



Multi-Functional Urban Green Infrastructure



A CIWEM Briefing Report

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Executive summary

Green infrastructure can provide sustainable regenerative solutions for the urban challenges we face now and into the future. A variety of green and open space standards have been put in place over the years relating to access and provision, and there are many places in the UK that boast significant amounts of green space; but a lack of attention has been paid to its function. In urban areas where land is valuable and the challenges are greatest, the quality of greenspace is important and the aim should be to achieve areas of multi-functionality. A shift that is beginning to take place, but still needs further action, is to embed green infrastructure into spatial planning and view it as part of the wider infrastructure of urban areas.

This report is aimed at policy-makers and practitioners and discusses the drivers and barriers to increasing green infrastructure provision in our towns and cities. Chapter 2 considers the policy drivers, from the need to adapt our cities to the impacts of climate change and extreme weather to the promotion of ecosystem health and human well being. A full review of the policy and legislation regarding green infrastructure and the range of scales over which it has influence is provided in Chapter 3. Chapter 4 addresses the challenges to implementing and increasing green infrastructure provision posed by planning, retrofitting, funding, and conflicting land-use demands. The report then concludes with calls, in line with other CIWEM policies to the Government, planners and decision makers, as to how to increase multifunctional land management through appropriate policies and funding. A range of case studies are also featured to highlight examples of best practice.

This briefing report is freely available to download from <http://www.ciwem.org/resources>

Abbreviations

AAP	Area Action Plan
ANGSt	Accessible Natural Greenspace Standard
AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
CABE	Commission for Architecture and the Built Environment
CIL	Community Infrastructure Levy
CPRE	Campaign for the Protection of Rural England
CSH	Code for Sustainable Homes
EA	Environment Agency
FWMA	Floods and Water Management Act
DEFRA	Department for Environment, Food and Rural Affairs
Dph	Dwellings per hectare
GI	Green Infrastructure
GIS	Geographical Information Systems
GLA	Greater London Authority
LA	Local Authority
LAA	Local Area Agreement
LBAP	Local Biodiversity Action Plan
LDF	Local Development Framework
LPA	Local Planning Authority
NAO	National Audit Office
NSIP	Nationally Significant Infrastructure Projects
PPG	Planning Policy Guidance
PPS	Planning Policy Statement
PPS (CIWEM)	Policy Position Statement
RCEP	Royal Commission for Environmental Pollution
RSS	Regional Spatial Strategy
SAB	Sustainable drainage systems Approving Body
SAC	Special Area of Conservation
SCS	Sustainable Community Strategy
SEPA	Scottish Environmental Protection Agency
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
UKBAP	UK Biodiversity Action Plan
UKCIP	UK Climate Impacts Programme
UHI	Urban Heat Island

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1.0 Introduction

1.1 Urban green infrastructure

A network of multifunctional open spaces

Green infrastructure (GI) can provide sustainable regenerative solutions for the urban challenges we face now and into the future. With careful planning and funding it can help our cities adapt to climate change and improve resilience to extreme weather events, enhance biodiversity and ecosystem services, and improve public health and well-being. The importance of green infrastructure for these purposes was confirmed by the Royal Commission on Environmental Pollution's (RCEP) report¹ on the Urban Environment, and has gained more recognition through strategies from Natural England and CABE and been afforded protection through EU and UK planning and environmental legislation.

GI includes both established green spaces and new developments that thread through and around the built environment linking urban areas to the wider rural hinterland. Examples that contribute to GI include parks, commons, open land, woodland, private gardens, street trees and green roofs, as well as "blue" spaces such as wetlands, swales, ponds and temporary flood storage areas. Functional links between areas are equally important, such as natural river corridors, disused railway lines and "woodland greenways" that enable the migration and movement of species².

A variety of green and open space standards have been in place over the years relating largely to access and provision and as a result there are many places in the UK that boast significant amounts of green space. However, a lack of regard has been paid to its function. In cities, where land is valuable, the quality of greenspace is important and the onus should be to achieve multi-functionality in response to urban challenges³. The ability of green spaces to fulfil more than one function simultaneously, such as the provision for healthy recreation whilst performing nature's services, requires both planning and management to optimise these functions.

GI should be strategically planned and delivered on a range of scales to provide usable space with support for natural and ecological processes⁴. It should provide a network of spaces for recreation, habitat creation/preservation, climate change adaptation (flood protection and microclimate control), cultural and spiritual wellbeing, and should be capable of delivering ecosystem functions such as provisioning, regulating and supporting services⁵. By considering different development layouts and densities, GI can be used to deliver multiple functions to help achieve sustainable communities⁶.

A major shift that is beginning to take place, but still needs further action, is to embed effectively green infrastructure into spatial planning and view it as part of the wider infrastructure of urban areasⁱ. Only then will GI be treated as an essential component of

ⁱ Green infrastructure should be distinguished from *environmental infrastructure* which some development documents refer to. Environmental infrastructure goes further than green infrastructure to describe the wider requirements at a settlement scale which may include the consideration of water supply, waste management, sewerage and energy generation. Green infrastructure as described here should be thought of as the network of open green and blue space.

new development and regeneration schemes and not as open space ripe for development. This incorporation will require the support of decision-makers, developers and planning authorities.

This briefing report will discuss the policy drivers and barriers to improving GI provision with a full review of current policy and practice. It concludes with calls for the Government to support, through funding and planning policy, a move towards multifunctional land management for the benefit of communities. A range of case studies will also highlight examples of best practice and aim to inspire collaboration between natural and built environmental professionals and engagement with community groups.

2.0 Policy drivers for multi-functional urban green infrastructure

2.1 The need to adapt to predicted climate changes

There is unequivocal evidence that the global climate is warming and a near scientific consensus that this is a result of human activities. In July 2009, the UK Climate Impacts Program (UKCIP) and DEFRA produced probabilistic projections (UKCP09) for climate at national and regional levels for the years 2020, 2050 and 2080. These projections include increased average and maximum temperatures, increased seasonality of rainfall and a rise in sea levels⁷. With more energy in the climate system, there is the potential for more gales and storms and an increase in the intensity or duration of extreme weather events.

Regardless of the success of mitigation measures, there will still be some degree of unavoidable change in climate as a result of past emissions. UK cities are likely to suffer from increased incidences, severity and duration of heat waves, flooding and drought⁸. Due to the nature of planning horizons, local authorities and central government must design new urban areas and developments to accommodate surface water flooding and attenuate heat waves, whilst our existing towns and cities need to be adapted to make them comfortable in a climatically different future and resilient to extreme weather⁹.

The stresses of climate change will be felt the greatest in urban areas and these are also the most densely populated. Green infrastructure can provide many solutions for cooling, tempering wind and natural drainage.

Flooding and surface water management

The devastating floods in 2007 showed that much of the UK is ill-equipped to cope with extreme rainfall and flooding. A Foresight report¹⁰, investigating the potential impact of climate change on flooding, identified that changes were likely to be largest in urban areas with rainfall intensities rising by up to 40% by 2080 and the costs of defending the UK increasing by four or eight fold. It is hoped that the Flood and Water Management Act (FWMA) will shift the way in which we manage flood risk with a mix of measures including increased implementation of Sustainable Drainage Systems (SuDS) (see section 3.2).

In natural environments, fluvial flooding occurs as a dynamic process between the river and its floodplain, yet increasing land pressure and a lack of planning controls have forced development onto flood plains, removing their natural flood protection and putting developments at greater risk.

In the past the solution to flooding in most urban areas has been to straighten rivers and contain them in channels and culverts. Constraining and speeding up river flow in this way attenuates flood risk by increasing peak flows. Un-engineered rivers with vegetated channels slow down flows and increase the channelling of water to natural flood plains avoiding flooding in built up areas¹¹.

Culvert blockages are also a contributor to flooding in urban areas, with litter and vegetation being washed into them during heavy rainfall events. This is a particular problem in summer when heavy rains follow a drought. Maintenance of culverts is the

responsibility of the land owner, rather than local authorities or the Environment Agency (EA), and is therefore difficult to enforce.

Urban areas are also at an increased risk of pluvial flooding from surface water runoff as they are made up of vast arrays of impermeable surfaces. Ageing and inadequate sewage systems and future developments may cause foul sewers to overflow, block natural flow paths or increase run-off rates and exacerbate these problems¹². Urban run-off also carries a range of pollutants from the surfaces of buildings and streets into watercourses reducing river water quality. Residential drains are typically designed for a one in 30 year flood occurrence¹³ which is likely to prove inadequate in light of climate change projections for the future, causing more widespread flooding of properties.

An increase in urban green space to reduce run-off and increase natural infiltration is one solution that controls flooding at its source¹⁴. The planting of trees and the provision of green and brown roofs can also increase interception levels, and permeable paving options can be used where there is no "green" option available¹⁵. Urban layout and landscape need to be carefully designed to allow the space for flood water to pass freely along pathways. A reduction in the amount of water in fixed channels is an optimum way to reduce flood risk but is increasingly difficult in urban areas where development borders on river channels. The EA, Scottish Environmental Protection Agency (SEPA) and the UK Government (see section 3.3) are now promoting sustainable management of urban watercourses, river restoration schemes and SuDS to assist in cost effective solutions for the reduction and management of flood risk.

SuDS cannot solve all flooding issues but offer numerous benefits compared with traditional systems and provide habitat creation alongside flood attenuation. They involve controlling flow rates near to the source with permeable surfaces, filters, storage areas, wetlands and balancing ponds which help to minimise surface water runoff, protect water quality and provide a habitat for wildlife in urban watercourses¹⁶. By improving water quality at the source rather than end of pipe, SuDs reduce water treatment costs and protect the natural environment. The traditional approach of constructing large underground storm water storage tanks to prevent flooding is not sustainable and will not provide adequate protection to cope with the predicted increase in intense storm events due to climate change. Where appropriate, SuDS should be integrated into all developments and provision made for their maintenance (see sections 4.2 and 4.5).

Urban heat islands

Whilst a milder climate may bring some benefits to the UK, extended periods of excessive heat, which are also likely will result in more heat related hospitalisations and mortalities, significantly affect work productivity and comfort and affect water resources and wildlife. The European heat wave of 2003 caused some 30,000 extra deaths and 600 extra in London alone¹⁷. UKCIP predict that these temperatures will be representative of an average summer by 2050 and as such we must put in place measures to adapt to extreme heat, especially in our cities.

Cities are more vulnerable to increased summer temperatures due the urban heat island (UHI) effect. Urban heat islands (the difference between rural and urban temperatures) considerably increase the risk of heat waves. This arises because increased amounts of solar radiation are absorbed by materials used in cities (asphalt, concrete, bricks) than

natural groundcover such as soil and vegetation¹⁸. This radiation is retained and released slowly during the night keeping temperatures higher than in surrounding natural environments¹⁹. The high incidence of reflective surfaces such as glass also adds to the effect by reflecting radiation between surfaces that would normally be emitted into the atmosphere in rural areas. Transport, heating and cooling systems, and industrial activities all add to heat the city. The UHI effect currently accounts for differences of up to seven degrees Celsius in UK cities and research is being undertaken to assess the impact that climate change may have on this difference²⁰.

Reducing the effects of UHI can be achieved at a strategic level with the addition of parks and green space, ponds and fountains and by changing building materials²¹. Increasing greenspace offers a simple solution as vegetation provides shading and cooling through evapo-transpiration and the evaporation of water bodies can have a cooling effect of a few degrees Celsius²². Creating large open space for urban parks is not essential and a considerable amount of cooling can be achieved through the careful planning of green corridors, smaller open spaces, street trees and green roofs²³. Germany and the city of Berlin in particular have long established continuous street tree canopies with the city estimated as averaging 79 trees per km of road²⁴. Green buildings, green walls and green roofs should also be an integral part of combating overheating.

The [ASCCUE Project](#)²⁵ (Adaptation Strategies for Climate Change in the Urban Environment) by Manchester University found that an increase in green areas of 10% will keep temperatures at or below current temperatures up until the 2080s. Here GIS and physical models are being used to plan and designate areas for increasing green space. The ASCCUE Project recommends that patches of green space are the best matrix to achieve urban cooling. However, for infiltration and shading a smaller matrix including domestic gardens is more effective, and for flood prevention linear corridors are best. To help adapt cities to climate change, there needs to be a mix of greenspace types.

An important note in the use of green space for urban cooling is that as ground moisture falls, leaf temperature rises, so as green spaces turn brown they no longer exhibit cooling properties. As a result, their management needs to be considered in light of climate change projections. Irrigation at night from a local source is one option that can be used if water features as an integral part of green space planning.

Green Roofs

Green roofs can provide the benefits of green infrastructure in densely built urban areas (such as the Barclays Bank building at Canary Wharf figure 1) and replace the footprint of greenspace that has been lost to development. They have multiple benefits such as managing storm-water, reducing the UHI through evapo-transpiration, improved visual amenity, creating opportunities for wildlife, reducing air pollution and improving the thermal efficiency of buildings.

Whilst green roofs in the UK are only just beginning to move out of the “novelty” realm (figure 2), in Germany - considered the leader in green roof research and where legislation requires certain developments to have green roofs - it is estimated that 12% of flat roofs are green.



Figure 1 Roof of Barclays Bank, Canary Wharf, London



Figure 2 Green roof on Sheffield bus stop

A range of plants can be grown on a green roof depending on the depth of the soil and substrate, from sedum to wildflower rooftop meadows. The vegetation suitable for the roof may not match that which is native to the area but can create habitats for rare insects and urban birds. Whilst capital costs may be more than a traditional roof, there are rewards to be earned from the reduction in maintenance and the increased thermal efficiency of the building. Before a green roof can be built the structure and waterproofing will need to be checked by an expert to ensure that the correct choice of roof has been made.

For further information please visit <http://www.livingroofs.org>, or <http://www.greenroofs.net>

2.2 Promoting ecosystem health – our life support systems

Biodiversity

Biodiversity is a measure of the variation of life within an ecosystem; it creates stability and provides us with ecosystem services that are essential for human well being. These are the processes by which the environment produces resources that we utilise such as clean air, water, food and materials²⁶. Included are supporting services such as soil formation,

photosynthesis, primary production and nutrient cycling; regulatory services for water, air and diseases, and provisioning services including food, fuel, fibre and pharmaceuticals. An understanding of ecological functioning should inform biodiversity planning as the majority of these services cannot, or cannot affordably, be replicated by humans so must receive protection.

Biodiversity is under threatⁱⁱ. As a result of human impacts, more species have become extinct in the last 200 years than in the preceding 65 million years²⁷. Actions have been insufficient to halt biodiversity loss, with almost half of European wildlife in serious decline and valuable ecosystems have become degraded. In the UK, freshwater ecosystems are at the most risk and populations of key species have declined significantly²⁸. The Environmental Audit Committee reported²⁹ that there is no reason why biodiversity loss could not be halted in England and that with leadership and effective policies, biodiversity loss could be reversed. It recommended that the Government should adopt a new target for halting and reversing biodiversity loss by 2020. Extinction and habitat loss may vitally affect our attempts to adapt to climate change by reducing an ecosystem's ability to self-repair and recover from shocks. Climate change and land use changes will further exacerbate biodiversity loss as they have a profound influence on species distribution and potentially extinction.

Ecological networks

With a warming climate, it is likely that species will migrate northwards to maintain their ecological niche³⁰. However this is only possible if a suitable route exists to the new habitat. Ecosystems in Europe have suffered from fragmentation more than anywhere else in the world by roads, housing and agriculture. This can considerably undermine the integrity of whole ecosystems as sessile species cannot migrate, genetic diversity is reduced, predators may not have a large enough range and edge effects are intensified. Species will be required to disperse rapidly through fragmented landscapes in order to keep pace with the changing climate, yet it is unlikely that they will be able to adapt quickly enough.

The development of green infrastructure, if planned properly, can allow for ecological networks that contribute to biological diversity from increased vegetation cover and connectivity³¹. Networks of natural habitats provide valuable links for the migration, dispersal and genetic exchange of species in the wider environment³². Whole-ecosystem management should be employed to create networks of rural and urban green infrastructure linked together to enhance migration routes and contribute to biodiversity. Corridors can be created from street trees, novel approaches such as green bridges (popular in the Netherlands and now in Mile End Park, London) and through the retention of natural river systems.

ⁱⁱ For further information see CIWEM's biodiversity PPS at <http://www.ciwem.org/policy/policies/biodiversity.asp>

Green bridges - Mile End Park, London, UK

Mile End Park in the heart of London's East End has been redesigned to reduce the amount of habitat fragmentation. Although the park was 90 acres, it was perceived as a series of smaller parks due to its dissection by a number of major and minor roads and railway lines. In order to join up two sides of the park a novel approach was taken to increase connectivity.



The green bridge spans five lanes of the Mile End Road, with 25 metres width of landscaped parkland. Rainwater runs off the bridge and down into tanks on either side. It is then pumped back onto it and recycled. The park now provides safe and attractive pedestrian and cycle routes in an area of heavily congested roads and connects to the wider East End green grid.

Figure 3 Mile End green bridge - "The Yellow Bridge"

For further information please visit <http://www.cpre.org.uk>

Retaining natural processes

Developers should recognise that urban areas exist within wider natural resource networks. Woodland and forests attenuate flood risk, whilst coastal zone management to retain salt marsh and flood meadow systems act as a natural buffer against coastal erosion and tidal inundation. It should be realised that multiple benefits are available from a mosaic of habitats and by working with nature these can reduce our reliance on "hard" and costly management approaches (see case study 5.5 on river restoration).

The conservation of functional habitat processes which support biodiversity, result in the protection of thousands of species, which is more appropriate than targeted action aimed at protecting one species³³. Natural England promotes the maintenance of all remaining semi-natural habitats in urban landscapes to enhance ecological quality and connectivity³⁴. Well-managed ecosystems provide people with resources and reduce our vulnerability to "shocks" whilst poorly managed systems can increase the risks of flood, drought, crop failure or disease³⁵.

Soils are also in need of attention in urban areas as they play an essential role in supporting ecosystems and drainage. Often in areas of new development, soils are cleared and replaced with soil from a store that lacks natural biota and important functions are lost. DEFRA has published its Soil Strategy for England³⁶ and there are draft policy documents for Wales and Scotland covering soils in the urban environment. Ideally, in new development, areas designated for green space should be fenced and left untouched allowing the soils and their biota to be conserved for the future.

2.3 Promoting human health and well-being

As well as being dependent on nature for ecosystem services and material needs, humans need nature to satisfy psychological, emotional and spiritual needs that can be derived from recreation, relaxation, spiritual and aesthetic experiences in greenspace^{37,38}.

Physical activity

Physical activity is essential for good health and contributes to well-being. In England only 35% of men and 24% of women are physically active enough to meet the national recommendations of at least 30 minutes of moderate activity five times a week³⁹. The Wanless report⁴⁰ calculated the costs of physical inactivity in England at over £8 billion annually. This does not include the contribution from inactivity due to obesity which contributes a further £2.5 billion per year, with the UK suffering the highest obesity rates in Europe⁴¹. According to the Department of Health, just a 10% increase in adult physical activity would save the UK over £500m a year⁴².

Regular physical activity also contributes to the prevention of more than 20 health conditions⁴³. People who are physically active reduce their risk of developing major chronic diseases (heart disease, stroke, some cancers and type II diabetes) and the risk of premature death. Increasing participation relies on changing personal attitudes towards physical activity and this will involve making our environments more conducive for active living. A study from the British Medical Journal found that residents were three times more active and 40% less obese in areas with higher levels of greenery⁴⁴. Active travel is one of the easiest ways to achieve regular exercise but must be accommodated for through the quality of the physical and natural environment with opportunities for recreation and exercise. The consequences of an ageing population will also have implications for improving accessibility in our towns and cities.

Health

Increasing contact with nature can offer an affordable, accessible and equitable choice in tackling health and well-being through preventative and restorative public health strategies. Greenspace Scotland have reviewed a number of epidemiological studies and concluded that greenspace has a positive influence on general health⁴⁵. Academic studies have also shown a positive relationship between access to green space and improved mental health and recovery from many chronic illnesses^{46,47}. Natural areas can be seen as one of our most vital health resources and the importance of natural views is being increasingly understood in stressful environments for example in hospitals.

Air quality is an important component of health that may be affected by urban development. High traffic densities in urban areas can result in pollutants exceeding EU and UK targets for NO₂ and PM₁₀, with NO₂ particularly linked to asthma. UK asthma rates are the highest in the world with one in eight children being treated at an estimated medicine cost of £115million^{48,49}. Green infrastructure can help to ameliorate air pollution and, through providing more attractive green transport solutions, reduce the reliance on cars for short journeys.

CABE have produced a report⁵⁰ that explores how the design of the built environment can affect and be used to deliver improved health. They conclude that health critically needs

to be integrated into all scales of planning with a focus on active and sustainable movement.

Social inclusion

Urban green infrastructure can also play a role in increasing social inclusion. In the UK and in cities around the world it has been noted that the distribution of socially excluded areas often coincide with sparse green space of poor quality⁵¹. In Greater Manchester a third of the area is classed as open space, yet in the more deprived inner-city trees and greenspace only constitute 2%, whereas in wealthy areas they make up 10%⁵². Planning at a city scale can help alleviate these discrepancies and create green spaces with a high aesthetic and cultural value.

In high density urban areas public space is essential for social interaction and community satisfaction. Yet it must be of good quality (with good access, cleanliness, be aesthetically pleasing and include the presence of wildlife) to ensure that it does not become a haven for antisocial behaviour⁵³. Community involvement in the design and management of GI can promote stewardship which will lead to reduced management costs from repairing vandalism over the long term⁵⁴. Creating a community identity is fundamental to the social well being of communities and individuals and green space can play a role in producing feelings of attachment towards the community⁵⁵.

2.4 Demographic changes

The UK population has been growing at its fastest rate since the 1960s and now stands for the first time at over 61 million people⁵⁶. Over a similar period, the average size of households has fallen from 2.91 persons (in 1971) to 2.35 persons (in 2007)⁵⁷ increasing the demand for housing. Over 80% of the population live in urban settlements (a trend that is set to continue) and as future projections of UK population growth are now over 70 million by 2031⁵⁸, this will drastically increase land use pressure in urban areas. Towns and cities will become more densely populated and/or there will be an increase in urban sprawl⁵⁹. Statistics for England already show that the average building density of new dwellings has increased (in the six years from 2001) from 25 dwellings per hectare (dph) to 44 dph. This increase in density (although it could legitimately be provisioned through multiple-story dwellings) in reality removes the potential for green space and exacerbates urban problems⁶⁰. If building density increases in urban areas then there will be little space left to allow for GI.

The UK Government made new housing one of its key priorities and set ambitious targets in 2007 to build 3 million new homes by 2020. For this level of housing growth to be sustainable, the pressures on environmental infrastructure need to be addressed (including those of flood risk, water supply and treatment, waste disposal facilities and greenhouse gas emissions). Eco-towns have been proposed by the Government as one solution, however these will contribute less than 5% of the new housing the Government claims is required by 2020. A more effective way of delivering the environmental, social and economic targets highlighted in the Eco-towns proposals would be to focus on existing towns and cities. Improved infrastructure, facilities and housing in areas of high population

density are likely to deliver greater improvementsⁱⁱⁱ. GI must be integrated into all new developments to help mitigate climate change impacts and by providing sustainable transport options.

ⁱⁱⁱ For further information see CIWEM's Eco-towns PPS at <http://www.ciwem.org/policy/policies/eco-towns.asp>

3.0 Current GI policy in the UK

Green infrastructure, whilst not having specific guidance or policy in the UK due to its multi-functionality and multiple incarnations, falls beneath a plethora of policy aims. The specifics are stated here and many are later discussed in Chapter 4.

3.1 Environmental Directives

The EC *Habitats Directive*⁶¹ (1992) is the foundation of Europe's nature conservation policy and affords protection for certain sites and species. Member States are required to encourage the management of features of the landscape that are of major importance to wild flora and fauna. Central to the directive is the creation of a Europe-wide ecological network of protected sites – *The Natura 2000 Network* - which includes 24,000 sites and collectively covers almost a fifth of European territory. Some of the designations under the directive include Sites of Community Importance (SCI), Special Protection Areas (SPAs) (as classified under the *EC Birds Directive* 1979), and Special Areas of Conservation (SACs).

Urban areas however are not considered "habitats" in their own right under the directive. Ecological corridors and networks such as hedgerows and riverbanks are however encouraged under Article 10 to maintain routes of migration, dispersal and genetic exchange⁶². Suitable planning conditions and obligations may serve to promote such management. The *European Biodiversity Action Plan*⁶³ calls on Member States to finalise, protect and allocate funding to manage the network by 2010. The UK is also a signatory to the *European Landscape Convention*⁶⁴ which points to the importance of urban green spaces as areas with special designations and emphasises the relationship with people.

The *Water Framework Directive*⁶⁵ (2000) aims to ensure secure and sustainable sources of water in the future. This is achieved in the UK through the protection of water bodies via River Basin Management Plans. Improving land management and creating better habitats for wildlife are key aims to the directive. The *Floods Directive*⁶⁶ (2007) has been produced to compliment this, requiring Member States to assess areas at risk of flooding and develop prevention, protection and preparedness plans by 2015.

Also at the European level is the European Commission's *Thematic Strategy on the Urban Environment*⁶⁷ (2006) which recognises that urban areas are vulnerable to the consequences of climate change and calls for more integrated planning in limiting environmental risk - through sustainable urban design, promotion of biodiversity and delivery of sustainable transport plans.

*The EU Adaptation White Paper*⁶⁸ acknowledged the need for both mitigation and adaptation strategies, but whilst mitigation is already embedded in legislation, more importance needs to be lent to adaptation.

3.2 UK Environmental legislation

The *Countryside and Rights of Way Act*⁶⁹ (2000) amends some aspects of the *Wildlife and Countryside Act*⁷⁰ (1981, amended 1991), increasing the powers for the protection and

management of Sites of Special Scientific Interest (SSSIs). The act also provides strengthened legal protection for threatened species and clarifies the procedure for designating Areas of Outstanding Natural Beauty (AONB). The *Natural Environment and Rural Communities Act*⁷¹ (2006) acted as a catalyst for the creation of Natural England and among other measures, contains a duty for public bodies to conserve biodiversity. There is no act for preservation of green space in the urban environment or its biodiversity, except for the *Greater London Authority Act* (1999) which places a statutory duty on the Mayor of London to produce a regional biodiversity strategy.

The *Planning and Compulsory Purchase Act*⁷² (2004) introduced a new spatial planning system, comprising *Regional Spatial Strategies* (RSS) and *Local Development Frameworks* (LDFs) that are to be delivered by regional and local planning bodies. GI needs to be recognised as fundamental to achieving sustainable development and embedded into these regional and local policies. Local authorities were expected to produce their LDFs by 2008; however there are still a great number in development.

The Planning Act (2008) introduced reforms to the town and country planning system through Nationally Significant Infrastructure Projects (NSIPs) and with the introduction of a *Community Infrastructure Levy* (CIL). CIL regulations are expected to come into force in 2010 empowering local authorities to charge developers to finance the additional infrastructure necessary such as roads, public transport and open space alongside developments⁷³. (For further information on financing green infrastructure see section 4.5).

*The Flood and Water Management Act*⁷⁴ (2010) has been passed to allow the recommendations from the Pitt Review that require legislation to be implemented. The Pitt Review, which was in response to the 2007 floods, promoted working with natural processes to minimise flood risk. The Act requires developers to include sustainable drainage (where practicable) in new developments built to national standards that reduce flood damage and improve water quality. The Act amends the right to connect surface water runoff to public sewers (section 106 of the Water Industry Act 1990) making connection conditional on meeting the new SuDS standards. Arguably, one of the more significant proposals that will help overcome the recognised challenge of adopting SuDS, is the introduction of a SuDS Approving Body (SAB). The SAB is the Unitary Authority for the area (or where there is no unitary authority, the County Council) who will approve the design of new schemes and adopt them.

3.3 Planning legislation (England)

Planning regarding integrated water management and urban design is a responsibility of the Devolved Governments. National planning policy in England is set out by planning policy statements (PPSs) and planning policy guidance notes (PPGs), which have an important bearing on regional and local authority land use and development plans⁷⁵. They are to be taken into account during the preparation of Regional Spatial Strategies, by the Mayor of London in relation to the spatial development strategy for London, and by local planning authorities in the preparation of local development documents and may also be material to decisions on individual planning applications. A number of PPSs are relevant to green infrastructure. These include PPS1: Delivering Sustainable Development; PPS3: Housing; PPS 9: Biodiversity and Geological Conservation; and PPS 25: Development

and Flood Risk. Relevant PPGs include PPG11: Regional Spatial Strategies and PPG17: Planning for open space, sport and recreation.

Planning Policy Statement 1: Delivering Sustainable Development (2005)⁷⁶ requires that development involves an appropriate mix of uses, including the incorporation of greenspace. The supplement *Planning and Climate Change* (2007) goes further and states that RSS and any development should help deliver, amongst other things, GI and biodiversity as part of a strategy to address climate change mitigation and adaptation. "Planning authorities should take into account: the contribution to be made from existing and new opportunities for open space and green infrastructure to urban cooling, sustainable drainage systems, and conserving and enhancing biodiversity." Multi-functioning green spaces with opportunities for flood storage, wildlife and people are also referred to. SuDS are mentioned and should be given priority "paying attention to the potential contribution to be gained to water harvesting from impermeable surfaces and encourage layouts that accommodate waste water recycling."

Planning Policy Guidance 2: Greenbelt (1995, amended 2001) outlines land-use objectives and sets out inappropriate development for greenbelts. The amendment specifies that for the first time there should be a more positive use of land within greenbelts. It states that land in them should have a more positive role to play in providing access, opportunities for recreation, retaining and enhancing landscapes, improving damaged land, securing nature conservation and retaining land uses in primary industries.

*Planning Policy Statement 3: Housing*⁷⁷ (2006) sets out the national planning policy framework for delivering the Government's housing objectives. It states that housing density policies should have regard to the capacity of facilities such as "public and private amenity space, in particular green and open space." Proposed developments should also "provide or enable access to community and green and open amenity and recreational space (including play space) as well as private outdoor space such as residential gardens, patios and balconies." The PPS promotes the re-establishment of biodiversity within residential environments.

*Planning Policy Statement 9: Biodiversity and Geological Conservation*⁷⁸ (2005) sets out how the planning system is to support UK Biodiversity Action Plan targets. Planning should contribute to "rural renewal and urban renaissance by enhancing biodiversity in green spaces and among developments so that they are used by wildlife and valued by people, recognising that healthy functional ecosystems can contribute to a better quality of life and to people's sense of well-being." It should also ensure "that developments take account of the role and value of biodiversity in supporting economic diversification and contributing to a high quality environment."

Habitat fragmentation is also addressed in the PPS and local authorities are asked to avoid further fragmentation and isolation through policies and plans. Where ecological networks already exist these are to be protected, maintained and enhanced where possible. The protection and extension of open space and access routes, such as canals and rivers, including those within urban areas, are explicitly mentioned yet other mechanisms to increase connectivity, such as street trees and green roofs, are not. The *PPS9 accompanying guide to good practice*⁷⁹ (2006) has a section on "building in biodiversity." This promotes the incorporation of wildlife-friendly landscaping, SuDS, green walls,

balconies and roofs and nesting and roosting places into small-scale developments through measures guided by local and regional BAPs.

*Planning Policy Statement 11: Regional Spatial Strategies*⁸⁰ (2004) makes reference to other policies to be taken into account when preparing RSS. These provide the statutory framework for sustainable development in the English regions and set the context for local spatial plans. Some examples of spatial planning with regard to green infrastructure are detailed in section 3.5.

*Planning Policy Statement 12: Local Spatial Planning*⁸¹ (2008) sets out the Government's policy on what should be included in local development documents, such as core strategies, which pay particular regard to land use. It states that core strategies should be supported by evidence of infrastructure (including green) and also cover who will provide this infrastructure and when. The PPS promotes spatial planning as a means to protect environmental assets for their intrinsic value and their contribution to social and economic well-being. The development of core strategies should include measures to protect and enhance designated sites and create a positive framework for environmental enhancement in general. This can be used by local authorities as a policy hook for green infrastructure.

Planning Policy Guidance 17: Planning for Open Space, Sport and Recreation (2002)⁸² outlines the importance of protecting high quality green space, particularly those of benefit to wildlife and biodiversity. In planning areas for sport and recreation the needs of the local community should be taken into account and these should be accessible, meet the regeneration needs of the area (using brownfield over greenfield sites) and avoid loss of amenity and biodiversity. Local authorities should also "recognise that most areas of open space can perform multiple functions." The PPG states that green space should not be built on unless it is surplus to requirements. Standards should be set locally and the companion guide contains criteria and advice on setting these standards. Whilst the PPG details the importance of accessibility and management of open areas, there is little recognition of their wider benefits and the ecosystem services they provide, and GI is not expressly referred to.

Planning Policy Statement 25: Development and Flood Risk (2006)⁸³ aims to protect land that is required for current and future flood management. Planning authorities are required to avoid inappropriate development in the flood plain and are recommended to make use of "the benefits of green infrastructure for flood storage, conveyance and SuDS; re-creating functional floodplain; and setting back defences." The PPS outlines that SuDS must be considered for all new developments in the UK in order to minimize their impact on surface waters, however there is no legal requirement for their implementation. *PPS25: Practice Guide*⁸⁴ (2009) has a section on surface water management with signposts to relevant technical guidance and the role of surface water management plans in the planning system.

3.4 UK policy

The *UK Biodiversity Action Plan* (UKBAP) is the Government's response to the Convention on Biodiversity signed at the 1992 Rio Earth Summit. It describes the UK's biological resources and sets out a detailed plan for their protection. There are more than 150

species and habitats set out in the UKBAP but few species are identified which depend on urban areas and urban habitats are not defined as needing protection in their own right. Some urban habitats are in need of greater protection and should be added to the UKBAP. Sites such as brownfield land which have highly alkaline soils support interesting plant communities such as rare orchids that can only thrive in these conditions.

Making Space for Water (2004) is the Government's long term vision and strategy to reduce flood risk recognising that adapting to flood risk is not a case of building more and higher defences. Through this programme the EA are using realignment to widen river corridors and areas of inter-tidal habitat. The Government also promotes *Surface Water Management Plans* (SWMPs) as the tool for local authorities to manage surface water, ground water and flooding from watercourses.

The *Code for Sustainable Homes*⁸⁵ (CSH) was introduced in April 2007 to improve the overall sustainability of new homes by setting a single national standard within the house building industry. In 2008, the Government made it mandatory that all new-build homes must have a code rating or state that they haven't been rated at all. The CSH has a scoring system of six levels and these are made up by achieving the appropriate mandatory minimum standards combined with a proportion of "flexible" standards. Within the code, one of the mandatory standards is for surface water run-off management. The peak run-off rate into watercourses must be no greater post-development than pre-development and should comply with CIRIA SuDS guidance⁸⁶ or for at least one in 100yr return periods. It is suggested that this might include rainwater recycling, permeable paving, green roofs and soakaways. There is also a non-mandatory standard that new developments must include a certain amount of outdoor space. There is no mandatory standard for retrofitting existing developments.

3.5 Regional and local plans

A number of *Local Biodiversity Action Plans* (LBAPs) address towns and cities and the environments within them such as parks and gardens, cemeteries and industrial areas. LBAPs for Newcastle, Birmingham and the Black Country, Westminster, Camden and Hull contain specific plans for buildings and other artificial structures⁸⁷. Others have action plans for species that use the built environment, such as swifts, house martins and bats. LBAPs are delivered by local biodiversity partnerships and generally conform to county boundaries.

Regional spatial strategies

There have been some notable examples of GI policy within regional planning. The RSS for the East of England has a section on environmental infrastructure which makes some useful policy points in relation to GI (see below). In the guidance document to PPS9 the East Midlands is given as an example of good practice for its policy on enhancing the region's biodiversity. The RSS sets out the mechanisms for implementation, identifies the lead and supporting organisations involved and for some policies sets specific targets and provides indicators to measure this. It is important for RSSs to embed GI into planning policy as they have such a strong influence on what is achieved "on the ground."

Other good examples of regional spatial planning are the Glasgow and Clyde Valley Structure Plan⁸⁸ and the London Plan⁸⁹ (see case study 5.2). Glasgow has suffered from severe flooding in recent years highlighting the need for a more sustainable drainage system. Glasgow City Council and Glasgow and Clyde Valley Green Network Partnership are working to provide a network of quality green spaces that will enable a strategic approach to the area's water management. Scottish Water and the Green Network project are looking to develop six exemplar SuDS retrofit studies in the Metropolitan Glasgow area to enable them to develop a toolkit for identifying and evaluation retrofit options.

RSS East of England- Policy ENV1: environmental infrastructure

“Local development documents will:

- provide connected and substantial networks of accessible multi-functional green space, in urban, urban fringe and adjacent countryside areas to service the new communities in the sub-region by 2021
- have a multiple hierarchy of provision of green infrastructure, in terms of location, function, size and levels of use, at every spatial scale and all geographic areas of the region
- provide and safeguard green infrastructure based on the analysis of existing natural, historic, cultural and landscape assets, provided by characterisation assessments, and the identification of new assets required to deliver green infrastructure
- identify biodiversity conservation areas and biodiversity enhancement areas, to deliver large-scale habitat enhancement for the benefit of wildlife and people
- set targets for the provision for natural green space within development areas.

Supporting text

9.4 [...]New provision for green infrastructure should extend and enhance existing infrastructure to create a coherent linked network of green space and deliver 'liveability' for new communities. This will be particularly important in the Sustainable Communities Plan growth areas, but also in other areas where locally significant development is proposed.”

Local Government

The *Sustainable Communities Act*⁹⁰ (2007) introduced the promotion of sustainability of local communities through partnership working at the local level and requires the development of *Sustainable Community Strategies* (SCS) and the negotiation of *Local Area Agreements* (LAA). SCS are key long-term (10-20 year) planning documents for improving the quality of life and services in a local area. They are to be developed by local authorities and a range of partners to contribute to sustainable development in the UK. CABE recommend that open space strategies form part of the SCS. It is from the SCS that LAA are developed. These are three year plans that set out the local priorities to improve communities and are negotiated between all the main public sector

organisations, local authorities and central government. Local authorities may also produce *Area Action Plans*. These set out the development principles and policies for the development of a specific area and may specify the requirements for new infrastructure and services.

National indicators have been developed to measure the performance of local authorities and local authority partnerships. There are 198 performance indicators in total from which each local authority selects a core 35 designated targets, focusing on the area's priorities. Indicators that can be met through the provision of green infrastructure include: Planning to adapt to climate change (NI188); Flood and coastal erosion risk management (NI189); and Improved local biodiversity – active management of local sites (NI197).

3.6 Other guidance for GI

Natural England has produced *Green Infrastructure Guidance*⁹¹ which articulates the importance of planning and delivery of strategies. GI funding and governance models are presented and they also include a range of case studies from their work on Green Growth for Green Communities.

Greenspace Scotland have produced guidance to help with the mapping of green infrastructure and a strategy to develop effective policies for urban renewal that provides clear health and social benefits⁹². Through partnering with Health Scotland (the Scottish NHS) there is a strong emphasis on health issues within greenspace management.

The Commission for Architecture and Built Environment (CABE) have produced a number of guidance documents and reports on GI. *The green information gap: mapping the nation's green infrastructure*⁹³; *Future health: sustainable places for health and well-being*⁹⁴; *Grey to Green: how we shift funding and skills to green our cities*⁹⁵; and *Open space strategies: Best practice guidance*⁹⁶ are just some of the documents available to help planners free of charge.

CIRIA produce practical guidance for designers, developers and planners in the construction industry. The SuDS manual (C697) provides best practice guidance on the planning, design, construction, operation and maintenance of SuDS.

Each of these agencies has their own agenda and there is a case for the development of more partnership working to present a more unified policy on urban planning and greenspace.

4.0 Current challenges to implementing GI

Chapter 3 highlighted the multitude of policy and legislation regarding green infrastructure and the range of scales over which it has influence. Chapter 4 now addresses the challenges to implementing GI posed by planning, retrofitting, funding, and conflicting land use demands.

4.1 'Joined-up' planning

Planning should avoid harm before the need of mitigation measures. At a policy level, planning and the planning system needs to incorporate green infrastructure and an ecosystem approach to ensure that benefits are optimised in the long term, especially in relation to climate change adaptation and biodiversity loss.

The provision of green infrastructure should be an integral part of the creation of sustainable communities throughout the UK. Green infrastructure should be recognised as providing a wide range of environmental and quality of life benefits and as a result, built into all regeneration and development schemes from the outset. Strategic planning for GI needs to incorporate preventing the deterioration of existing areas, improving the quality of areas to serve local needs, increasing the connectivity between areas and a consideration of the management of all green areas regardless of public or private ownership.

Addressing multi-functionality and biodiversity

The current range of PPSs and PPGs do make reference to green infrastructure in its variety of forms, although the benefits of multi-functionality are often not addressed and this may be due to their treatment of elements of GI in isolation. Planning policy uses the primary function of greenspace for definition (park, green belt or protected area etc.), which makes it difficult to provide sustainable approaches to urban planning that acknowledge the multiple functions and services that are provided. If planned properly GI can provide numerous opportunities for urban development, nature conservation, public health promotion, local food production and environmental education⁹⁷. This is not to say that all open spaces should provide for all types of activity but that multi-functionality across them should be maximised.

To illustrate: parks are a significant feature of our urban heritage and an essential component of successful cities around the world, however many in the UK are "lifeless" pockets of mown grass. PPG17 recognises the value of open space for recreation and pays attention to issues such as the provision of facilities and their management. A park may be compliant with PPG17 but not maximise the value that could be generated in terms of biodiversity and human well-being, and the benefits that could be developed as part of a wider, connected GI network. The Green Flag Award scheme (which CIWEM supports) has been developed to act as a benchmark for high quality parks and green spaces, especially in urban areas and rewards the best green spaces in the country.

The EAC report on halting biodiversity loss recommended that the government must protect and enhance biodiversity across all departments and policies, essentially through an ecosystem approach⁹⁸. The Government's National Ecosystem Assessment⁹⁹ is

beginning to build an evidence base which will hopefully inform all government departments and embed the concept of ecosystem services into decision making at all scales. Delivery of biodiversity protection needs to now take place at local and regional scales.

RCEP have suggested¹⁰⁰ that Government guidance should be produced, potentially alongside that of PPG17 that promotes ecological services, drawn from guidance such as the Town and Country Planning Association's *Biodiversity by Design*¹⁰¹. Evidence to the Commission from several sources suggested that this design guide should be adopted by the Government and referred to in planning guidance. The TCPA guide stresses that park management needs to be encouraged to move away from creating a traditional manicured appearance to one that is species-rich with structurally diverse vegetation. It is hoped that the the proposed *Planning Policy Statement: Planning for a Natural and Healthy Environment* will consider multi-functionality and ecosystem services more fully than current efforts and work to "join-up" the current range of PPSs.

Planning ecological functioning networks

As previously stressed, green and blue ribbon strategies for habitat and recreational corridors are also essential considerations when planning GI. The size and connectivity of GI has important implications for biodiversity and in reducing edge effects. It should be recognised that a network, for coherence and resilience, is represented by more than just a physical continuity between two or more ecological units and must involve *functional* links. It has been known for planning authorities to only acknowledge a link as being functional if it was designated as a protected area (SSSI for example). A polar but equally ridiculous example: planning inquiries have been known to accept a tarmac covered footpath as maintaining a link for the ecological continuity of two ponds. Planning guidance needs more emphasis on functionality to assist decision makers.

Increasing connectivity through linear habitats such as greenways can provide opportunities to incorporate footpaths to promote sustainable travel patterns (see [case study 5.1 on the Peterborough Green Grid network](#)). However, when planning for recreational corridors, there can be a conflict between providing areas for recreation and maintaining biodiversity. This is addressed in the TCPA guide¹⁰² which suggests footpaths need to be well designed so that they do not interfere with habitat creation and provide natural surveillance so that they do not become havens for crime.

To create a connected network, there needs to be an understanding of the existing GI network and its functional requirements in order that a hierarchy of linked spaces can be created. A good example is the Peterborough Green Grid Strategy (see [case study 5.1](#)). Protected habitats should be incorporated into network plans and RSSs should be used to embed GI into regional and local policy.

The Secretary of State for Environment, Food and Rural Affairs announced in 2010 an independent review¹⁰³ of England's wildlife sites and ecological network. The review will complement the National Ecosystem Assessment which is currently being prepared. It will take account of the continuing importance of ecosystems in the wider countryside and urban areas and will draw on the results of the Foresight project on land use¹⁰⁴ which was published earlier this year.

Planning on a range of scales

The provision of green infrastructure should be an integral part of the creation of sustainable communities throughout the UK. Whilst large scale projects (such as the redevelopment of the Lea Valley for the 2012 Olympics) work well at demonstrating what can be achieved, there is a great deal that can be accomplished locally. Community gardens and schemes such as the RHS Britain in Bloom have helped improve social cohesion and small scale campaigns to stop the paving of front gardens all add up to make an impact without being expensive.

Community Participation – The Mersey Forest

The Mersey Forest is a community forest spread across Cheshire and Merseyside which was launched in 1994 as part of a 30 year plan. It comprises a network of woodlands and green spaces contributing to city cooling and attracts visits of at least once a week from 20% of local people. More than 8 million trees have been planted through community and partnership working creating 6000 hectares of new woodland and improved habitats.



One of the fundamental objectives of the forest was that everyone should be encouraged to participate in the planning, development and enjoyment of their forest and through their long term commitment, play a part in its ownership and stewardship.

For further information please visit <http://merseyforest.org.uk>

4.2 Increasing the use of SuDS

The *Flood and Water Management Act* places added pressure on local authorities to implement SuDS into development schemes (see section 3.2). CIWEM would hope to see a presumption for SuDS unless there are compelling reasons otherwise and also further attention being paid to retrofitting SuDS to existing properties where feasible. PPS25 recommends the use of SuDS for new developments and refers developers and planners to the *CIRIA SuDS Manual*¹⁰⁵ for guidance. This contains seven criteria for the design of SuDS and it is CIWEM's view that all SuDS should be implemented following this best practice guide and incorporate enough treatment trains to neutralise pollution. National standards will have to be developed as the FWMA places a duty on the Minister (Welsh Ministers or the Secretary of State in England) to create them for the implementation of new SuDS.

DEFRA are currently trialling a range of SuDS systems at Lamb Drove near Cambridge which incorporates a range of measures (swales, detention basin, retention pond,

permeable paving, water butts, and a green roof) within a new affordable housing development. The trial SuDS system cost £11,000 less than a traditional drainage system. The outcomes of the study, due in 2011, will measure how much surface water has been reduced due to the scheme.

Retrofitting SuDS

Surface water management is most effective when placed at the heart of urban design. The retrofitting of measures to manage risk in existing urban areas is especially challenging in areas where little potential remains for additional greenspace. Achievement has been modest in terms of SuDS retrofit and stormwater quality control in the UK; the US is significantly ahead (see case study 5.4 on Portland). Scottish Water is currently working to define a tool kit for identifying and evaluating retrofit options and looking for pilot sites. The Netherlands has also made advances with an emphasis on keeping water on the surface, replicating natural processes. Whilst SuDS control flow rates from the source, the use of open channels rather than drains allows for the storage and transfer of excess water in storm events (see case study 5.5 on river restoration). This is important because SuDS alone cannot cope with the magnitude of flood flows seen in 2007¹⁰⁶. CIRIA are now developing guidance on retrofitting surface water management measures which is welcomed.

4.3 The loss of GI

Urban creep

A recent trend is the loss of private gardens. Private gardens are a valuable resource for urban drainage as they can absorb up to ten litres of rainwater a minute¹⁰⁷. In Greater London, private gardens make up a fifth of the area, yet here and elsewhere there has been a trend of converting front gardens into paved areas of hard standing to provide car parking spaces¹⁰⁸. A report¹⁰⁹ by the London Assembly estimates that the loss of green space from the conversion to hard standing has amounted to 32km², an area 22 times that of Hyde Park. The loss of front gardens results in increased pressure on street drainage, has implications for the transfer of pollutants to rivers and intensifies the UHI¹¹⁰. Following the Pitt Review, the Government has removed the unrestricted right to pave over front gardens using impermeable materials but there are no requirements for retrofitting measures.

“Backland development” and new high density developments are also reducing the extent of private gardens. This is where new housing is filled in the back gardens of existing streets by the owners or developers usually for one or two plots. Development in this way often results in eroded amenity and the removal of mature vegetation. Large gardens and long established trees are especially important for biodiversity, although this is often overlooked. National planning policy stresses that planners should take into account the scale and character of the development and its impact on environmental quality. However, often once one development has been given approval, a precedent is set for a whole street. Planning guidance is required to ensure that local authorities and developers are fully aware of the potential biodiversity value of such areas and to promote effective measures for its evaluation.

Housing targets and planning policy

As stressed in 2.4 new housing is a main priority to supply the demands of a growing population. Increases in housing density targets remove the potential for green space and will exacerbate urban problems. The emphasis placed on increasing housing should also include the full provision of environmental and green infrastructure to support it.

The revision of "Planning Policy Statement 3: Housing" has done little to protect private gardens from development. The Government's recently published review of development on garden land¹¹¹ concluded that there was no universal definition of garden land with some authorities classing them as "brownfield" land whereas others did not. The treatment of gardens as "previously developed land" suitable for development is at odds with the services they provide. The lack of consistency between local planning authorities (LPAs) makes it difficult to track developments on private gardens. It was also found that garden development is more of an issue in some areas rather than others. Some LPAs suggested that additional guidance is required to help interpret PPS3, such as cross referencing to other policy statements. Two thirds of the LPAs expressed that the criteria within PPS3 favoured the desire to increase density over other criteria, and that "the presumption in favour of brownfield development was used by developers to push for acceptance of proposals." Density thresholds are needed for new housing on private gardens to ensure that adequate green infrastructure is provisioned. Planners also need to take into account the contribution to biodiversity (which can be significant in large gardens) in the area rather than just the identification of protected species.

4.4 Maximising the potential of existing GI

Green Belts were first designated in the 1930s as a barrier to curb our ever expanding cities. Whilst a recent report¹¹² by Natural England and CPRE found that greenbelt had been effective in controlling urban creep, some argue that it has more negative impacts by adding to building density in urban areas and by not allowing for a sustainable urban form. Although this effectiveness has often been debated, what is essential is that, with greenbelt accounting for almost 13% of land in England, greater emphasis must be placed on the multifunctional use of this land.

Land managers should be empowered to make positive land use objectives within greenbelts through landscape enhancement and habitat creation recognising the ecosystem services they provide. The report which also surveyed the environmental state of England's greenbelt echoes the findings of the Barker review¹¹³ of land use planning: that further action was needed in terms of protecting and enhancing greenbelt land and more should be done to maintain and enhance networks. Greenbelt land is already making a contribution to GI but if managed effectively it could deliver multiple benefits.

Similarly there is recognition that green space within our towns and cities is not being maximised. School playing fields are often locked up outside of school hours, providing neither for recreation or biodiversity value. Poorly designed or inappropriately managed greenspaces do not encourage use by the community or social interaction and can become havens for antisocial behaviour. Community involvement in the design and management of green infrastructure can promote stewardship which will lead to reduced management costs from vandalism over the long term¹¹⁴. Before considering the addition

of new greenspace, it is important that the function and quality of what already exists within an area is assessed.

Historic landscapes such as old hedges, ditches, old trees and public rights of way should be protected and celebrated within new development. Allotments also need to be safeguarded in perpetuity, due to their importance not only as greenspace but also the added benefits to health from exercise and growing fresh food. Provision of these should be actively built into new developments, especially Housing Association type developments which tend to favour flats without gardens.

4.5 Funding and maintenance

The nation spends almost £700million on urban green space a year from central government and lottery funds¹¹⁵. The majority of central government funds are channelled through local authorities. Funding for parks and green space is currently non statutory for local authorities and there has been a trend of disposing of open land to avoid the costs of management. Whilst investment in “grey infrastructure” such as road building runs into billions of pounds, funding for GI remains fractional. The value of greenspace as part of environmental infrastructure for flood prevention and for climate change adaptation needs to be accounted for. CIWEM urges the Government to prevent future cuts to ensure this vital resource is maintained.

Ideally arrangements for the funding and maintenance of green infrastructure should be linked closely with the LBAP and biodiversity duties on the public sector at every level with Natural England utilising its powers under the Habitats Regulations to secure funding for natural green space.

CABE have criticised local authority funding calling for a complete change of priorities so that every decision aims “to improve quality of life whilst reducing levels of pollution, water, energy use and waste”. They recommend a switch of spending from grey to green infrastructure to include investment in green roofs, street trees and urban greenways to stimulate a green economy. CABE and Natural England have called for the Government’s green stimulus package to support low carbon housing to be extended to incorporate GI. Natural England has also called for the recognition of the value of private gardens to GI.

The Natural England *Accessible Natural Greenspace Standard* (ANGSt) review¹¹⁶ indicated that where green space targets are not being delivered, key barriers to delivery included lack of staff skilled in securing funding, and lack of knowledge of the current mechanisms available for delivering greenspace. RCEP also found that where greenspace is falling short of its potential it is largely due to the depletion of skills and resources in GI management and a lack of understanding for the potential of biodiversity¹¹⁷.

The National Audit Office (NAO) conducted a value for money report on enhancing urban green space¹¹⁸. They found that resources need to be better targeted to achieve greater value for money and a strengthening of skills. Greenspace is often underrepresented in decision making arenas and can easily slip down priority lists. The NAO suggest that green space managers are trained to more effectively make the case

for GI expenditure. One third of urban local authorities were found not to have strategies for their green space and many of the existing strategies were "weak". Central government was urged to support poorer performing local authorities with advice and mentoring. It was also found that some LAs were spending as much as five times more than others in maintaining their green space highlighting the need for improved efficiency.

The funding and maintenance of SuDS is a challenge that is often cited. Ideally, SuDS that require minimal maintenance should be implemented. However, where this is not possible, the most appropriate organisation should take responsibility for the funding and maintenance whether this is the developer, utility company, highways agency or local authority. The FWMA deems that where the SAB adopts a drainage system it becomes responsible for maintaining the system. CIWEM considers that the long term management could also be funded through the Community Infrastructure Levy (CIL) or Section 106 agreement.

The Planning Act 2008 established the legislative framework for the CIL, with the detail to be set out in secondary legislation as a consequence of the Housing Green Paper in 2007. CIL will ensure that the costs incurred in providing infrastructure to support the development of an area can be funded (wholly or partly) by owners or developers of land¹¹⁹. CIL Regulations are expected to come into force in 2010 and could provide funding for the creation and maintenance of extensive green infrastructure.

4.6 Accessible vs. natural greenspace

The first accessibility standard for greenspace was introduced by Queen Elizabeth I which stated that each resident should be within three miles of greenspace. More recent attempts include the *Six Acre Standard* by the National Playing Fields Association, *Space for People* by the Woodland Trust and ANGSt by English Nature. PPS3 and PPG17 both require green space to be accessible.

Natural England have adopted ANGSt, which states that within 300 metres of every doorstep there should be an accessible area of natural greenspace of at least 2 hectares in size. In addition, there should be at least one accessible 20 ha site within 2 km, one accessible 100 hectare site within 5 km and at least one accessible 500 ha site within 10 km of home. The standard recommends statutory Local Nature Reserves at a minimum level of one hectare per thousand people. Natural England is working to secure ANGSt in national policy and suggest it is considered a long-term aim for all local authorities within their greenspace strategies.

Increasing access to greenspace helps to improve physical and emotional attachments to nature providing health and well being benefits. However recreation and biodiversity can create conflicts of land use. Where protected species are present, access will have to be restricted. Dr William Bird (the British doctor who in 1995 first set up Health Walks for his patients) suggests that accessible, suitably surfaced areas for physical activity could be created alongside more natural wildlife-rich green space since a main motivator for physical activity in green space is the view of nature, rather than physical access through it.

Throughout the development of SuDS, there has been some debate as to whether natural or engineered drainage was “better.” One view is that a mix of solutions will ultimately be required as it may be challenging for natural options alone to fully address the extent of challenges faced, particularly in the existing built environment. There are opportunities to exploit added benefits using a combination rather than a single approach. An example of a combination approach is that of the enhanced swale, which incorporates engineered storage underneath. There are also examples of engineered storage systems being installed under parkland (see [case study 5.5 on river restoration](#)). Some of the most successful SuDS implementations are those in which a range of techniques have been integrated together, for example combinations of green roofs, permeable paving, rainwater harvesting, sub-surface storage, along with swales, ponds, and wetlands (see [case study 5.4 on Portland](#)).

5.0 Case studies - Opportunities for GI

5.1 Planning functional networks - Peterborough Green Grid Strategy

The Peterborough Environment City Trust (PECT) has been working on green grid initiatives with Peterborough City Council, Natural England, The Countryside Agency, Forestry Commission, the Environment Agency and other partners to improve the network of green infrastructure in and around Peterborough.

The Green Grid Strategy incorporates all resources; both publicly and privately owned and focuses on the connections between the urban and rural areas. A number of generic guiding principles underpinned and informed the development of the green infrastructure strategy:

- Connectivity
- Landmark Projects
- Multi-functionality
- Landscape Character Enhancement
- Biodiversity Enhancement
- Extended Access

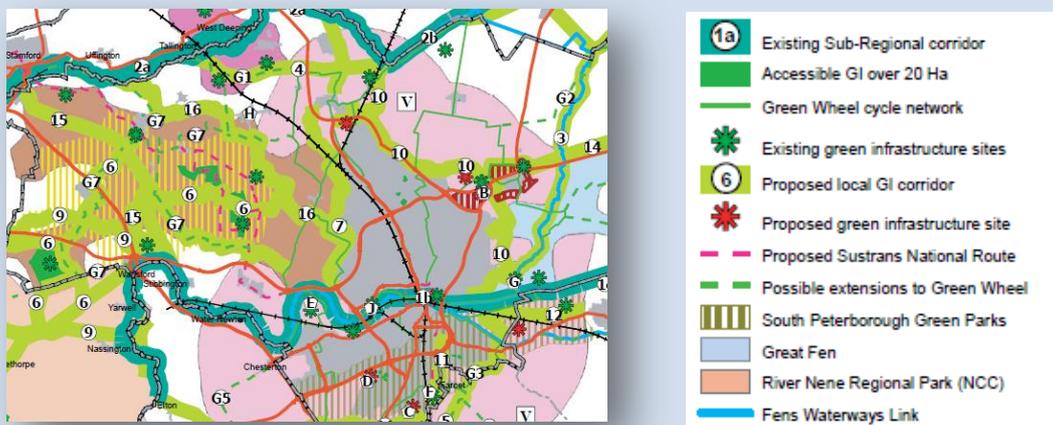


Figure 4 Example from the Greater Peterborough Strategy, Green Grid Network

The project began by bringing together a wide range of environmental and social data to identify the gaps and opportunities in ecological and recreational networks. Existing GI provision was mapped and the Green Grid Strategy was developed with the help of local stakeholders (figure 4). Following a successful bid from the partnership, DCLG provided £1 million funding to deliver projects under the strategy. One such project is the green wheel, which is a 45 mile long cycle route that circles the city joining up radial routes from the city centre, providing sustainable transport options. Other projects are now under development contributing to the 20 year vision.

For further information please visit: <http://www.pect.org.uk> and <http://www.naturalnet.org.uk>

5.2 Building in Biodiversity - The London Plan

London is the only area in the UK that has a statutory duty to prepare a biodiversity strategy as part of the region's spatial plans. The Mayor of London published the biodiversity strategy in 2002 as part of the 2004 London Plan. This has enabled greenspace to be integrated into planning with the broader functional benefits of GI taken into account, protecting and enhancing London's natural areas and their associated species.

The nature conservation strategy began in 1984 with the undertaking of wildlife surveys. The GLA now has a rolling programme of biodiversity surveys, averaging around three boroughs per year to add to this database. This has provided a strategic tool for the planning and implementation of the biodiversity strategy and informing planners of the ecological implications of proposed new developments. The programme has involved many different groups including the London Boroughs, voluntary bodies such as the London Wildlife Trust and included strong support from local communities.

The impact of the biodiversity strategy has been the hierarchy of designations that are now in statutory planning procedures. The two main aims have been to ensure that there is no net loss of Sites of Importance for Nature Conservation and that the Areas of Deficiency are reduced. Individual boroughs must also ensure that their LDFs improve accessibility to nature through new access points and improvements made to footpath provision.



Figure 5 The City of London

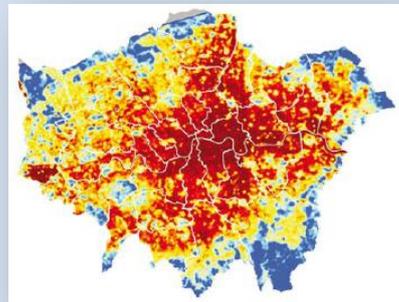


Figure 6 London's urban heat island

The Strategy contains information about Greater London's wildlife and its habitat and takes account of LBAPs. It also has proposals, commitments and targets for the promotion of biodiversity in London by the Mayor and partners and includes a consideration of climate change adaptation and blue space.

Climate change adaptation

There is now a replacement plan in consultation with formal publication due towards the end of 2011. The Mayor's recent *Vision for the environment* recognises the importance of ecosystem services and the *Draft climate change adaptation strategy for London* supports the use of street trees and trees in front gardens to increase shading

and reduce the urban heat island (figure 6).

Biodiversity

Green roofs are cited as a method to increase biodiversity in the design of new buildings. London has a number of green roofs with one that was created as a habitat for black redstarts winning the Stirling Prize for Architecture. The roof of the Laban Dance Centre has an aggregate-based roof to provide a habitat for these wholly urban species.

London's Blue Ribbon Network

The London plan has established the Blue Ribbon Network. This includes the Thames, the canal network, the other tributaries, culverts, rivers and streams within London and London's open water spaces such as docks, reservoirs and lakes. The Mayor will work with others and particularly the Environment Agency to establish a restoration strategy for the tributary rivers of the network and identify options for reinstating natural features. The London Plan protects biodiversity within the network by avoiding inappropriate development, promoting opportunities to open culverts and restore river channels and encouraging the management of surface water run-off on site with SuDS.

For further information please visit: <http://www.london.gov.uk/thelondonplan/>

5.3 Surface Water Management & Engagement – Dŵr Cymru Welsh Water

Dŵr Cymru Welsh Water has developed a surface water management strategy to reduce and avoid new surface water flowing in their sewers. This will enable them to decrease their energy costs and future pollution incidents, and also adds to community measures of supporting conservation, countering urban creep and adapting to climate change. The aim is to achieve drainage that mimics natural systems as far as possible, leading to measures that are preventative rather than those that react to flood events.

In Wales they have realised that building larger and larger sewers is unsustainable and that the key is in reducing existing and avoiding additional flows. Reducing surface water can only be achieved with the cooperation of other parties. Dŵr Cymru has developed an engagement process which aims to raise awareness about the possible technical solutions to drainage and also the offer of assistance to anyone willing to implement them.



Figure 7 Glencoe School car park before, Portland, USA



Figure 8 Glencoe School car park after retrofit with sustainable drainage and planting

Following the example set in Portland, USA, pilot studies for rainwater harvesting and a “SuDS showcase site” are to be set up under the strategy. The example of Glencoe school car park in Portland (Figs 7, 8) shows that multiple benefits can be derived from sustainable drainage and the improved visual aspect that can be gained from having water and green space within urban areas.

Dŵr Cymru's final business plan to 2015 includes £15 million investment in SuDS and a further £8 million to investigate additional surface water removal.

Further information is available from <http://www.dwrcymru.com>

5.4 Integrating SUDS - Portland, USA.

Portland, Oregon is generally accepted as one of the leaders in SuDS implementation. In its "Green Streets" scheme three design principles are followed:

- The management of stormwater runoff both at the source and the surface
- The use plants and soil to slow, filter, cleanse, and infiltrate runoff
- The design of facilities that aesthetically enhance the community



Figure 9 Managing storm water through vegetated planters



Figure 10 Permeable paving parking strips replace impervious concrete

Green Streets (figures 9 and 10) provides excellent examples of how to retrofit surface water management measures in completely built up areas. Managing storm water within the city was a main aim to create cleaner water and healthier watersheds. Vegetated planters and street and pavement improvements were installed to provide attractive yet functional storm water facilities that provide habitat, slowly release storm flow, filter pollutants, recharge groundwater and reduce erosion. Wherever possible multi-functionality is embraced by using SuDS to protect homes, act as traffic calming measures, serve as an educational resource and provide general amenity.

Through the Clean River Rewards scheme, residents receive reduced or zero storm water charges if they manage storm water on their property.

The whole community has become involved in the scheme with a long-established (10 years) downspout disconnection programme. More than 42,000 homeowners have disconnected downspouts, removing more than 942 million gallons of storm water per year from the combined sewer system.

Further information can be found at <http://www.portlandonline.com>

5.5 River Restoration and flood storage - Chinbrook Meadows and the River Ravensbourne (River Quaggy), London, UK.

Greater London's parks and green spaces are a valuable environmental asset making up almost two thirds of the area. Sadly so many of the rivers have been lost from view and had their functions limited through channelisation or buried in culverts.

The River Quaggy flows 17km through the south eastern London Boroughs of Bromley, Greenwich and Lewisham. It is an urban river that has seen extensive channelisation to alleviate flooding that has primarily arisen from development of the floodplain. These measures have acted to increase flooding. Flowing through Chinbrook meadows prior to 2002, the river was bounded by a straight concrete channel and flanked with a hedge for safety, this divided the green space, increased maintenance costs and diminished natural amenity (figure 11). The park was a flat green area lacking any real biodiversity.



Figure 11 Chinbrook Meadows pre- 2000
Straight concrete channel



Figure 12 Chinbrook Meadows in 2003
Restored natural channel

A restoration scheme was undertaken by the Environment Agency and a range of partners to remove the culverts and revert the river to its natural state. 300m of concrete channel were replaced with 350m of meandering river and wetland. Sutcliffe Park has been turned from an underground culvert into a "natural" floodplain able to hold 85,000m³ of water, providing flood protection for the town of Lewisham (EA). A popular green space was created for the community and new varied habitats were created for wildlife. At Chinbrook, wildlife has burgeoned and an outdoor classroom has made it into an educational resource (figure 12). The park was redesigned and upgraded with new footpaths, planting, gates, lighting, bridges, sports facilities, educational resources and art features resulting in park visits rising by 73%. Most of these visits are now for exercise as there was an awareness raising scheme and the creation of walking and cycling routes through the park.

The River Quaggy restoration scheme won CIWEM's living wetlands award in 2007. For further details of CIWEM's awards please visit <http://www.ciwem.org/>

Further information is available from: <http://www.qwag.org.uk/quaggy/> and the Environment Agency. Partners in this project are the London Borough of Lewisham, Groundwork Thames, Gateway London South, Quaggy Waterways Action Group, and Glendale Grounds Management.

6.0 Conclusion

In the UK, our towns and cities are facing a number of challenges ahead. With over 80% of people living in urban areas and a growing population that will see these numbers set to rise, there will be a dramatic increase in land use pressure. Urban sprawl and building densities will swell to levels that override the potential for green and blue space. It is essential that as urban development continues, green infrastructure is recognised as providing numerous and essential services and is embedded into planning and funding priorities.

The stresses of climate change will be felt the greatest in urban areas as these are more vulnerable to the impacts of extreme heat. Surface water flooding is becoming increasingly common from urban development and extreme weather, impacting on the costs of defence, clean-up and threatening public safety. Increased fragmentation of the natural environment is affecting biodiversity and the ecosystem services upon which we rely. Human well-being should also be considered and maximised in urban areas as so much of people's time is spent working and living there.

Green infrastructure can provide numerous solutions to the challenges of climate change and extreme weather. Vegetation provides shading, greenspace removes some of the causes of UHI and water bodies supply cooling in temperate climates from evapo-transpiration. A considerable amount of cooling can be achieved through the careful planning of green corridors, smaller open spaces, street trees and green roofs. In the prevention of flooding, urban greenspace acts to reduce run-off and increase natural infiltration. The planting of trees and the provision of green and brown roofs can also increase interception levels, and permeable paving options can reduce surface run-off. The restoration of natural river channels also adds to flood prevention and reduces the reliance on "hard" management approaches.

The conservation of functional habitat processes which support biodiversity, result in the protection of thousands of species. Well-managed ecosystems provide people with resources and reduce vulnerability whilst poorly managed systems can increase the risks of flood, drought, crop failure or disease. Carefully planned green infrastructure can allow for ecological networks that contribute to biodiversity from increased vegetation cover and connectivity. These networks of natural habitats provide valuable links for the migration, dispersal and genetic exchange of species in the wider environment. An understanding of ecological functioning should inform biodiversity planning as the majority of these services cannot, or cannot affordably, be replicated by humans, so must receive protection. There is no reason why biodiversity loss could not be halted in England with leadership and effective policies.

Green infrastructure can also help to ameliorate air pollution and through providing more attractive green transport solutions, reduce the reliance on cars for short journeys. Active travel is one of the easiest ways to achieve regular exercise but must be accommodated for through the quality of the physical and natural environment with opportunities for recreation and exercise. Community involvement in the design and management of green infrastructure add to social inclusion and can promote stewardship which will lead to reduced management costs over the long term. A number of the case studies featured in this report were developed through active community involvement.

Green infrastructure falls under a number of policy aims at European, national, regional and local levels but fails to be addressed in such an integrated manner. The UK planning policy statements refer to GI separately but should be used collectively by local authorities as planning hooks to implement GI. The following are calls from CIWEM that we consider would help to raise the profile and provision of green infrastructure in the UK.

Calls from CIWEM

Planning should avoid harm before the need for mitigation measures. The provision of green infrastructure should be an integral part of the creation of sustainable communities throughout the UK. Green infrastructure should be recognised as providing a wide range of environmental and quality of life benefits should be built into all regeneration and development schemes from the outset.

At a policy level, planning and the planning system needs to incorporate GI and an ecosystem approach to ensure that benefits are optimised into the long term, especially in relation to climate change adaptation and biodiversity loss. Strategic planning for GI needs to prevent the deterioration of existing areas, improve the quality of areas to serve local needs, increase the connectivity between areas and consider the management of all green areas regardless of public or private ownership.

Planning policy should acknowledge that there are numerous functions that GI can provide rather than relying on its primary definition. The current range of PPSs needs to be "joined up" with cross references to promote multi-functionality and sustainable approaches to urban planning. Government guidance should be produced or integrated into the current range of PPSs to promote ecosystem services and give more guidance on functionality to assist planners with decision making.

Strategic planning should create networks and corridors for wildlife. These should incorporate protected habitats and those identified in the Biodiversity Action Plan targets. Regional Spatial Strategies should be used to embed green infrastructure into regional and local policy.

CIWEM would hope to see a presumption for SuDS in new developments unless there are compelling reasons otherwise. These should be designed and maintained according to CIRIA Guidance C697 with the appropriate amount of "treatment trains" to improve water quality, resulting in a reduction in surface water run-off rates and diffuse pollution loads. Further attention should be paid to retrofitting SuDS to existing properties where feasible and CIWEM welcomes the new guidance being developed on retrofitting surface water management measures.

Density thresholds are needed for new housing on private gardens to ensure that adequate green infrastructure is provisioned. Planning guidance is also required to ensure that local authorities and developers are fully aware of the potential biodiversity value of private gardens and to promote effective measures for its evaluation.

Funding for parks and green space is currently non statutory for local authorities. Whilst investment in grey infrastructure runs into billions of pounds, the value of greenspace as part of environmental infrastructure for flood prevention and for climate change

adaptation needs to be accounted for. CIWEM urges the Government to prevent future cuts to ensure this vital resource is maintained. It is hoped that CIL regulations will provide funding for the creation and maintenance of extensive green infrastructure.

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7.1 Image Credits

Cover images:

- Portland SUDS/Traffic calming - Dwr Cymru surface water management strategy
- Tower block in meadow - CIWEM image library
- Green roof bus stop – SUDSnet

Figure 1 – Natural England. 2009. No charge? Valuing the natural environment.

Figure 2 - Green roof bus stop – SUDSnet

Figure 3 – Mile End Bridge – londontown.com

Community participation – Mersey Forest – merseyforest.org.uk

Figure 4 - Greater Peterborough Strategy, Green grid network

Figure 5 – The city of London – Googleimages – devono.com

Figure 6 – GLA. The London plan

Figure 7 – CIWEM conference presentation

Figure 8 - CIWEM conference presentation

Figure 9 - CIWEM conference presentation

Figure 10 - CIWEM conference presentation

Figure 11 – River Quaggy - qwag.org.uk/quaggy/

Figure 12 - River Quaggy - qwag.org.uk/quaggy/

About CIWEM

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Working for the public benefit for a clean, green and sustainable world, CIWEM (The Chartered Institution of Water and Environmental Management) is the only independent, chartered professional body and registered charity with an integrated approach to environmental, social and cultural issues.

- Supports thousands of members worldwide
- Powerful evidence-based lobbying force within the UK and abroad
- Provides training and professional development opportunities
- Provides a forum for debate through conferences, events and publications
- Works with governments, international organisations, NGOs, creative organisations and faith groups for a holistic approach to environmental issues
- Develops partnerships with like minded organisations across the world
- Supplies independent advice to governments, academics, the media and the general public
- Brings members from all over the world together under common policy issues
- Directly inputs into European and UN policy developments
- Promotes excellence in environmental management through an awards portfolio
- The first chartered professional body to have its Environmental Management System (EMS) accredited to ISO14001 standard, demonstrating our commitment to continuous improvement