat, however, means that linear movements of foraging bats along the entire length of the river through the BCREA may not regularly occur for several species, especially those most intolerant of light pollution or lack of cover. Clearly the BCREA is from its west end to near Pultney Weir of City Value at least for bats, but with significant scope for enhancement locally. It could be argued that this value increase to Regional further upstream given the use by horseshoe bats.

13.3 ENHANCEMENT OPPORTUNITIES

The two crucial factors for the provision of foraging opportunities for bats are low lighting levels and continuous canopy cover.

One site where a continuous tree-line is to be lost is at North Quay where hybrid Black-poplars *Populus x canadensis* are to be removed as part of the proposed redevelopment. It is anticipated that these non-native trees, which are short-lived, are to be replaced with native Black-poplar and native White Willow, *Salix alba*. Native tree species are intrinsically preferable as bat foraging habitat as they usually support a much higher invertebrate population than non-native species. Gradual replacement of non-native tree and shrub species with native species along the whole length of the river corridor would create a more sustainable foraging habitat for Bath's bat populations.

Directing lighting away from the tree canopies would be essential to allow continuous, or near-continuous foraging corridors to provide free movement of bats. At present the north bank of the river, from Churchill Bridge to the western extremity of the BCREA area, has riverside pedestrian and, in part, cycling access. There is therefore a potential conflict between creating optimal low lighting conditions for bats and ensuring public safety. Choice of lighting fixtures in terms of light frequency and

direction of illumination must therefore play an important part in design. One other possible strategy is the use of motion-sensitive lighting along the riverside path so that throughout much of the night the path and the trees and shrubs along its length are kept in the dark.

The undersides and parapets of bridges are favoured sites for bat roosts. Installation of artificial refuges for bats under bridges would make a significant contribution to the sustainability of Bath's bat populations, particularly for species such as Daubenton's Bat which are most often forage over water. Where lighting levels of the bank-side vegetation adjacent to bridges are kept at low levels other species such as the pipistrelles would also make use of dark roosting conditions under the bridges conclusive for establishing breeding and roosting colonies. Two existing bridges have been identified as potential 'green bridges' to provide corridors for wildlife whilst also permitting pedestrian and cycle traffic. Another 'green bridge' has been mooted to connect North and South Quays. These bridges would make ideal candidates for supporting bat colonies but, given appropriate lighting conditions and good foraging habitat nearby, road and rail bridges could also be adapted to support bat colonies.

The survey carried out by Simecology demonstrates the importance of the 'green corridors' entering Bath along the Bristol Avon from upstream and downstream.. Other green corridors have been identified (see Section 6.0). It is important that the potential of these corridors to bring bats into the city are realised by appropriate planting of native tree and shrub species. Where there are perceived breaks in the integrity of corridors facades and green roofs can supplement ground level planting.

Plate 13.1: Daubenton's Bats

Plate 13.2: Lesser Horseshoe Bat

14.0 EUROPEAN OTTERS

14.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

The European Otter *Lutra lutra* is a species that has suffered historic declines due to hunting and pollution but which has recovered in many areas and in recent years become adapted to urban river stretches in many cities and towns.

Fully protected under the Wildlife and Countryside Act 1981 (as amended) and Conservation of Habitats and Species Regulations (2010). Protection extends to the places of shelter or protection.

Otters typically have 40 lying up sites that they use as refuges through the year and holt sites. Coghill (1980) summarised the types of resting site recorded in the upper reaches of the Severn catchment. From a total of over 250 sites:

- 42% were under the roots of trees (90% Ash or Sycamore)
- 20% of sites in open air in reed or osier beds, young forestry plantations, islands, rhododendron bushes, bracken, hedges, scrub,
- 13% stick heaps and rocks
- 11% enclosed drains
- 14% - varied: badger setts, rabbit burrows, 'hollow islands', and a car body

Most lying up sites are within 10 m of water but some can be 50 m away.

Thom (1997) identified holt locations from an extensive study

- 58% were under trees (with half of these under Ash or Sycamore).
- 33% were in rocky banks, stone filled gabions or caves, and
- 9% were piles of debris or holes in the bank.

Average holt density = one holt per km of stream, but distribution clumped, with around a third of 5km sections having no holts and some 5km sections having around 10 holts.

14.2 BCREA BASELINE

14.2.1 General Distribution, Condition and Trends

The distribution of clusters of key Otter sightings through the study area is summarised in Figure 15.1. These data were taken from BRERC 2011.

The sites favoured are all either confluences with incoming waters (Newton Brook and the Kennet and Avon Canal), where relatively shallow areas in low flow conditions present feeding areas or where oxygenated areas below weirs attract fish.

14.2.2 Biodiversity Valuation

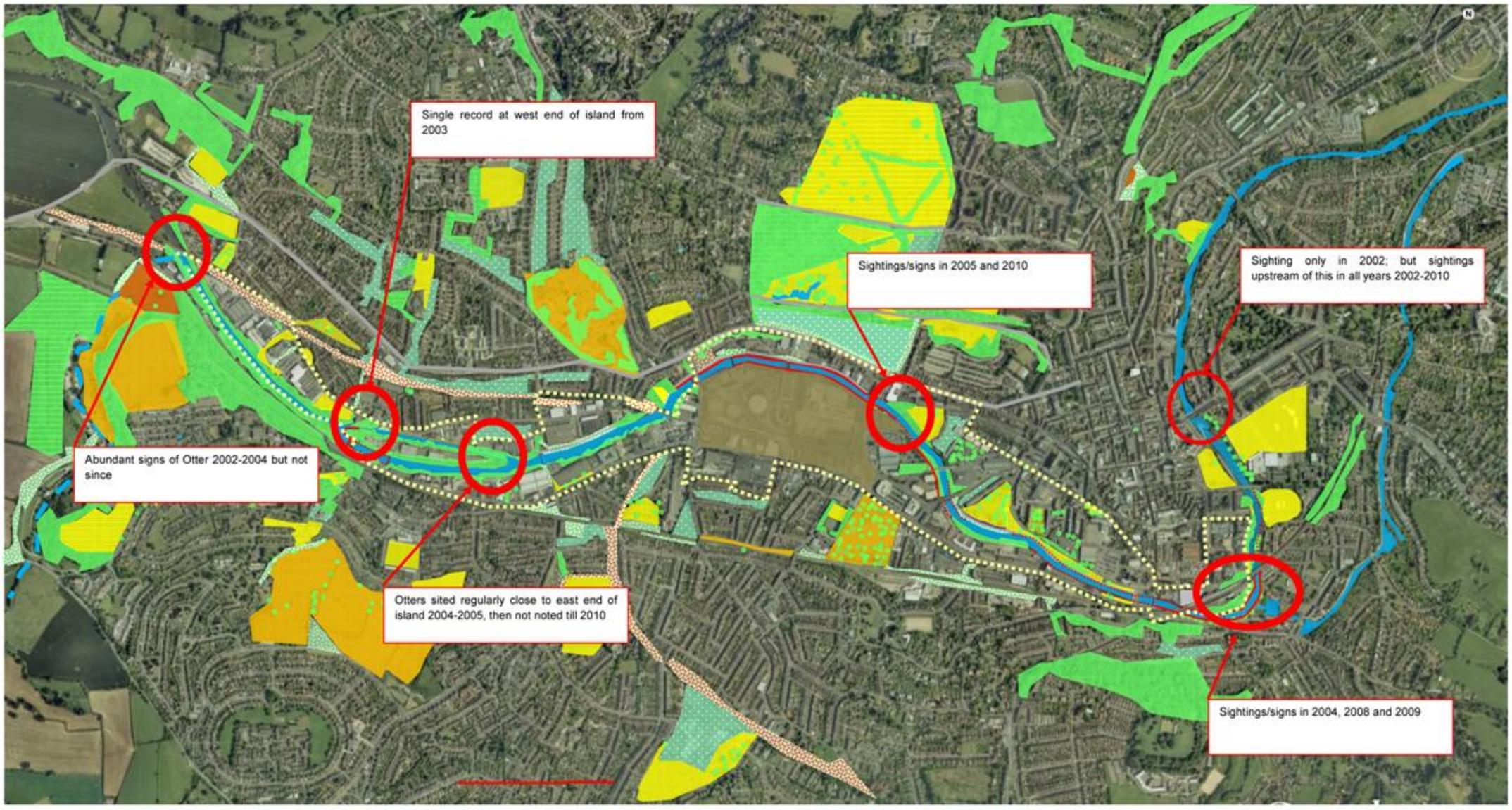
To have Otters foraging and commuting through the heart of Bath is clearly an ecological feature of City Value.

14.3 ENHANCEMENT OPPORTUNITIES

Enhancements could include e.g.:

- Increasing the number of secure lying up sites through the city protected by thorny barriers so that only accessible from river and ensure not available as moorings.
- Creation of artificial holts
- Bank and riparian enhancements as described in previous sections
- Ensuring that there are 5 secure holt sites through the city and 10 secure lying up sites.

Figure 15.1: Key Clusters of Otter Records through the Bath City Enterprise Area, 5km stretch



15.0 KINGFISHER

15.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

As a fairly rare, easily disturbed bird, the Kingfisher *Alcedo atthis* is afforded the highest degree of legal protection under the Schedule 1 of the Wildlife and Countryside Act 1981. It is an offence to take, injure or kill a Kingfisher or to take, damage or destroy its nest, eggs or young. It is also an offence to intentionally or recklessly disturb the birds close to their nest during the breeding season.

Kingfishers breed beside still or gently flowing freshwater.

Where there are no available nesting banks, they sometimes take to nesting on ledges or gaps in walls. Although shy and wary it can adapt to human settlements or to rivers much used for recreation when other conditions are sufficiently favourable.

Pairs are solitary and territorial and, although feeding may take place up to 1km from the breeding territory, each pair usually occupies a length of watercourse or shoreline of 0.8-1.5km. (Andrews and Kinsman, 1990). Breeding territories are vigorously defended.

The nest site is a tunnel in a steep or vertical bank, normally over water, and mostly 90 – 180cm above the water. Nests are re-used in successive years. If there are not any suitable banks available they may nest among the roots of fallen trees or in a sandpit (Holmes, 1985). Artificial banks for nesting have been successfully deployed (Hopkins, 2001)

During the breeding season Kingfishers feed mainly on small fish such as minnow, stickleback and fry, supplemented by a variety of aquatic insects, including caddis flies and the nymphs of dragonflies. Kingfishers will eat tadpoles, small molluscs and crustaceans such as crayfish (Holmes, 1985).

To rear a brood successfully, kingfishers need to catch about 100 small fish a day for up to four weeks (RSPB *et al.,* 2001).

Fish are caught by diving, either from a perch over the water or from hovering flight. Although fish may be taken from a depth of up to 1m, shallower water is preferred. Clear water is essential, since the kingfisher needs to see its potential prey (Andrews & Kinsman, 1990).

15.2 BCREA BASELINE

15.2.1 General Distribution, Condition and Trends

Kingfishers nest throughout the Bristol Avon catchment and have been recorded on all stretches of the River Avon within the Bristol Regional Environmental Records Centre area. The population appears to be stable. Hard winters lead to significant falls in population and occupied territories but numbers tend to recover fairly quickly to pre-crash levels.

Most of the riverbanks within the BCREA are sub-optimal as nesting sites.

Sitings of Kingfisher in the BCREA are concentrated at the confluences of the Newton Brook and the Kennet and Avon Canal where mixing of waters provides habitat for fish fry. Other concentrations of sitings are upstream of Weston Island where overhanging willows provide feeding perches (Figure X) and upstream of Pulteney Weir where still clear water offers feeding opportunities.

15.2.2 Biodiversity Valuation

The foraging Kingfisher population of Bath is relatively abundant. This species appears to be a favoured prey of the resident Peregrines. For an urban site, the population would seem exceptional and the BCREA therefore considered to be of City Value to foraging Kingfishers with potential for enhancement of the breeding population.

15.3 ENHANCEMENT OPPORTUNITIES

Within the BCREA there is probably only room for 2 – 3 territories. It is not known how many of these are currently being held.

Artificial Kingfisher banks could be installed near to the Newton Brook confluence and the Kennet and Avon confluence.

It is important that overhanging branches are frequent along as much of the river corridor as is possible whilst not proving potential obstructions to peak flows.

16.0 BIRDS OTHER THAN KINGFISHER

16.1 GENERAL CHARACTERISTICS AND PROTECTION STATUS

A diverse array of avifaunal species has been recorded within a 0.5km corridor either side of the River Avon but many are either wintering birds, stopping over during their spring and autumn migrations or else vagrants to urban areas (BRERC 2011).

Many of the birds which have likely bred, or could be encouraged to do so, in the corridor are associated with urban woodland and scrub habitats rather than strictly riparian habitats. In total 42 species have been identified as making a contribution to the biodiversity of BCREA, now and in the future, mostly as breeding birds.

The only one of these species afforded the highest degree of legal protection under the Schedule 1 of the Wildlife and Countryside Act 1981 is the Peregrine *Falco peregrinus* which has for several years successfully raised fledglings on St John's Church.

Of the other 41 species those which have been accorded national, regional or local BAP status, or are recognised as 'Birds of Conservation Concern' (Eaton *et al.,* 2009) are: Bullfinch, Cormorant, Dunnock, Grey Heron, Grey Wagtail, House Martin, House Sparrow, Mallard, Mistle Thrush, Reed Warbler, Sedge Warbler, Song Thrush & Swift. A full description of their status, together with the scientific names of all birds mentioned in the text, is given in the species listing in Appendix 1.

Not all bird species make a positive contribution to Bath's urban realm. One of the commonest of bird species within Bath, the Feral Pigeon, is generally considered a pest species. Similarly two species of gull, the Herring Gull and the Lesser Black-backed Gull, regard the roofs and ledges of Bath's tall buildings as good substitutes for their usual cliff nest sites. Whilst they are well-formed animals and impressive and graceful fliers, their scavenging habitats, raucous cries and smelly excreta have put them at odds with Bath's citizens. Efforts to control their numbers using trained falcons to disturb them in the breeding season do not seem to have met with much success.

16.2 BCREA BASELINE

16.2.1 General Distribution, Condition and Trends

The 41 species, their habitat associations and requirements are listed in Table 16.1.

Table 16.1: Bird species other than Kingfisher are known to occur within or near to the BCREA

Species	Habitat etc
Blackbird	Highest breeding density in small urban parks & gardens. Beautiful song.
Blackcap	Nests in broadleaved woodland with a well-defined shrub layer. A warbler. Visits gardens.
Blue Tit	Nests in broadleaved woodland, parks & gardens in holes or nest boxes.
Bullfinch	Uncommon breeder in Bath. Prefers dense cover in scrub or large gardens. Beautiful plumage.
Carrion Crow	Nests in the larger areas of broad-leaved woodland in Bath e.g. Beechen Cliff.
Chaffinch	Breeds in almost any wooded habitat. Forages on a varied assortment of wildflower and tree seeds throughout the city.
Chiffchaff	Preferred nesting sites are in broad-leaved woodland with a well developed shrub layer.
Coal Tit	Nests in most types of woodland including in urban areas of Bath. Uses nest boxes.
Collared Dove	A pretty bird associated with human habitation.
Coot	Primarily associated with lake habitat but recently this species nesting on River Avon in Bradford-on-Avon town centre. Undisturbed platforms on riverbank could encourage this species in the BCREA corridor.
Cormorant	A substantial number of these bold charismatic birds gather in the trees on Weston Island. Good views of them fishing can be seen from footbridges in the city.
Dunnock	Found in virtually any habitat with dense low cover.
Goldcrest	In Bath associated with Yew and ornamental conifers in parks and churchyards Form loose flocks with tit species foraging though tree canopies.
Goldfinch	Nests mainly in scrub in loose colonies. Roaming flocks of these exotically coloured birds feed on riparian Alder in winter.
Great Spotted Woodpecker	Nests in broad=leaved woodland and parks in Bath.
Great Tit	Nests in broadleaved woodland, parks & gardens. Uses nest boxes.
Greenfinch	A handsome bird nesting in parks and gardens in Bath.
Grey Heron	A shy and stately bird dependent on shallow water for hunting, At present there are few such sites within the BCREA area.
Grey Wagtail	The most characteristic riparian bird of western England nesting on ledges, among tree roots or beneath man-made structures such as bridges. Will use nest boxes.
House Martin	Associated with man-made structures such as under eaves and bridges. A limiting factor with regard to breeding success in Bath at present is likely to be lack of mud along the river's edge, a vital raw material for nest construction.
House Sparrow	In decline. Associated with human habitation. Will use colonial nestboxes
Jackdaw	Most nests in Bath are in chimneys.
Jay	A spectacular bird in Bath's parks, associated with oaks.
Long-tailed Tit	Nests in deciduous woodland & gardens. Increasingly urban. Highly attractive. Flocks in winter move through all scrub, including riparian.
Magpie	Breeds in mature trees in Bath.
Mallard	Several pairs nesting in Bath mainly under canopy of trees overhanging the river.
Mistle Thrush	Nests in parks in Bath. Forages in grasslands including recreation grounds and amenity grassland. The largest of England's thrushes.
Moorhen	Several pairs nesting in Bath mainly under canopy of trees overhanging the river. Busy birds and slightly comical jerky movements.
Mute Swan	At present probably does not regularly nest within the BCREA corridor but adult birds that nest upstream of Bath or along the canal bring their cygnets into the main river to beg for food.

Species	Habitat etc
Nuthatch	Nests in parks & gardens in Bath.
Pied Wagtail	Breeds in a wide variety of habitats in the city. Large roosts gather in trees in winter even in highly urbanised parts of the city centre.
Reed Warbler	Currently the riparian habitat in Bath is sub-optimal for this species but could be encouraged to breed by linear reed installations along banks.
Robin	Probably UK's most popular bird. Nests in parks and gardens and in scrub along the riverbanks.
Sedge Warbler	Currently the riparian habitat in Bath is sub-optimal for this species but could be encouraged to breed by linear reed installations along banks.
Siskin	Flocks of this attractive finch visit riparian Alder in the winter.
Song Thrush	Can breed in virtually any habitat where there are trees and shrubs. Sadly populations are in decline. A beautiful song.
Swift	Can be encouraged to nest under the eaves of new buildings by installation of 'Swift Brick' nests.
Tawny Owl	Can nest wherever there are large trees in parks, churchyards and gardens. Has a charismatic and exciting call.
Treecreeper	Nests in parks in Bath.
Woodpigeon	Common in parks and gardens.
Wren	Nests tend to be placed in Bramble, Hawthorn or Blackthorn thickets. Widespread throughout many habitats in Bath

16.2.2 Biodiversity Valuation

The river and immediately associated riparian habitats in the BCREA must be overall considered of City Value, though local stretches would in isolation be valued at Parish or lower value. Beyond the river, there are few particularly valuable habitats for birds – and most habitats would be assessed as of value to birds only within their zone of immediate ecological influence.

16.2.3 Ecosystem Services

A rich diversity of birds throughout the year, with their diverse forms, plumage, movements and song, make a significant contribution to the biophilic response of residents, workers and visitors to the area.

Development of new habitats and enhancements of existing ones will increase the diversity and quantity of avifauna giving a concomitant increase in the biophilic benefits to people.

16.3 ENHANCEMENT OPPORTUNITIES

Several strategies have been identified as making, in part, a contribution to enhancing the quality and quantity of habitats for birds whether nesting or foraging within the river corridor:

- Marginal aquatics strategy
- Woodland enhancement and deadwood strategies
- Living architecture strategy
- Wildlife refuge strategy

The south bank of the river is less subject to human disturbance than the north bank which currently has a footpath/cyclepath along much of its length. Installation of refuges for breeding birds should therefore be concentrated on the south bank within existing and new scrub development.

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APPENDIX 1: BRERC RECORDS RELEVANT TO STUDY AREA

The records in the table below relate to all significant flora and fauna from BRERC records from map areas within which part of the BCREA area lies. A location plan for the map areas is provided at the end of the table.

Scientific Name	Common Name	BRERC Status	BAP	RSPB List	Statutory Status	Map
Mammals						
Arvicola amphibia	Water Vole	Rare	UKBAP; SWAP; BNESBAP;		NERC S.41; WCA S.5	27; 28; 32; 33
Erinaceus europaeus	Hedgehog	Common/ Declining?	UKBAP; AvonBAP; BNESBAP;		NERC S.41	27; 28; 30; 31; 32; 33
Lutra lutra	Otter	Rare – was locally extinct/recolonising from the south	UKBAP; AvonBAP; BNESBAP;		NERC S.41; WCA S.5; Annex II	24; 26; 28; 29; 30; 32; 33
Meles meles	Badger	Widespread & Common – national stronghold.			Badger Act	24; 25; 26; 27; 28; 29; 30; 31; 32; 33
Mustela vison	American Mink	Proposed BRERC Notable 2009 Invasive Species				24;
Myotis mystacinus	Whiskered Bat	Rare	BNESBAP;		WCA S.5	24;
Myotis nattereri	Natterer's bat	Rare			WCA S.5	33
Myotis daubentonii	Daubenton's Bat	Local	BNESBAP;		WCA S.5	25;
Nyctalus noctula	Noctule	Local – some internationally roosts	UKBAP; AvonBAP; BNESBAP;		NERC S.4 WCA S.51;	32;
Pipistrellus pipistrellus	Common Pipistrelle	Proposed BRERC Notable 2004 as protected	SWAP		WCA S.5	27; 32;
Pipistrellus pygmaeus	Soprano Pipistrelle	Proposed BRERC Notable 2004 as protected	UKBAP; AvonBAP; BNESBAP;		NERC S.41; WCA S.5	24; 32;
Plecotus auritus	Brown Long-eared Bat	Rare	UKBAP; AvonBAP; BNESBAP;		NERC S.41 WCA S.5	26; 28; 32;
Rhinolophus ferrumequinum	Greater Horseshoe Bat	Local – Avon is a national stronghold	UKBAP; AvonBAP; BNESBAP;		NERC S.41; WCA S.5; Annex II	29;
Rhinolophus hipposideros	Lesser Horseshoe Bat	Local – Avon is a national stronghold	UKBAP; AvonBAP; BNESBAP;		NERC S.41; WCA S.5; Annex II	32;
Birds						
Acrocephalus schoenobaenus	Sedge Warbler	Fairly common	BNESBAP			23;
Acrocephalus scirpaceus	Reed Warbler	Fairly common	AvonBAP; BNESBAP			33
Actitis hypoleucos	Common Sandpiper	Proposed BRERC notable 2009		Amber		23;
Alauda arvensis	Skylark	Common/Declining	UKBAP; AvonBAP; BNESBAP	Red	NERC S.41	23;
Alcedo atthis	Kingfisher	Uncommon	BNESBAP	Amber	WCA S.1	23; 24; 26; 27; 28; 29; 30; 31; 32; 33
Anas platyrhynchos	Mallard	Common		Amber		23; 24; 26; 27; 29; 30; 32; 33
Anser anser	Greylag Goose	SoCC		Amber		33
Apus apus	Swift	Proposed BRERC notable 2009 as amber listed	AvonBAP;	Amber		24; 25; 26; 27; 30; 32; 33
Ardea cinerea	Grey Heron	Fairly common	BNESBAP			23; 32; 33
Aythya ferina	Pochard	Fairly common	AvonBAP; BNESBAP	Amber		26;
Corvus corax	Raven	Scarce				
Cygnus olor	Mute Swan	Fairly common		Amber		23; 24; 26; 29; 30; 32; 33
Delichon urbica	House Martin	Common	AvonBAP;	Amber		26; 27; 30; 32; 33

Scientific Name	Common Name	BRERC Status	BAP	RSPB List	Statutory Status	Map
Egretta garzetta	Little Egret	Scarce		Amber		26;
Emberiza citrinella	Yellowhammer	Uncommon, has declined	UKBAP; AvonBAP; BNESBAP	Red	NERC S.41	24; 28;
Erithacus rubecula	Robin	Proposed BRERC notable 2009 as protected				24; 25; 26; 27; 29; 30; 33
Falco peregrines	Peregrine	Uncommon	BNESBAP	Amber	WCA S.1	33
Hirundo rustica	Swallow	Common	AvonBAP;	Amber		26;
Larus argentatus	Herring Gull	Common/Declining	SWAP	Red	NERC S.41	26; 27; 30;
Larus fuscus	Lesser Black-backed Gull	Common		Amber		23; 24; 26; 27; 30; 32; 33
Larus ridibundus	Black-headed Gull	Proposed BRERC notable 2004 as amber listed		Amber		26; 27; 29; 32;
Motacilla cinerea	Grey Wagtail	Fairly common		Amber		27; 29; 30; 32; 33
Passer domesticus	House Sparrow	Proposed BRERC notable 2004 as nationally notable	UKBAP; AvonBAP;	Red	NERC S.41	25; 26; 27; 30; 32; 33
Phalacrocorax carbo	Cormorant	Common		Amber		23; 24; 26; 27; 30; 33
Phoenicurus ochruros	Black Redstart	Scarece/uncommon		Amber	WCA S.1	33
Phylloscopus trochilus	Willow Warbler	Common	AvonBAP;	Amber		27; 32; 33
Picus viridis	Green Woodpecker	Fairly common		Amber		24;
Prunella modularis	Dunnock	Abundant	UKBAP; AvonBAP;	Amber	NERC S.41	24; 26; 27; 28; 30; 32; 33
Pyrrhula pyrrhula	Bullfinch	Fairly common/ declining	UKBAP; AvonBAP; BNESBAP;	Amber	NERC S.41	27; 33
Regulus regulus	Goldcrest	Common		Amber		24; 25; 26; 29; 30;
Sterna hirundo	Common Tern	Fairly Common		Amber		33
Sturnus vulgaris	Starling	Abundant/declining	UKBAP; AvonBAP;	Red	NERC S.41	27; 30; 32; 33
Sylvia communis	Whitethroat	Common		Amber		23; 24;
Tachybaptus ruficollis	Little Grebe	Proposed BRERC notable 2009 as amber listed	AvonBAP;	Amber		26;
Troglodytes troglodytes	Wren	Proposed BRERC notable 2009 as protected				23; 24; 26; 27; 29; 32; 33
Turdus iliacus	Redwing	Common		Red	WCA S.1	30; 33
Turdus philomelos	Song Thrush	Uncommon	UKBAP; AvonBAP;	Red	NERC S.41	24; 26; 27; 28; 29; 32; 33
Turdus pilaris	Fieldfare	Common		Red	WCA S.1	30;
Turdus viscivorus	Mistle Thrush	Proposed BRERC notable 2006 as amber listed	AvonBAP;	Amber		27; 32;
Tyto alba	Barn Owl	Uncommon/Increasing	AvonBAP; BNESBAP	Amber	WCA S.1	26; 27; 28; 30;
Reptiles						
Anguis fragilis	Slow-worm	Widespread/Locally common	UKBAP; AvonBAP;		NERC S.41	25; 27; 28; 29;
Natrix natrix	Grass Snake	Uncommon/Declining	UKBAP; AvonBAP; BNESBAP;		NERC S.41	28;
Zootoca vivipara	Viviparous Lizard	Not common/status not well known	UKBAP; AvonBAP;		NERC S.41	24
Amphibians						
	A newt	Proposed BRERC notable: Widespread/Declining/Locally Abundant when breeding				23;
Bufo bufo	Common Toad	Proposed BRERC notable: Widespread/ Locally Abundant when breeding	UKBAP; AvonBAP; BNESBAP		NERC S.41	26; 27; 28; 29; 30; 31; 32; 33;
Lissotriton helveticus	Palmate Newt	Proposed BRERC notable: Widespread/Locally Common				26; 33
Lissotriton vulgaris	Smooth Newt	Proposed BRERC notable: Widespread/Locally Common				26; 30;
Rana temporaria	Common Frog	Proposed BRERC notable: Widespread/Declining/Locally Abundant when breeding	BNESBAP			23; 26; 27; 28; 29; 30; 31; 32; 33;
Triturus cristatus	Great Crested Newt	Proposed BRERC notable: Widespread/Locally Abundant (Avon is a stronghold of this species)	UKBAP; AvonBAP; SWAP; BNESBAP		NERC S.41; WCA S.5	26;
Fish						

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Anguilla anguilla	Eel	Proposed BRERC Notable 2008 as UK BAP listed	UKBAP; AvonBAP;		NERC S.41	24;
Cottus gobio	Bullhead	SoCC				24;
Salmo trutta subsp. *fario*	Brown Trout	Proposed BRERC Notable 2008 as UK BAP listed	UKBAP; AvonBAP;		NERC S.41	24;
Butterflies						
Callophrys rubi	Green Hairstreak	Local	BNESBAP;			32;
Coenonympha pamphilus	Small Heath	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	30; 32;
Erynnis tages tages	Dingy Skipper	Rare	BNESBAP;		NERC S.41	32;
Lysandra coridon	Chalkhill Blue	Rare	BNESBAP;			30;
Satyrium w-album	White-letter Hairstreak	Local	UKBAP; AvonBAP;		NERC S.41	24; 29;
Thymelicus lineola	Essex Skipper	Local				24; 27; 28;
Moths						
Acronicta psi	Grey Dagger	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28;
Acronicta rumicis	Knot Grass	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Agrochola litura	Brown-spot Pinion	Local	UKBAP; AvonBAP;		NERC S.41	28;
Agrochola lychnidis	Beaded Chestnut	Proposed BRERC Notable as 2008 UK BAP listed	UKBAP; AvonBAP;		NERC S.41	28;
Allophyea oxycanthae	Green-brindled Crescent	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28;
Amphipyra berbera svenssoni	Svensson's Copper Underwing	Local				32;
Amphipyra tragopoginis	Mouse Moth	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Apamea remissa	Dusky Brocade	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	32;
Apamea sordens	Rustic Shoulder-knot	Local	UKBAP; AvonBAP;			32;
Arctia caja	Garden Tiger	Proposed BRERC Notable as UK 2008 BAP listed			NERC S.41	28
Atethmia centrago	Centre-barred Sallow	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Bena bicolorana	Scarce Silver-lines	Local				28; 32;
Brachylomia viminalis	Minor Shoulder-knot	Local	UKBAP; AvonBAP;		NERC S.41	28;
Conistra ligula	Dark Chestnut	Local				32;
Diarsia rubi	Small Square-spot	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Dioryctria abietella	A pyralid moth	Local				28;
Drepana falcataria falcataria	Pebble Hook-tip	Local				32;
Eilema sorocula	Orange Footman	Rare	BNESBAP;			32;
Ennomos fuscantaria	Dusky Thorn	Proposed BRERC Notable as UK 2008 BAP listed			NERC S.41	32;
Ennomos quercinaria	August Thorn	Proposed BRERC Notable as UK 2008 BAP listed			NERC S.41	32;
Eupithecia linariata	Toadflax Pug	Local				28;
Eupithecia succenturiata	Bordered Pug	Local				28;
Furcula bifida	Poplar Kitten	Local				32;
Hadena compta	Varied Coronet	Local				28; 32;
Hemistola chrysoprasaria	Small Emerald	Common	UKBAP; AvonBAP;		NERC S.41	28;
Hoplodrina blanda	Rustic	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Hydraecia micacea	Rosy Rustic	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28
Larentia clavaria	Mallow	Rare	BNESBAP;			25;
Lycia hirtaria	Brindled Beauty	Proposed BRERC Notable as UK 2008 BAP listed			NERC S.41	32;

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Macaria alternata	Sharp-angled Peacock	Local				28;
Malacosoma Neustria	Lackey	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	32;
Melanchra persicariae	Dot Moth	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Mesoligia literosa	Rosy Minor	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	32;
Mormo Maura	Old Lady	Local				32;
Mythimna comma	Shoulder-striped Wainscot	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28;
Nycteola revayana	Oak Nycteoline	Local				28;
Orthosia gracilis	Powdered Quaker	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Orthosia opima	Northern Drab	Rare	BNESBAP;			32;
Nephopterix angustella	A pyralid moth	Proposed BRERC Notable as UK 2004 BAP as nationally notable				32;
Parastichtis ypsillon	Dingy Shears	Local				32;
Phigalia pilosaria	Pale Brindled Beauty	Local				32;
Rhizedra lutosa	Large Wainscot	Local				32;
Spilosoma lubricipeda	White Ermine	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28;
Spilosoma luteum	Buff Ermine	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Tachystola acroxantha	A micro-moth	Proposed BRERC Notable as UK 2004 BAP as nationally notable				32;
Timandra comae	Blood-vein	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 32;
Tyria jacobaeae	Cinnabar	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	28; 33
Watsonalia binaria	Oak Hook-tip	Proposed BRERC Notable as UK 2008 BAP listed	UKBAP; AvonBAP;		NERC S.41	32;
True Flies						
Lucilla sp.	Lucilla sp.	Proposed BRERC Notable 2009 as nationally notable				29;
Beetles						
Cetonia aurata	Rose Chafer	Local				31;
Harmonia axyridis	Harlequin Beetle	Proposed BRERC Notable 2007 Invasive Species				
Lamoyris noctiluca	Glow-worm	Proposed BRERC Notable 2011 as S Glos BAP & Local Distribution	SGLOSBAP			24;
Lucanus cervus	Stag Beetle	Rare	UKBAP; AvonBAP; BNESBAP;		NERC S.41; WCA S.5	33
Grasshoppers						
Conocephalus discolor	Long-winged Conehead	Rare	BNESBAP;			27;
Dragonflies & Damselflies						
Aeshna grandis	Brown Hawker	Local				23; 24; 27; 30;
Calopteryx virgo	Beautiful Demoiselle	Proposed BRERC notable 2009 as nationally notable				30; 33
Corulegaster boltonii	Golden-ringed Dragonfly	Rare – Possibly breeding in North Somerset				30;
Erythroma najas	Red-eyed Damselfly	Rare	BNESBAP			23;
Libellula fulva	Scarce Chaser	Rare	BNESBAP			23; 24; 33
Platycnemis pennipes	White-legged Damselfly	Rare	BNESBAP			23; 24
Plants						**23;**
Adiantum capillus-veneris	Maidenhair Fern	Proposed BRERC notable 2004 as nationally notable				29;
Alisma lanceolatum	Narrow-leaved Water-plantain	Scarce				24;

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Anacamptis pyramidalis	Pyramidal Orchid	Uncommon				24; 27;
Anagallis tenella	Bog Pimpernel	Scarce				23; 27;
Aquilegia vulgaris	Columbine	Uncommon				26; 30;
Arenaria serpyllifolia leptoclados	Small Thyme-leaved Sandwort	Uncommon				26;
Blackstonia perfoliata	Yellow-wort	Uncommon				27;
Bromus commutatus	Meadow Brome	Uncommon				30;
Buxus sempervirens	Box	Uncommon				25; 27;
Carex acutiformis	Lesser Pond-sedge	Uncommon				26;
Carex distans	Distant Sedge	Scarce				23;
Carex panicea	Carnation Sedge	Scarce				23;
Catapodium rigidum	Fern-grass	Uncommon				26; 30;
Chaenorhinum minus	Small Toadflax	Uncommon				24;
Chenopodium polyspermum	Many-seeded Goosefoot	Uncommon				24; 30;
Cochlearia danica	Danish Scurvygrass	Uncommon				24;
Cruciata laevioes	Crosswort	Uncommon				24;
Cuscuta europaea	Greater Dodder	Rare	BNESBAP;			25; 32;
Cyclamen hederifolium	Cyclamen	Proposed BRERC notable 2004 as protected				26; 27;
Daphne laureola	Spurge-laurel	Uncommon				27;
Diplotaxis tenuifolia	Perennial Wall-rocket	Uncommon				25; 27; 29; 30;
Dipsacus pilosus	Small Teasel	Uncommon				23; 24; 25;
Draba muralis	Wall Whitlowgrass	Rare	BNESBAP;			27;
Echium vulgare	Viper's Bugloss	Scarce				24;
Epilobium roseum	Pale Willowherb	Scarce				32;
Epilobium obscurum	Short-fruited Willowherb	Uncommon				30;
Erigeron acer	Blue Fleabane	Uncommon				24; 26;
Erodium cicutarium	Common Stork's-bill	Uncommon				30;
Fallopia japonica	Japanese Knotweed	Proposed BRERC Notable 2006 Invasive Species				24; 25; 26; 32; 27; 28; 30; 33
Foeniculum vulgare	Fennel	Uncommon				30;
Frangula alnus	Alder Buckthorn	Scarce	BNESBAP;			25;
Fritillaria meleagris	Fritillary	Proposed BRERC notable 2004 as nationally notable				30;
Fumaria muralis boraei	A Few-flowered Fumitory	Rare	BNESBAP;			30;
Galium saxatile	Heath Bedstraw	Uncommon				27;
Glyceria maxima	Reed Sweet-grass	Uncommon				24; 26; 32;
Helleborus foetidus	Stinking Hellebore	Scarce	BNESBAP;			27;
Hieracium maculatum	A hawkweed	Uncommon	BNESBAP;			27; 30; 32;
Hyacinthoides non-scripta	Bluebell	Common				24; 25; 27; 30; 33
Hydrocotyle vulgaris	Marsh Pennywort	Rare	BNESBAP;			24;
Impatiens glandulifera	Himalayan Balsam	Proposed BRERC Notable 2006 Invasive Species				23; 24; 25; 26; 28; 30; 32; 33
Iris foetidissima	Stinking Iris	Uncommon				27;
Lamium amplexicaule	Hen-bit Dead-nettle	Uncommon				27; 28; 29; 30;
Lathraea squamaria	Toothwort	Uncommon				32

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Lepidium campestre	Field Pepperwort	Uncommon				24;
Lychnis flos-cuculi	Ragged Robin	Uncommon				23;
Mecanopsis cambric	Welsh Poppy	Scarce				29;
Menyanthes trifoliata	Bogbean	Rare				33
Medicago sativa falcata	Sickle Medick	Rare				28;
Muscari neglectum	Grape-hyacinth	Proposed BRERC Notable 2004 as nationally notable	UKBAP; BNESBAP;		NERC S.41	25; 30;
Myosoton aquaticum	Water Chickweed	Uncommon				24;
Nuphar lutea	Yellow Water-lily	Uncommon				24; 25; 26; 30; 32;
Nymphaea alba	White Water-lily	Scarce				26;
Ononis spinosa	Spiny Restharrow	Uncommon				24;
Ophioglossum vulgatum	Adder's-tongue	Scarce				24;
Ophryis apifera	Bee Orchid	Uncommon				24;
Ornithogallum pyrenaicum	Bath Asparagus	Uncommon	BNESBAP;			24; 25;
Papaver dubium lecoqii	Yellow-juiced Poppy	Uncommon				24; 30;
Pastinaca sativa	Wild Parsnip	Uncommon				33
Picris hieracioides	Hawkweed Oxtongue	Uncommon				24; 27;
Pinus sylvestris	Scots Pine	Proposed BRERC Notable 2009 as nationally notable				28; 30; 33
Poa compressa	Flattened Meadow-grass	Uncommon				24;
Polystichum aculeatum	Hard Shield-fern	Uncommon				27; 30;
Populus nigra. belulifolia	Black Poplar	Scarce				24;
Populus tremula	Aspen	Uncommon				24; 29; 33
Potamogeton nodosus	Lodden Pondweed	Scarce	BNESBAP;			24; 25; 30;
Potamogeton pectinatus	Fennel Pondweed	Uncommon				30;
Quercus petraea	Sessile Oak	Uncommon				26;
Ribes nigrum	Black Currant	Uncommon				25;
Rorippa palustris	Marsh Yellow-cress	Scarce				29;
Rubus adscitus	A bramble	Rare	BNESBAP			33
Rubus cissburiensis	A bramble	Scarce	BNESBAP			32; 33
Rubus dasyphyllus	A bramble	Uncommon	BNESBAP			33
Rubus elegantispinosus	A bramble	Rare				25; 26; 30; 32;
Rubus leightonii	A bramble	Rare				26
Rubus raduloides	A bramble	Uncommon	BNESBAP			32; 33
Rubus rubritinctus	A bramble	Uncommon	BNESBAP			24;
Rumex hydrolapathium	Water Dock	Scarce				32;
Ruscus aculeatus	Butcher's-broom	Scarce				27;
Sagina apetala apetela	An annual pearlwort	Scarce				30;
Sagittaria sagittifolia	Arrowhead	Scarce				24; 30; 32;
Salix purpurea	Purple Willow	Rare	BNESBAP			26;
Sambucus ebulus	Dwarf Elder	Rare				32;
Schoenoplectus lacustris	Common Club-rush	Scarce				24; 25; 26; 30;
Sedum album	White Stonecrop	Uncommon				27;

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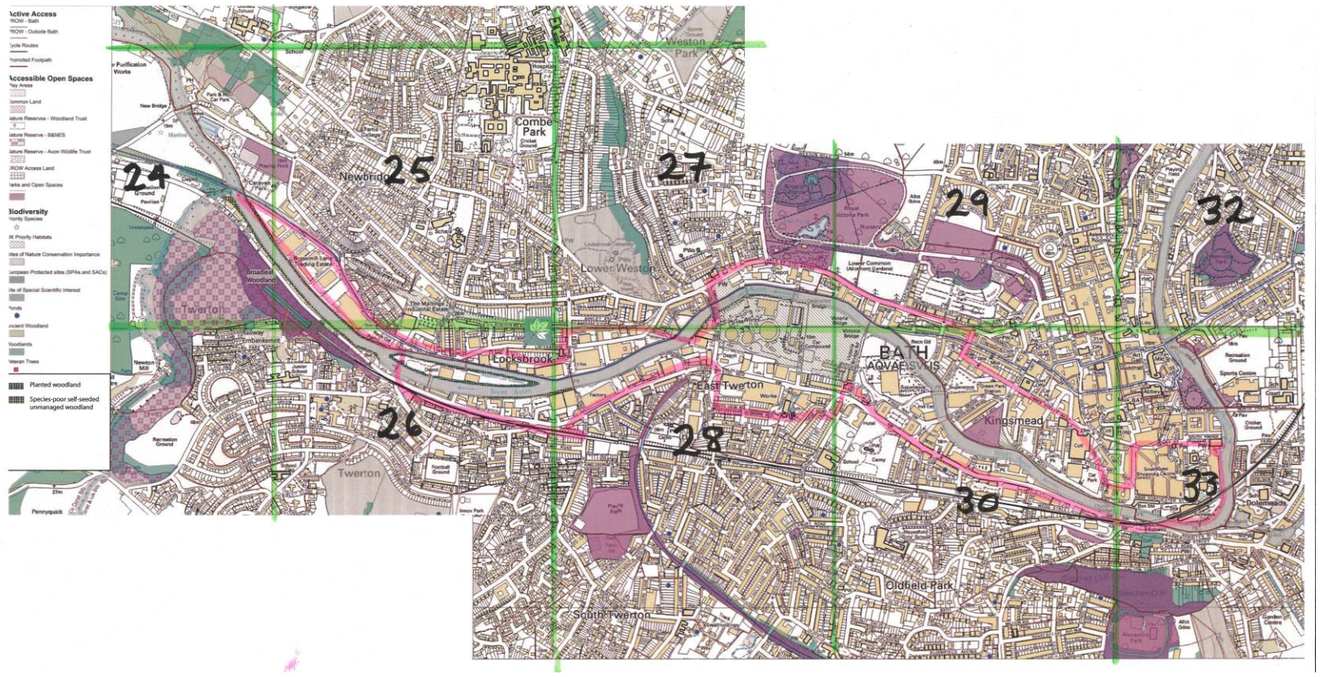
Sorbus aria	Whitebeam	Uncommon				28;
Sorbus aucuparia	Rowan	Uncommon				26;
Sparganium emersum	Unbranched Bur-reed	Uncommon				24; 30; 32;
Tilia platyphyllos	Large-leaved Lime	Rare				33
Trifolium fragiferum	Strawberry Clover	Uncommon				23;
Trifolium micranthum	Slender Trefoil	Scarce	BNESBAP;			27;
Valerianella carinata	Keeled-fruited Cornsalad	Uncommon				27; 28; 30; 31;
Valerianella locusta	Common Cornsalad	Uncommon				33
Vicia tetrasperma	Smooth Tare	Uncommon				24;
Vulpia bromoides	Squirrel-tail Fescue	Uncommon				30;
Vulpia myuros	Rat's-tail Fescue	Scarce				26; 30;
Zannichellia palustris	Horned Pondweed	Uncommon	BNESBAP;			24;
Mosses						
Bryum pallescens	Tall-clustered Thread-moss	Nationally Scarce				33

Location Plan for Sub-areas (final column of table)



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