Greater Manchester Green Roof Programme: Feasibility Study

Part 1 Report: Scoping & Work Programme Development

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MANCHESTER CITY COUNCIL EDAW | AECOM new economy Northwest DRIVERS JONAS

Greater Manchester Green Roof Programme: Feasibility Study

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1. Introduction

1.1 Drivers Jonas LLP, together with AECOM (formerly EDAW), were appointed by the Commission for the New Economy to establish the feasibility of a conurbation-wide Green Roof Programme for Greater Manchester.

Figure 1.1 – The Greater Manchester City Region

1.2 The brief for the Feasibility Study includes the following two-fold purpose:

- to scope and propose a work programme for a Greater Manchester green roof project that, upon implementation, will result in the increased installation of green roofs across Greater Manchester. This is to include green roof feasibility studies for five existing buildings within the City of Manchester to act as demonstrator projects; and
- to produce a Greater Manchester green roof guidance document .

1.3 The Study therefore comprise three distinct elements:

- Part 1 – to analyse a range of pertinent contextual factors from which the potential scope of a conurbation-wide green roof work programme can be established. These factors include specific local policies and objectives and the governance structures and organisational capacity and expertise in place to deliver them.
- Part 2 – to undertake green roof feasibility studies on five individual buildings within "The Corridor" (a spatially-defined area of economic development activity centred on the Oxford Road corridor in the City of Manchester).
- Part 3 – to produce Green Roof Guidance for Greater Manchester that can be used by building designers, contractors, owners and managers, and planners, and which may be adopted by individual local authorities within the conurbation as a Supplementary Planning Document.

1.4 This report concludes Part 1 of the Study. It draws together our analysis of a number of contextual factors and has been informed by a combination of desk-based research, a stakeholder workshop (refer to Appendix One for a list of stakeholders) and input from a project Steering Group. In particular, the report considers:

- the parameters, and in particular the limitations, of the current policy framework, from the national through to the local level;

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- relevant studies undertaken previously from which pertinent intelligence on key delivery impediments and opportunities can be drawn;
- lessons learnt from a wide range of comparator cities, where focused intervention to stimulate the delivery of green roofs has been put into effect;
- existing green roof activity across the conurbation, particularly in respect of research arrangements and physical delivery;
- a number of green roof case studies, from within and beyond Greater Manchester; and finally
- the capacity that exists within the conurbation, including potential funding sources, to effect greater delivery of green roofs on new and existing buildings.

1.5 From this preliminary background analysis, a number of particular issues have been identified which, to a greater or lesser extent, are acting as barriers to the delivery of green roofs in Greater Manchester. In addition, there are a number of important opportunities that can be harnessed to deliver a step-change in delivery.

1.6 The Feasibility Study responds to these barriers and opportunities by:

- Proposing a series of objectives for a GM Green Roof Programme;
- Identifying the parameters (scope) of such a Programme; and
- Establishing the most appropriate governance arrangements in respect of policy and delivery.

Overview of Green Roofs

1.7 A green or living roof can be defined as a system where a vegetation is incorporated into a roof, usually comprising the vegetation itself supported by a growing medium, filter sheet, drainage/reservoir layer, root barrier and waterproof membrane.

1.8 There is a spectrum of different types of green roof, broadly ranging from *intensive* to *extensive* – a reference to the degree of maintenance they require. Intensive roofs (roof gardens) consist of lush vegetation on a comparatively deep and relatively nutrient rich substrate which can accommodate shrubs and even trees. They can require significant increases in load bearing capacity and ongoing management, including irrigation and application of fertiliser. Extensive roofs often have a shallow to medium depth substrate and are designed to be relatively self-sustaining. They require minimal maintenance and often only initial irrigation for establishment purposes. In addition, there are numerous permutations for intermediate treatments typically referred to as semi-intensive or simple-intensive green roofs.

1.9 Interest is growing in the potential for green roofs to improve the urban environment through their multiple benefits. These include:

- enhanced building energy efficiency resulting from their insulation properties, and evapo-transpiration which reduces cooling loads;
- the potential to ameliorate surface water run-off and improve water quality, thereby comprising an important component of sustainable drainage systems (SuDs);
- amelioration of the urban heat island effect due to micro-climatic cooling;
- improvement in air quality;

Extensive green roof, Canary Wharf, London.

Terraced green roof on a commercial office building in Fukuoka, Japan.

Extensive green roof using shallow, crushed brick substrate on a factory in Switzerland.

- enhanced public amenity, including active and passive recreation and horticultural therapy, where the green roof is accessible to people;
- urban space for food production; and
- enhanced biodiversity.

2. Policy Context

2.1 Despite their obvious benefits, policy specifically encouraging green roofs is very limited in the UK. The lack of policy emphasis is perhaps unsurprising given the relatively weak and fragmented policy context for green infrastructure more generally. As the Landscape Institute points out, "(t)here is currently no national policy for green infrastructure[1]".

2.2 However, it should be noted that Government has very recently announced proposals to develop a new Planning Policy Statement (PPS) on green infrastructure, although this may ultimately seek to bring together existing planning policies on rural planning, biodiversity and geology and public open space. Whilst the announcement by Government has been welcomed strongly by the RTPI and other professional bodies, the need to focus on practicalities, resolve complexities and deliver social and environmental benefits has been emphasised.

2.3 It is important to bear in mind that, whilst delivering multiple benefits, green roofs play a particularly integral role as a component of Sustainable Drainage Systems (SuDs). SuDs are part of an emerging doctrine of surface water management which seeks to provide an alternative to the traditional pipe-drainage methods for surface water in urban areas. This review of policy therefore considers the wider context of SuDs, as well as green roofs specifically.

National

2.4 Its multifunctional nature means that there is an extensive policy context for the various components of green infrastructure[2]. Some policy documents acknowledge green infrastructure directly or, at the very least, the important role that the natural environment has to play in the way in which development and land use planning is approached. In particular[3]:

- **PPS1: Delivering Sustainable Development (2005)** recognises the value of the natural environment to economic and social wellbeing
- **Supplement to PPS1: Planning and Climate Change (2007)** underlines the value of green infrastructure to 'urban cooling, sustainable drainage systems and conserving and enhancing biodiversity'
- **PPS7: Sustainable Development in Rural Areas (2004)** emphasises the role of the planning system in rural areas to ensure the protection and enhancement of the natural environment
- **PPS9: Biodiversity and Geological Conservation (2005)** sets out how the planning system should contribute to biodiversity and geological conservation
- **PPS12: Local Spatial Planning (2008)** states that a local planning authority's 'core strategy should be supported by evidence of what physical, social and green infrastructure is needed to enable the amount of development for a proposed area, taking account of its type and distribution. This evidence should cover who will provide the infrastructure and when it will be provided. The core strategy should draw on and in parallel influence any strategies and investment plans of the local authority and other organisations.'
- **PPS25: Development and Flood Risk (2006)** invites responsible parties to make 'the most of the benefits of green infrastructure for flood storage, conveyance and sustainable drainage systems (SuDs)
- **PPG17: Planning for open space, sport and recreation (2002)** requires local authorities to carry out open space audits, assessments and develop open space standards

[1] Landscape Institute (2009) "Greening the future: Green infrastructure and the value of connected, multifunctional landscapes" Landscape Institute, London.

[2] "Green infrastructure is the region's life support system – the network of green and blue spaces that lies within and between the North West's cities, towns and villages which provides multiple social, economic and environmental benefits." Definition provided in the North West of England Plan (GONW, 2008).

[3] Landscape Institute (2009).

2.5 From a SuDs perspective, Planning Policy Statement 1: Delivering Sustainable Development (PPS1) states that "local authorities should promote....the use of sustainable drainage systems in the management of run off...(and) water resources" (ODPM, 2005). The Planning and Climate Change Supplement to PPS 1 explicitly promotes the use of SuDs as a means of building resistance in the face of climate change (DCLG, 2007). This is also reflected in Planning Policy Statement 25: Development and Flood Risk (PPS25) and its accompanying 'Practice Guide' (DCLG, 2008b).

2.6 Building Regulations H3: Rainwater Drainage (ODPM, 2002) encourages and provides guidance on the incorporation of SuDs in drainage systems using a hierarchical approach, similar to the 'Surface Water Management Train' (CIRIA, 2004b). However, the 2008 Pitt Review recommended a revision of the Building Regulations to ensure that all new or refurbished buildings in high flood-risk areas are "flood-resistant or resilient", something to which green roofs could significantly contribute.

2.7 Planning policy departments are now required by mandatory Core Indicators from Government to report on achievements against the Building for Life standard in their Annual Monitoring Reports. Inclusion of a green roof in the design could contribute to this requirement through meeting the Building for Life Criteria No. 5 – Reduction of Environmental Impact.

2.8 Furthermore, Policy DP9 of the Regional Spatial Strategy (RSS) requires that the minimum standards of the North West Development Agency's (NWDA) Sustainability Checklist are achieved. This involves more detailed disclosure of compliance to a number of sustainability measures. The inclusion of green roofs in development proposals is not a requirement of minimum compliance, but is noted as a measure of good and best practice.

2.9 There are a number of established and benchmarking schemes for assessing the sustainability of buildings including BREEAM and Code for Sustainable Homes (CSH) standards. These include categories assessing water use, energy efficiency, biodiversity, and health and wellbeing, all of which can be enhanced by the use of green roofs.

2.10 A number of local authorities are now requiring or recommending that new buildings achieve certain BREEAM or CSH ratings. Such aspirations could be seen as encouraging the implementation of green roofs as their multiple benefits can be a cost effective way of achieving higher ratings.

2.11 Ultimately however, within this broad national policy context, specific emphasis on the role of green roofs is absent. The majority of policies which might be deemed to support the development of green roofs are largely implicit, by reference to the functions and benefits which green infrastructure generally can provide.

2.12 In addition, it should be noted that this policy context principally targets new buildings rather than existing stock, a common feature of planning and urban policy more generally.

Regional

2.13 The North West Regional Spatial Strategy (NW RSS) (2008) forms the regional planning framework. Whilst SuDs are referred to in policies DP9: Reduce Emissions and Adapt to Climate Change, EM5: Integrated Water Management and L3: Existing Housing Stock and Housing Renewal, there is only one reference to green roofs in Policy DP9: Reduce Emissions and Adapt to Climate Change. Green roofs are mentioned explicitly as a recommended measure to reduce emissions. However, policies DP7:

Promote Environmental Quality, EM3: Green Infrastructure, and MCR1 Manchester City Region Priorities all highlight the importance of promoting policies relating to the creation of green infrastructure and the greening of towns and cities, in which green roofs have a significant role. However, it is indicative of the current weak policy position that the North West Green Infrastructure Guide published to support policy EM3 makes no mention of the potential contribution of green roofs.

2.14 The NW RSS sets out sub-regional frameworks as important emerging features, alongside the 'traditional' levels of national, regional and local policy, which could have the potential to be utilised further in the future as a prominent link in the national-regional-(sub-regional)-local policy chain.

2.15 The North West Best Practice Design Guide (NWRP, 2007) emphasises the importance of sustainable design. Planning conditions and early design incorporation are mooted as ways of securing the use of SuDs, demonstrating consideration of SuDs barriers and how they can be overcome. However, it does nothing to translate national SuDs policy to the specific regional context, rendering it of little use to policymakers at the sub-regional and local levels. Consequently, although a positive feature is the new emphasis on the retrofitting of SuDs rather than purely focussing on their incorporation within new developments, the translation of national to regional policy is weak, and there remains no specific prompt for the installation of green roofs.

2.16 Overall, detailed green roof guidance is lacking in the RSS and the suite of relevant supporting documents.

Local

2.17 Within Greater Manchester, a number of local authorities have adopted *Supplementary Planning Documents* which refer to green roofs[4]. However, these references are often fleeting, with little detail of what standards are expected in relation to particular scales or types of development, whilst sign-posts to further guidance are also limited. As such, it is highly unlikely that these policies will stimulate significantly greater uptake of green roofs within the conurbation.

2.18 The strength of local authority policies relating to SuDs also varies widely. Their efficacy relates to a number of factors including the strength of policy wording, the positioning of SuDs within policy text or supporting text and the consideration of SuDs with reference to what are seen as the biggest barriers to their implementation.

2.19 The *Greater Manchester Biodiversity Action Plan* currently contains 19 action plans covering a range of habitats and species occurring in Greater Manchester which require action to conserve them for the future. There is a specific action plan policy encouraging an increase in the amount of urban managed green space, though there is no direct mention of green roofs. It is recognised that although few priority habitats are suitable for re-creation on green roofs, the creation of habitats which are functionally equivalent to 'post industrial land with high ecological value' is definitely feasible. This is often characterised as 'unmanaged flower rich grasslands with sparsely vegetated areas developed on edaphically poor substrates', and would support important populations of invertebrates including bees, wasps and spiders. A number of priority species may also benefit from green roof provision. These include bat, bird and invertebrate species.

[4] The SPD's include: Bolton Sustainable Design and Construction; Bury Design and Layout of New Development; Guide to Development in Manchester; Oldham and Rochdale Urban Design Guide; Rochdale Biodiversity and Development; Salford Sustainable Design and Construction; and, Stockport Sustainable Design and Construction.

Environmental Regulation

2.20 In addition to the national, regional and local policy context, it is helpful and important to consider the potential impact of an emerging suite of regulations targeting the environmental performance of buildings.

2.21 There are currently a number of outcome focussed regulatory drivers that could influence the implementation of green roofs nationally. In particular, they are targeted on either energy usage or surface water run-off mitigation.

EU Energy Performance of Buildings Directive (EPBD)

2.22 The EPBD stimulated the introduction of Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs) through national Building Regulations.

2.23 EPCs are now required whenever a building is sold, built or let. The certificate provides an energy efficiency A-G rating for the building, based on its anticipated performance taking account of the building fabric, use and services. The ratings are similar to those found on white goods, where clear display of energy usage has moved demand towards much more efficient products.

Example of an EPC asset rating.

2.24 EPCs are designed to create a similar market shift in the built environment by allowing the energy efficiency of one building to be easily compared with another building of a similar type at the point at which a transaction is considered by a prospective purchaser or tenant.

2.25 There is currently substantial debate about the extent to which EPCs are stimulating a market shift. The fact of the matter is that it remains 'early days' for the implementation of the legislation whilst the property market, both residential and commercial, is experiencing its sharpest downturn in history. That said, a competent building energy assessor will take into account the presence of a green roof in determining the asset rating for the building, although this is likely to be a relatively superficial consideration of the properties of the green roof in most cases.

2.26 DECs use a similar rating system to EPCs, but they are based on actual energy consumption. They are required for public buildings where they must be displayed at all times in a prominent place clearly visible to the public. The installation of a green roof may have a significant and measurable impact on reducing the cooling load, and therefore improve the operational asset rating.

Building Regulations: Conservation of Fuel & Power

2.27 There is a statutory requirement to comply with the Building Regulations' minimum standards on conservation of fuel and power (Part L) and drainage (Part H), and these standards are becoming increasingly stringent. The combined insulating and run-off mitigation properties of green roofs and living walls can make a significant contribution to the attainment of the minimum standards. Importantly, this could be achieved at a lower cost than installing separate solutions for insulation and drainage.

Regulatory Escalator Towards Zero Carbon

2.28 The Government is committed to ensuring that all new housing is zero carbon by 2016, closely followed by all public buildings in 2018, and all other buildings by 2019. Whilst the definition of zero-carbon remains a matter of public consultation, it is inevitable that this will drive much higher standards in the energy efficiency of new buildings. This regulatory escalator will be enforced through increasingly stringent Part L standards under Building Regulations, which for residential properties will increase by 25% in 2010, 44% in 2013, and with zero-carbon coming into effect in 2016. In addition, the Government is also currently consulting on the Heat and Energy Saving Strategy, which aims to ensure that all existing UK homes are near zero carbon by 2050.

The Lighthouse at BRE: the first zero-carbon residential unit in the UK, for which the original designs included a green roof.

Carbon Reduction Commitment (CRC)

2.29 The CRC was adopted as Government policy in the Energy White Paper 2007 and applies a mandatory 'cap and trade' emissions trading scheme to cut carbon emissions from large commercial organisations (for example, from offices, hotels, large shopping centres, supermarkets) and public sector organisations (local authorities and central government departments) whose electricity use is above 6,000 MWh per annum (roughly equating to £1,000,000 p.a.). By putting a price on carbon, the CRC aims to provide an incentive for organisations to reduce their consumption and requisite emissions. This will be further supported by the publication of a performance league table that ranks participants each year – a reputational driver designed to ensure organisations strive to reduce their emissions in order to attain a high ranking on the table.

2.30 Where mechanical cooling is used in a building, the insulating properties of green roofs could play a significant role in reducing electricity demand, thereby enhancing participants rank on the league table and reducing their exposure to escalating carbon prices.

Water & Floods Bill

2.31 The recent publication of the draft Water and Floods Bill responds to commitments in Government's 'Future Water' strategy for England. It aims to create a simpler, more effective regime for flood and coastal risk management by reflecting the 92 recommendations of the 2008 Pitt Review.

2.32 From a property perspective the greatest potential impact of the bill comes from Pitt's Recommendation No.10: the removal of the automatic right to connect the surface water drainage of new developments to the sewerage system. This is intended to encourage developers to use SuDs to reduce excessive run-off into an already over-stretched sewer system. Where this is not possible the developer will have to gain permission to connect to the sewers as part of the planning process. As green roofs and living walls could form a significant component of SuDs, the uptake of such measures could increase significantly when the bill is enacted and planning requirements attempt to mitigate surface water run-off.

National Indicators

2.33 It may also be helpful to consider that in 2007 the Government published a set of 198 national indicators that underpin the performance framework for local authorities as part of the Local Area Agreement mechanism. All local

authorities are required to report against all 198 Indicators, though the priority given to particular indicators varies between them. Several of these Local Authority targets could potentially be achieved with the proliferation of green roofs and living walls:

- NI 5 Overall/general satisfaction with local area
- NI 185 CO_2 reductions from LA Operations
- NI 186 Per capita CO_2 emissions in the LA area
- NI 188 Adapting to climate change
- NI 194 Level of air quality
- NI 197 Improved local biodiversity – active management of local sites

2.34 In particular, a green roof programme for GM could play a significant role in contributing towards NI 188. However, this Indicator is a relatively new addition to the list, with first reporting occurring at the end of May 2009. Consequently, NI 188 is currently less prevalent as a priority indicator, and we are only aware of 3 local authorities within GM where it is emphasised. As it becomes a more common focus for local authorities within GM, there may be considerable impetus to progress a strategic approach to green roof delivery in relevant areas.

Conclusion

2.35 At all levels of policy, from national through to local, references to green roofs are relatively scarce and often vague. There is also a lack of understanding over the role and function of SuDs and green roofs, particularly in respect of cost-benefit and issues of practical implementation, resulting in an incoherent framework. This ambiguity has important repercussions in that there is a lack of certainty for all those involved in the implementation of green roofs, and a distinct lack of policy 'bite'.

2.36 This broad divide between the 'strongest' and 'weakest' local SuDs and green roof policies is further testament to this inconsistent translation of national policy to the local level. It is acknowledged that these policies have been produced over a lengthy time span, and that contemporary emphasis has shifted in favour of green infrastructure, SuDs and green roofs. However, the fact remains that these documents still represent the current policy framework, regardless of how outmoded they are. Even new policies coming forward could be more definitive in relation to green roof delivery.

2.37 Attention at the Greater Manchester level on enabling local authorities to enhance the policy framework for green roofs would therefore seem appropriate, given the important but poorly understood role that green roofs have for a number of major policy goals, including Local Area Agreement commitments.

2.38 The growing traction of building-focused environmental regulation will undoubtedly stimulate demand for higher standards of energy efficiency and water attenuation. Green roofs have an important and cost-effective role to play in this respect, but uptake in response to these regulatory pressures will be dependent on greater awareness of their functional properties and benefits.

3. Review of Relevant Studies

3.1 This chapter considers key UK and locally-focused publications on the subject of green roofs by way of establishing context for this Feasibility Study. It also considers activity underway in the UK to develop standards for green roof installation, which will be pertinent to the production of Green Roof Guidance in later stages of this commission. Firstly however, it highlights the important intelligence provided by recent work to establish a Green Infrastructure Framework for Greater Manchester.

Towards a Green Infrastructure Framework for GM

3.2 TEP - The Environment Partnership, on behalf of Association of Greater Manchester Authorities (AGMA) and Natural England, has prepared a feasibility study to inform the development of a Green Infrastructure (GI) Framework for the city-region. This is a highly significant point of reference for a GM Green Roof Programme in so far as it establishes a suite of spatially-defined GI intervention priorities which should underpin the delivery focus for green roofs (refer to Work Programme objectives in Chapter 9).

3.3 The usefulness of the two mapping extracts overleaf, showing proposed GI priorities in support of growth and GI investment in response to climate change impacts respectively, is abundantly clear.

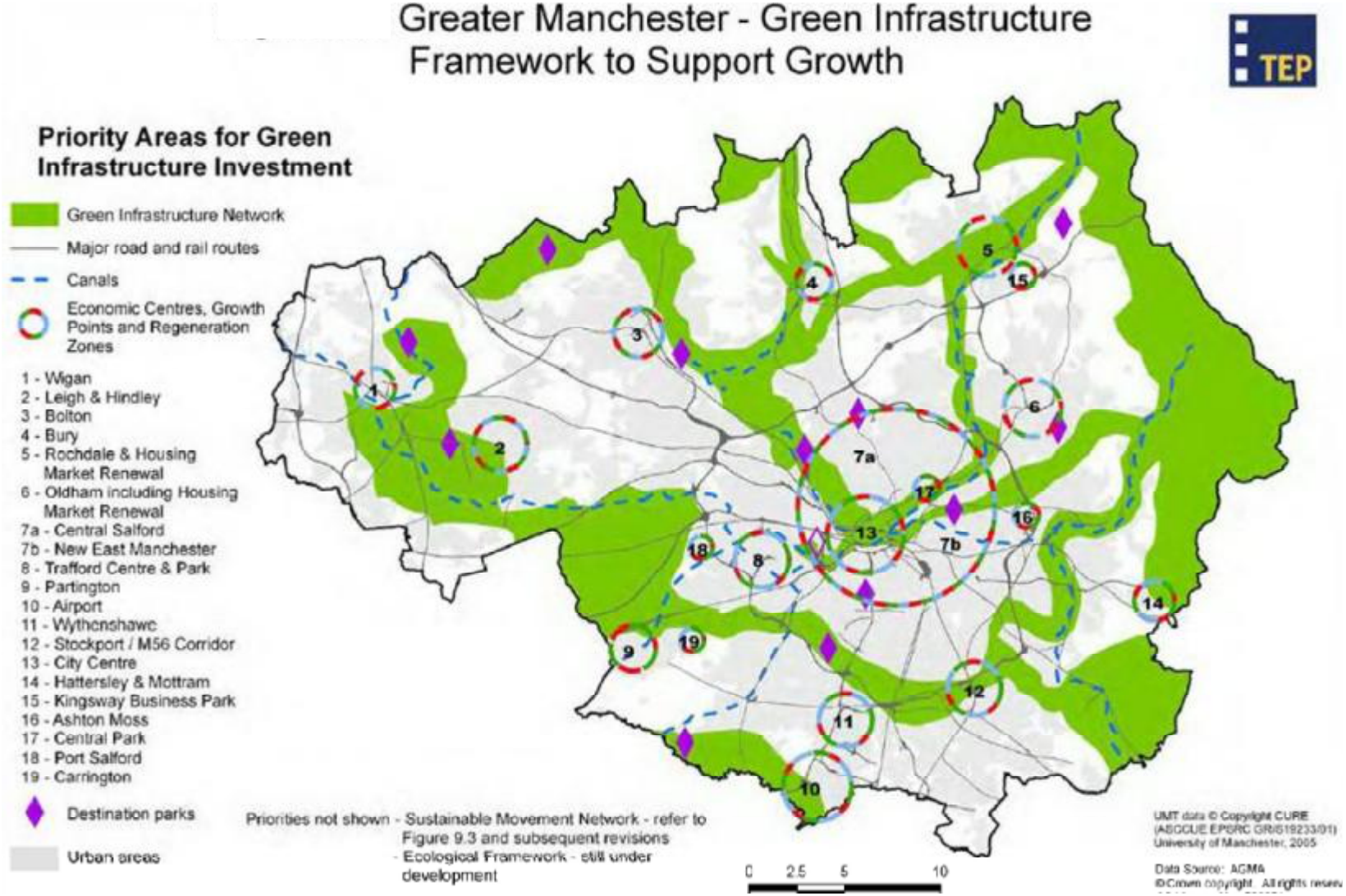


Figure 3.1 – Green Infrastructure Framework to support Growth (TEP, 2008)

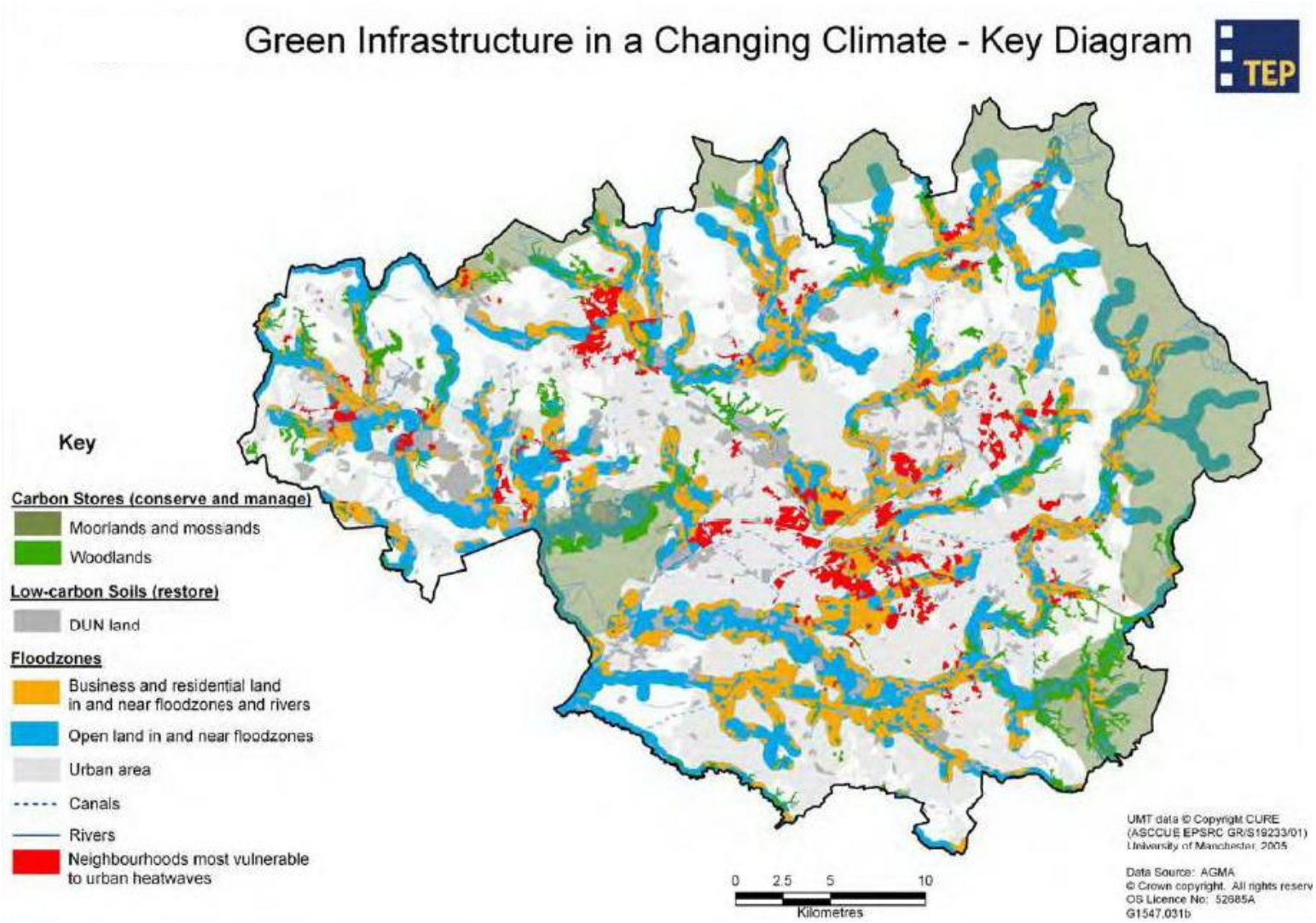


Figure 3.2 – Green Infrastructure in a Changing Climate (TEP, 2008)

Green Roof Research and Guidance

A Review of Roof Greening in Greater Manchester

3.4 Natural Economy Northwest commissioned this study in 2007 as part of a research programme aiming to optimise the natural environment's contribution to the regional economy and quality of life. It identifies a number of constraints to green roof development in Manchester, including:

- High capital costs;
- Maintenance costs;
- Performance uncertainties;
- Appearance uncertainties; and,
- Lack of appropriate skills and expertise.

3.5 In order to overcome these constraints, the report makes the following recommendations:

- Introduction of accredited national standards for green roof construction; and
- Introduction of new policy drivers and financial incentives to facilitate roof greening in the short to medium term, particularly in urban regeneration areas.

3.6 However, it is *not* recommended that green roofs become a specific policy requirement in sub-regional and district plans, rather that they are encouraged as a way of implementing other existing sustainable development policies. The reasons stated for this is the current lack of an accepted definition of what constitutes a green roof, or adopted building standards for green roofs, which make a specific policy requirement difficult to implement.

Delivering Green Roofs for Schools

3.7 In association with Greenroofs.org, CIRIA (the Construction Industry Research Information Association) has recently launched a project to produce guidance for roof greening in schools. This is due to be published in 2009 and will provide an important input to a wider drive for roof greening in GM.

Living Roofs & Walls Technical Report: Supporting London Plan Policy

3.8 Published in February 2008, this study found that in major cities where implementation of living roofs and walls is taking place, policy drivers and/or financial incentives are the main contributor to their success. It cites a lack of positive policy support, concerns over development costs and lack of technical standards as reasons for poor take up in the UK.

3.9 The review of other cities found that many of these obstacles to living roofs are overcome when new policy drives a market demand for green roof products and suppliers. The Mayor's Chief Advisor on Architecture and Urbanism, Richard Rogers, also believes that a policy requirement for living roofs to be part of all new major development would stimulate a step change in delivery.

Planting Green Roofs and Living Walls. Timber Press (2004) by Nigel Dunnett

3.10 Nigel Dunnett is a senior lecturer in the Department of Landscape at the University of Sheffield. His book is a reference that discusses the practical techniques involved in the greening of roofs and walls. It describes how roofs may be modified to bear the weight of vegetation, considers the different options for drainage layers and growing media, and lists the plants

suitable for different climates and environments.

Space for Urban Wildlife: Designing Green Roofs as Habitats in Switzerland. Urban Habitats, Vol 4 (1) (2003) by S. Brenneisen

3.11 Stephan Brenneisen carried out a detailed study in Basle, Switzerland in 2003. He monitored the insect and bird life of seventeen green roofs. Key findings included the fact that there was little difference in the number of spiders and beetles found on the roof and on the ground; that birds visited the roofs primarily for food; and that roofs in urban areas were visited more frequently by birds than those in urban fringe areas, implying the relative importance of green roofs in urban areas as a food source for birds.

Green Roofs: their existing status and potential for conserving biodiversity in urban areas. English Nature Research Report No 498, (2003) by Gary Grant

3.12 This report was considered to be an update of *Roof gardens – a review,* which was published by the Nature Conservancy Council in 1990. It was commissioned at a time when there was a renewed groundswell of interest in green roofs. The introduction considers the huge untapped potential of roofs and the advances being made in roof greening in Germany, where 13.5 million square metres of green roof were installed in 2001.

3.13 A brief history provides examples of roof gardens from ancient times, through the Italian Renaissance, on to the garden city movement of the late 19th century and the modernist movement of the 20th century. Classic roof gardens of the 1930s are described and the postwar growth in the green roof industry in Europe.

3.14 The three categories of green roof are explained:

- intensive (equivalent to parks or gardens);
- simple intensive (with well maintained lawns or ground cover);
- and extensive (low maintenance and normally low growing turf, moss or sedum mats).

3.15 The various benefits of green roofs are discussed, including:

- attenuation of storm water run-off;
- absorption of air pollutants and dust;
- reduction in the 'urban heat island' effect;
- provision of wildlife habitat;
- attractive open space;
- health benefits;
- protecting the building fabric from sunlight and temperature fluctuations; and
- reducing costs, including drainage, heating, air conditioning.

3.16 The policy background for roof greening in the UK is examined. Although policies on urban renewal, the construction industry, open space, green networks, biodiversity conservation, sustainable urban drainage and urban design are all relevant, in the UK policy makers have largely ignored green roofs.

3.17 In the chapter on ecology and biodiversity it is suggested that almost any habitat that can be re-created could in theory be created on a roof. However, in practice technical and financial constraints mean that

grasslands, sedum mats, mosses and arrested pioneer communities will tend to predominate. In the UK, there is currently interest in using green roofs as mitigation for habitats lost during urban regeneration, especially on brownfield sites.

3.18 There is little information relating to the fauna of green roofs, however studies of roofs in Basel, Switzerland, have shown that they support many invertebrates including Red Data Book species.

3.19 A review of UK Biodiversity Action Plans identifies several species which might benefit from green roofs, including bats, several birds, beetles, flies, bees, wasps and spiders.

3.20 Various issues to be considered by those planning green roofs include urban design, building structure, waterproofing of the building protection of the waterproofing layer, insulation, growing medium, drainage, irrigation, fire prevention, access and maintenance and cost. These issues are considered in turn in the chapter on construction and design.

3.21 The report concludes by reiterating that green roofs can provide many general environmental and associated aesthetic and health benefits. Although individual green roofs offer local environmental benefits, any significant contribution to wider environmental quality is only likely to become apparent once a more substantial area of town and city roof space has been greened. Such a programme will require political commitment and concerted action underpinned by science, technical expertise and good design.

3.22 In order to refine the design of green roofs for biodiversity conservation, some further research and experimentation is required. Suggestions include studies of patterns of colonisation and succession on green roofs of different types over a number of years and experimentation with different designs.

Green Roofs and Facades. BREPress, London (2006) by Gary Grant

3.23 This book repeats much of the information in the English Nature Research Report (No 498) by the same author. It is presented as an introduction to the subject. It begins by defining the various terms including roof garden, intensive green roof and extensive green roof and introduces the term building-integrated vegetation, which is an all encompassing term that includes green roofs and green (or living) walls.

3.24 A brief introduction espouses the ecosystem services approach to urban greening and this is followed by a brief history. Green roofs are as old as buildings themselves, but the modern green roof movement in Germany was accidently born in the 1880s when the bitumen roofs on tenement blocks were covered by sand as a fire precaution measure.

3.25 The book goes on to consider the policy background to roof greening before describing the benefits, which include rainfall attenuation, cooling, wildlife habitat and amenity. A chapter on technical issues associated with the design, construction and maintenance of green roofs is followed by a final chapter which speculates on the future including how climate change may lead to greater acceptance of building-integrated vegetation, for summer cooling and a more pleasant outlook.

Emerging Standards

Code of Practice

3.26 Work is presently underway to develop a **Code of Practice for Green Roof Installation** for the UK. It is likely to be published later in 2009 and is being coordinated by the Green Roof Centre in Sheffield and involves an extensive panel of stakeholders organised under the following thematic groups:

- **Technical (Green Roof Organisation – GRO)** – principally a forum for the major actors in the green roof industry, including the National Federation of Roofing Contractors, which is examining the applicability of the German FLL Guidelines to the UK.
- **Vegetation** – a working group looking to establish the flora suitable for green roofs in the UK climate; and
- **Statutory Bodies** – a group of bodies representing the planning, Health & Safety, Building Control sectors, together with sustainable building consultants from the BRE, to consider the policy and legislative implications of the prospective Code.

3.27 It is considered likely that the Code will effectively provide a UK translation of the recognised FLL standard in Germany, but it is important to note that it will strictly be concerned with installation guidelines (e.g. regarding substrate depth) rather than tackling development/planning policy. There will therefore be a clear distinction between the Code and the Green Roof Guidance prepared for Greater Manchester, albeit that the Guidance is likely to make reference to the Code where relevant and appropriate.

British Standard

3.28 Separately, albeit with the involvement of the GRO which is also contributing to the Code of Practice, the British Standards Institute intends to develop a British Standard for green roof installations. The inception of the project is largely a function of a wider and politically problematic European Commission project and is unlikely to generate any formal output for some time. Funding is still being sought to take this matter forward.

Quantifying Economic Benefits

3.29 It is not currently possible to monetise some of the benefits of green roofs and living walls, such as improved air quality, enhanced public amenity, urban food production, and enhanced biodiversity. However, there is some data on the potential direct economic benefits derived from energy savings, extended roof life, saving on drainage costs, and employment. These will be dealt with in turn below.

3.30 It is also worth considering that there are further potential *indirect* economic benefits. These include:

- Reduced fire insurance premiums (as experienced in Germany)
- Improved health, with concomitant decreases in healthcare costs and raised productivity
- Property value uplift (see CABE Space (2005): Does Money Grow on Trees?)
- Reduced likelihood of flooding

Energy Savings[5]

London City Wide

3.31 In 2008 the GLA considered the potential for green roofs in four areas of central London with a total surface area of 10 million m^2. They calculated that 3.2 million m^2 of this has the potential to be greened, resulting in potential energy savings of 19,200 mWh per year (equivalent to 8,256 tonnes CO_2e). This equates to a saving of 6 kWh/m^2/year.

Reducing Winter Heat Loss

3.32 Although green roofs do provide energy savings by improving building insulation these are complex to measure accurately. This is due to the fact that wet roofs provide less insulation, and climatic conditions vary considerably throughout the winter months. Studies from Germany (ZinCo) estimate that 2 litres of fuel oil are saved per m^2 of green roof per year. A more recent study of domestic buildings with flat roofs suggests that there is a 3-10% winter saving on fuel bills. The results of the study suggest that there is a maximum saving of 6.8kWh/m^2 (equating to 1.5kg CO_2e/m^2) and a minimum saving of 2.0kWh/m^2 (0.44kg CO_2e/m^2). It is notable that this study omitted to calculate any savings made during the summer due to reduced cooling loads – see below.

Reducing Summer Air Conditioning Requirement

3.33 An Ottawa study[6] compared a conventional roof system with a green roof system. The average daily energy demand for space conditioning under the reference roof system was between 6 and 8kWh. In contrast, the green roof system reduced the average daily energy demand to less than 2 kWh - a reduction of between 66% and 75%.

3.34 A study by the City of Toronto[7] estimated that citywide greening would result in reduced energy demand for cooling equivalent to $22 million per year. This is equivalent to 4.15 kWh/m^2/year or 1.7kg CO_2e/m^2. The study also concluded that there would be a reduction in peak demand in the order of 114.6MW leading to fossil fuel reductions in the region of 56,300 metric tonnes per year.

3.35 A similar study undertaken by the City of Chicago estimated even greater energy savings to the value of $100 million could be made through reducing demand for air conditioning by wide scale roof greening. This would equate to a reduction in peak demand in the order of 720MW.

3.36 Environment Canada have also shown that energy savings from green roofs can be modelled[8]. The model typically suggests energy demand reductions of 25% for the floor beneath the green roof through reduction in cooling needs. (Dr. Brad Bass Environment Canada)

3.37 In Canary Wharf in London, electricity bills suggest that an 850m^2 retrofitted green roof has achieved a reduction of 25,920kWh (equivalent to 11.46 tonnes CO_2e] a year[9]. This has been achieved through a reduction in heating demand and the cooling requirements of the plant room below the roof (equivalent to 30 kWh/m^2) The green roof was estimated to be saving up to £4,000-£5,000 per year in electricity. It should be noted however that this is an atypical situation – the floor located directly underneath the green roof was entirely given over to plant and machinery, and therefore has different heat and cooling demands to a typical floor given over to office use. Energy savings are unlikely to be this high in the majority of cases.

[5] GLA (2008) Living Roofs and Walls Technical Report: Supporting London Plan Policy

[6] Liu,K (2002) Energy Efficiency of and Environmental Benefits of a roof top garden. National Research Council Canada www.professionalroofing.net

[7] Banting, D., Doshi, H. *et al.* (2005) Report on the Environmental Benefits and Costs of Green Roof Technology for the City of Toronto

[8] Martens, R. and B. Bass. (2008). Roof-Envelope Ratio Impact on Green Roof Energy Performance. Urban Ecosystems 11(4):399-408.

[9] pers.comm. Tony Partington Canary Wharf Co.

3.38 In conclusion, the general consensus is that energy savings from green roofs are reported to be in the order of 6kWh/m^2/year. At current average electricity prices of around 13 pence per kWh this equates to a saving of 78 pence/m^2/year. However, electricity prices are predicted to increase as the economy moves out of recession, which will increase the savings achievable with green roofs.

Improving the Efficiency of Photo Voltaic Cells (PVs)

3.39 The rated power of PV panels is fixed under Standard Test Conditions at a temperature of 25°C. A temperature increase of 1°C leads to a 0.5% decrease of the electricity output. On hot summer days temperatures on gravel roofs often exceed 50°C while uncovered roofs can exceed 70°C.

3.40 Using the efficiency figures above, these temperature increases can be extrapolated to reductions in PV efficiency of 12.5% and 22.5% respectively.

3.41 The evaporative cooling from green roofs has been shown to reduce the temperature of associated PVs, thereby improving efficiency and the production of electrical power.

3.42 In contrast with the unvegetated roofs above, the temperatures on green roofs are normally below 35°C. This can be extrapolated to equate to just a 5% decrease in PV output.

3.43 This phenomenon should be factored in to any cost benefit analysis of green roofs which are combined with PVs.

Extended Roof Life

3.44 A green roof system protects the waterproofing membrane from climatic extremes, UV light & mechanical damage, and in so doing almost doubles its life expectancy. Therefore a good quality root resisting waterproofing system with a normal 30 year life expectancy when exposed to the elements can be expected to last up to 60 years. This saves the client the cost of re-waterproofing during the average buildings expected life time. One example of this phenomenon is the Zurich waterworks roof. This was built in 1914 with a green roof, and has not required any repair after 95 years.

Saving on Drainage Costs

3.45 Reduction in run-off from a building could theoretically result in a reduction in the sizing/capacity of drainage pipes, thereby saving money. In Germany, zero discharge schemes (de-coupling) are made possible by using green roofs. This can save building owners sewerage costs as well as possible reductions in surface drainage charges where applicable.

3.46 This benefit would currently be difficult to realise in the UK without reform of the existing charging system for sewerage. However, we understand that that United Utilities is currently in the early stages of revising their Surface Water and Highway Drainage charges to reflect the reduced run-off afforded by permeable surfaces, including green roofs. This could be achieved by calculating the drained area of the property, and then applying a discount for the area of the green roof.

Employment

3.47 In the UK there are now a number of small companies specialising in the design, supply and installation of green roofs and these are set to grow in

number and size. One such example is Blackdown Horticultural Consultants[10], who specialise in supplying vegetation for green roofs.

[10] www.greenroof.co.uk

3.48 The number of people working full time in jobs related to roof greening in the UK is currently very low, probably less than 100. However this will increase rapidly as the market matures. A particular niche yet to be exploited by UK companies is for the hardware required for green roofs (e.g. drainage boards and root barrier membranes), much of which is currently imported from Germany.

3.49 Current estimates are that the UK green roof industry is worth between £12m-£15m per annum, and an industry survey is planned.

3.50 As an indication of the potential growth in this market, it is estimated that 269,000m^2 of green roofs were installed in the entire UK between 2004-2009, while the planning system currently holds applications for around 350,000m^2 of green roofs in London alone.

Conclusions

3.51 Contextual analysis reveals a comprehensive research base that emphasises the key role that green roofs can play in helping Greater Manchester to adapt to the temperature and water management problems inherent in climate change. Simultaneously, they can also help reduce energy demand for cooling, improve biodiversity, and positively impact on human health, comfort and amenity. On a financial level, green roofs have been shown to extend roof life by a factor of two. As the functionality of green roofs becomes better understood in the UK further benefits such as reduced fire insurance premiums, drainage cost reductions, and protected property values may be enjoyed.

3.52 The literature also identifies a number of significant barriers to uptake of green roofs in the UK, including: a lack of positive policy support; concerns over development and maintenance costs; lack of technical standards; and, lack of appropriate skills and expertise. However, attitudes now appear to be changing, and progress is being made on several of these fronts - most notably in the development of a new national Code of Practice for Green Roof Installation.

4. Experiences from other Cities

Green roofs in Europe

4.1 Germany, Austria and Switzerland have long established policy frameworks and political support for green roofs, and are consequently the main focus of green roof activity in Europe. In particular, Germany has a legal framework and guidelines for green roofs on new flat-roofed or shallow pitch roofed (up to 20 degrees) buildings. Supporting such regulation are a raft of local incentives which typically subsidise installation costs by up to 50%. The reduction of urban flooding resulting from storm run-off has been the major driver of green roofs in Europe.

Basel, Switzerland

4.2 Basel has promoted green roof development through a number of policies. Specifically:

- Investment in two incentive programmes to provide subsidies for green roof installation;
- Building regulations stipulate that all new and renovated flat roofs must be greened to provide valuable habitat (primarily for invertebrates), using specified materials including: the use of native soils and flora; the depth of the growing medium; the inclusion of mounds to encourage insect life; and mandatory consultation with the city expert for all roofs greater than 1,000m^2;
- A grant for research on the biodiversity protection benefits of green roofs. The results of this study shaped the design specifications for green roofs in Basel;
- Best looking green roof contest in 2005/06.

Office buildings in Basel. All new commercial buildings in Basel must be extensive green roofs which use local river terrace gravels and local wild flower seed mix to benefit invertebrates

4.3 More than 85,000m^2 of roof area has been greened since the late 1990's, including 15% of all flat roofs. This has resulted in a saving of 4GW/year of energy.

Berlin, Germany

4.4 Berlin has pioneered the use of a ratio between 'ecologically effective surfaces' and total site area, known as the 'Biotope Area Factor' (BAF). The BAF target values vary according to development type, with new housing set at 0.6:1 and commercial development at 0.3:1.

4.5 Different types of ecologically effective surface are given different weightings. These targets are mandatory in certain key areas of the city and voluntary in others. Berlin also utilises indirect financial incentives in the form of a Municipal Wastewater Charge system. This is calculated as €1.7/m^2 of impervious surface, with a 50% discount applied for the presence of landscaped roofs.

The modern extensive green roof system was born by accident. The first 6 storey concrete tenement blocks in Berlin in the late 19th century had bitumen covered roofs that became a fire hazard. These were covered with a layer of sand which would be colonised by self-established vegetation. roofs.

Munster, Germany

4.6 Munster charges a stormwater fee, according to the amount of stormwater that runs off a property and into the sewer system (i.e. if there is no runoff, there is no fee). The fee is reduced by 80% or more when a green roof is installed. More than 12,000m^2 of green roofs have been installed in the city.

Stuttgart, Germany

4.7 Stuttgart has been providing financial incentives for green roofs since 1986, and has a budget of 50,000 Euros per year to provide free consultation and

information leaflets. Policy states that all flat and slightly sloped roofs (up to 12 degrees) on new development must be extensively greened to certain standards. A 50% subsidy of the actual costs up to a maximum of €17.90/m^2 is also provided. As a result 55,000m^2 of roofs have been greened, with provision for more than 1,500,000m^2 in the local development plan.

Linz

4.8 The city has a Green Space Plan (2001) stipulating that new buildings with an area of over 100m^2 and a slope of up to 20 degrees are to be greened, with a growing medium of at least 12cm and 80% roof coverage. The policy was first introduced in 1985 and has instigated a significant shift in building practice, as the image below illustrates. Subsidies are also made available for up to 30% of eligible costs.

Figure 4.1 - Impact of green roof policy in Linz, Austria

Paris

4.9 Paris is to introduce a new planning concept known as the "biotype coefficient" which is designed to stimulate the 'vegetalisation' of new build construction and major refurbishment in the city. The intention is to combat the low proportion of green areas and vegetation in the city - 35% of the city's population is within the densely populated area that has the least green space. The system will aim to build upon the successes of similar coefficient standards in several cities in Northern Europe and Germany, in particular Berlin. The principal advantage of the Paris coefficient is that it seeks to reconcile quantity and quality – it not only calculates the surface area of vegetation cover but also its environmental quality. Green roofs and living walls will form a key component of this drive, and a minimum green roof area of 50% of the building footprint will be required.

The Quai Branly living wall, Paris designed by Patrick Blanc.

4.10 Paris is also drafting a Climate Plan which has the principal objective of reducing emissions by 30% (compared to 2004 levels) by 2020, rising to 75% by 2050. The Climate Plan will be supported by a new Parisian Climate Agency which aims to combine the public and private sectors in developing a coordinated approach to energy infrastructure and the environment.

Green roofs in North America

4.11 In North America, Chicago is leading a number of cities who have chosen to pioneer green roof development with high profile greening programmes, including Portland, Oregon, Seattle, Washington, and Toronto.

4.12 Flood risk management has been a driver, though the main stimulus in the majority of North American cases is the attempt to reduce the pollution of rivers and water courses that results from run-off in the high rainfall climate of the north-west coast.

Toronto

4.13 Toronto suffers from significant urban heat island effects, which see summer temperatures in the city centre reach dangerous and uncomfortable levels. The city sees green roofs as a key tool in combating this phenomenon as they significantly reduce the amount of heat reflected off a roof surface, and also reduce the amount of heat leaving a building. As a consequence green roofs are supported through various initiatives and policy objectives, which include:

- where feasible and practical, green roofs with a coverage of 50% - 75% of the building footprint be constructed on all new City-owned buildings;
- where feasible and practical, green roofs be installed on existing City owned buildings, when roofs are due to be replaced.

New York

4.14 Green roofs have been identified as a Best Management Practice in New York's Water Quality Initiatives. This technology is named in Initiative 9: Provide Incentives for Green Roofs as a part of a larger mandate to expand, track, and analyze new Best Management Practices. Since 2007, the City has supported the installation of extensive green roofs by enacting a property tax abatement to off-set 35% of the installation cost of a project. This pilot will end in 2012, when it will be reassessed for extension and inclusion of other technologies. In 2007 the City also started developing four residential and two commercial pilots to analyze the potential cumulative benefits of green roofs on the city's combined sewer system. A Green Roof Policy Task Force has also been established to:

- educate and engage potential stakeholders
- engage many stakeholders to map out the nature of the market into which green roofs would be incorporated
- develop a framework for the incorporation of green roofs into building practices.

A New York City green roof.

4.15 Green Roofs are not a new idea in New York – it is home to one of the earliest roof gardens in North America – the series of green roofs on the Rockefeller Centre dating from 1936. Currently, the largest green roof installation in the city is on Silvercup Studios in Long Island City, Queens, measuring 2,800m^2.

Portland, Oregon

4.16 Portland City has internal green building consultants to assist City buildings in meeting the following policy objectives:

- All new City-owned buildings are required to be built with a green roof that covers at least 70% of the roof. The remaining roof area must be covered with Energy Star rated roofing material.
- When practical, all roof replacements must also include a green roof.

4.17 It also offers a 35% reduction in storm water management charges and has an "Ecoroof Initiative" to raise awareness.

4.18 More than 20 years ago the city added a floor area ratio (FAR) bonus to its building code whereby builders could get permission to build extra square footage by employing favoured practices. Green roofs were eventually classified as a favoured practice in the 1990's. One example cited is that a developer who installed 4,000 sq ft of green roof at a cost of $60,000 received permission to build an extra 12,000 sq ft of building density. This equated to six extra condo units, then selling for $395,000 each, a total of $2,370,000.

4.19 As a result of such incentives, there are currently around 16,000m^2 of green roofs in Portland.

Portland, Oregon.

Chicago

4.20 The City of Chicago also grants a density bonus option to developers whose buildings have a minimum vegetative coverage on the roof of 50% or 160m^2 (whichever is greater), usually in the form of a green roof. Roofs are required to achieve a minimum solar reflection (albedo) of 25% - often met through the use of green roofs.

4.21 In addition, planning applications that include a green roof are fast tracked via a dedicated team of planners, cutting the application processing time by 66%.

4.22 In 2007 there were in excess of 300 green roofs totalling more than 278,000m^2.

The green roof at Chicago's City Hall.

Green roofs in Japan & Asia

4.23 As is the case in the UK, electricity demand in Japan peaks during the summer as a result of air conditioning requirements. The Japanese government has therefore given green roofs a high priority at national and city level as a primary means to reducing building energy use. As a result, Japan is one of the major global centres of green roof implementation, with a particularly famous example being the Prefectural International Hall in Fukuoka City.

Tokyo

4.24 The average annual temperature has increased by 3°C in the last century – mostly due to the urban heat island effect. Consequently the city has introduced policies that require green roofs to be installed on 20% of all new flat roof surfaces on public buildings exceeding 250m^2, and 10% of all flat roofs on private buildings exceeding 1,000m^2. This results in the construction of around 50,000m^2 of green roofs annually.

Green roof cityscape, Tokyo, Japan.

4.25 It has been estimated that if half the roofs in the city were planted with gardens, daytime summer temperatures would fall by 0.84°C, saving 110 million Yen, approximately £722,244, in air conditioning costs.

Singapore

4.26 In 1996, a technology transfer agreement was signed to bring the German green roof concept into Singapore, and assess its suitability to tropical conditions. In 2003 the first large-scale extensive green roof was installed at HDB's Pilot Project in Edgefield Plains, Punggol.

4.27 Another high profile example of green roofs is Fusionopolis, a science and technology powerhouse for Singapore. This integrates 13 roof gardens amounting to some 3,000 m² of sky greenery, including 6 large-scale thematic ones on the 5th, 18th and 21st storeys. They serve as the 'green lungs' and social pockets for the office and lab staff. The highest roof garden is located at the 24th storey.

4.28 Energy simulation programmes have been conducted on a hypothetical 5-story commercial building with a roof garden in Singapore[11]. The results showed significant savings on energy in terms of:

- approximately 15% of net annual energy savings;
- up to 80% reduction in the peak cooling load can be achieved, resulting in the possible downsizing of air-conditioning systems and thereby savings in capital investment; and
- a reduction of peak Roof Thermal Transfer Value (RTTV) of up to 80% making roof gardens as a viable substitute for roof thermal insulation.

4.29 In addition, Singapore is a thriving Asian city-state with miniscule farmland resources, and a survey of the food-from-the-roof opportunity found it may be able to devote up to 1,000 hectares of its urban rooftops to fresh vegetable production, now mostly imported at a considerable fossil fuel energy cost.

Hong Kong

4.30 In Hong Kong Intensive Green Roofs are already well-established in the form of podium gardens as they provide what Hong Kong needs most – valuable functional open space for human use. Extensive Green Roofs, on the other hand, are better-suited to retro-fitting projects which have their own technical constraints, and are not yet well-established in Hong Kong. Despite Intensive Green Roofs being well-established, a consolidated approach to green roof techniques and standards is still needed.

4.31 It appears that no information exists on the percentage distribution of green roofs in Hong Kong. Existing government policies and standards influence the creation of intensive green roofs in the public and private sector in both direct and indirect ways.

4.32 Joint Practice Notes 1 and 2 (JPN) are designed by Government and set out the initial incentives that Government is providing to encourage the incorporation of 'green' features, and give guidance on how to apply for them under the Buildings Ordinance, the Lease Conditions and the Town Planning Ordinance, as appropriate. JPN 1 refers to residential developments and JPN2 refers to commercial developments.

4.33 Furthermore, the purpose of JPN116 is to provide incentive to private developers to include amenity features that are not a statutory requirement but which enhance the quality of life for residents and users.

Organic green roof at the School of Art, Design and Media at Nanyang Technology University, Singapore.

[11] NParks & NUS – Handbook on Skyrise Greening in Singapore (2002)

Intensive green roof in Hong Kong. There is an aim that green roofs will be retrofitted on existing Government buildings. Pilot schemes to install vertical green panels at lift towers and external walls will also be carried out in public housing estates.

Green roofs in the UK

4.34 The above international examples, usually supported by robust national policy frameworks, all have a strong regional and city level focus to meet contextual needs. They are also characterised by high levels of interaction and cooperation between local authorities, local research communities, the green roof industry, and community and regeneration organisations.

4.35 The UK does not currently benefit from such a coherent and integrated approach, and the majority of UK projects have been one-off rather than part of a wider strategy. There are no mandatory national policies in place, and there is no national standard for green roof implementation or maintenance.

London

4.36 Policy *4A.11 Living Roofs and Walls* of The London Plan states that:

> *The Mayor will, and boroughs should, expect major developments to incorporate living roofs and walls where feasible.*

Biodiversity green roof on Barclays HQ, Canary Wharf, London.

4.37 Current notable examples of living roofs include the famous pre-war roof garden of Derry and Toms Department Store, extending to over 6,000m^2, Jubilee Park Gardens in Canary Wharf, Westferry Circus, Canada Square, and the Royal Artillery & Gunnery Quays SE10. In total, a recent audit estimated that the capital contained over 60,000m^2 of intensive and almost 33,000m^2 of extensive green roofs, totalling 93,000m^2. In addition, it is thought that around 80,000m^2 of green roofs are planned in London as mitigation for black redstarts where the birds nesting and foraging habitat is disturbed by development.

4.38 The Greater London Authority (GLA) is in the process of developing a standard definition to underpin its policy aspirations. The 'Mayor's Preferred Standard' is currently:

- A minimum of 70% of the roof should be vegetated
- At least 25% of the total roof space should be accessible to residents and/or workers
- Average depth of substrate should be 100mm with 80% of this having an average holding capacity of 2 litres/10mm/m^2, which is equivalent to a minimum water holding potential of 20 litres/m^2.

Barking & Dagenham

4.39 The London borough of Barking and Dagenham is trying to embed solutions to tackle climate change in hundreds of new buildings through the ongoing borough-wide regeneration. Green roofs provide a simple and effective solution to both mitigation and adaptation, and the council has produced a Planning Advice Note (PAN) on the subject, which includes:

- explanation of a green roof;
- the policy framework;
- the different options available to developers: green roofs designed for amenity, biodiversity, or water management;
- cost and maintenance; and


A sedum roof, Barking and Dagenham, London.

- how to design a green roof: important considerations such as structural capacity of the roof, access, plant selection, and watering and drainage issues.

4.40 At planning application stage the council refers applicants to the PAN to ensure the green roof is built in a way that achieves the preferred objective, whether biodiversity enhancement or water flow regulation. As a result, Development Control officers are aware of the benefits of this technology, and encourage its deployment in new developments.

4.41 However, being a Planning Advice Note, and not a Supplementary Planning Document (SDP), this document cannot be considered planning law. It therefore cannot be legally enforced on its own, and an SPD on green roofs is now considered to be a more effective route by the council.

Sheffield

4.42 The first national green roof conference, attracting over 200 delegates, was held at the University of Sheffield in September 2003, in partnership with Sheffield City Council. This conference cemented the working partnership between University of Sheffield and Sheffield City Council, and led directly to the implementation of green roof projects in the region, including a vibrant programme of University research and trials. The conference spawned a national green roof organisation, Livingroofs.org, which is an independent UK website which promotes green roofs and provides advice on their installation. Moreover, the close partnership that has developed with Sheffield City Council (and Groundwork Sheffield) is unique in the UK in this context, and has great potential, through the contact networks of those two organisations, for rolling out throughout the sub-region to maximise knowledge exchange and technology transfer. In 2004 the Green Roof Forum was established in Sheffield, comprising Sheffield City Council, Groundwork Sheffield and the University of Sheffield and is striving to establish green roof sites in the sub region, in order to demonstrate their benefits to mainstream developers. As a result, this area has pioneered green roof implementation in the UK, with over 40 examples including schools commercial buildings and city centre apartments. Crucially, Development Control Officers are becoming very keen on sustainability including green roofs, while other areas of the planning department are providing enthusiastic support. This allows Development Control to negotiate with confidence. However, this is currently taking place without any specific policy support, though consultation on 'preferred options' for new green roof policy is underway.

The Home Office's new office in Sheffield, Vulcan House.

4.43 Three options have been provided for consultation:

- Green roofs will be required only on medium or large developments within 100m of the green belt, green network, waterways, parks, and open spaces greater than 1 hectare. (medium or large = non-residential development over 1,000 sq metres and residential over 10 dwellings).
- Green roofs will be required on all medium and large developments.
- Green roofs will be required on all developments.

4.44 Groundwork Sheffield has also recently been awarded £700,000 of EU LIFE+ funding for an innovative 3 year project focusing on the development of UK green roof Code of Best Practice. The code will focus on the specification, design and implementation of green roofs in the UK climate. This is intended to increase confidence in the technology and incidence of green roof application through stimulating the production of Supplementary Planning Documents throughout the UK.

4.45 The project will be delivered in partnership with national and international experts in the field including Livingroofs.org and the European Federation of Buildings (EFB), and is sponsored by the Homes and Communities Agency.

Conclusions

4.46 The experience of international case studies has demonstrated that most, if not all, of the cities that have successfully implemented green roof programmes have utilised some form of policy framework to support uptake. It therefore seems logical that a similar approach will be important to greater uptake of green roofs in Greater Manchester, particularly in respect of new buildings.

4.47 On face value, this would appear to contradict the findings of Natural Economy Northwest's recommendation that green roofs do not become a specific feature of the policy framework until a further evidence base has been established. However, the rationale behind this conclusion is stated as the current lack of an accepted definition of what constitutes a green roof, and the absence of relevant building standards. Whilst it is accepted that these factors serve to complicate the issue, they do not form insurmountable barriers to successful policy and in some respects might be considered a red herring – a point to which we return in more detail in the following chapter.

4.48 Moreover, the GLA is currently developing a standard definition to underpin its existing policy aspirations, and the standard German definition has been adopted internationally. Either of these could provide a useful baseline for Greater Manchester, thereby helping to overcome some of the perceived impediments to a robust policy position. This approach would be far preferable to abandoning policy in the short to medium term.

4.49 However, it is important not to lose sight of the other measures implemented alongside policy interventions in the international case studies, as a number of core themes are evident in successful green roof programmes. In particular, the following ingredients are common to a number of cities which have achieved widespread green roof development.

Key ingredients of successful green roof delivery in cities

- Strong regulatory or policy standards for new development, either on green roofs specifically or at least on key 'outcomes' to which green roofs are an inevitable contributor (e.g. albedo effect, surface water run-off rates);
- The use of subsidies and other fiscal incentives, despite the potential role of green roofs in reducing 'bottom line' costs such as energy consumption for heating and cooling;
- Awareness raising and advisory support, for policy-makers, designers, building owners and occupiers;
- Leadership on the public sector estate and through public procurement projects providing a number of demonstration projects.

4.50 A Green Roof Programme for Greater Manchester should therefore take reference from these key themes, whilst also exploring innovative solutions which take advantage of the unique governance, geophysical and cultural circumstances of the conurbation.

5. Existing Activity in Greater Manchester

5.1 The commissioning of this study is a reflection of the fact that there is limited activity on green roofs across the conurbation. However, it would be a mistake to assume that the local context for this study is a 'blank canvas'; indeed, there are a number of established and planned green roofs within Greater Manchester, whilst a growing body of broader city-region research and policy-making activity provides a degree of contextual momentum to which a Green Roof Programme should be attuned.

Research and Policy

5.2 A number of studies are already underway across Greater Manchester which fall within the broad Terms of Reference for the Planning and Housing and the Environment Commissions, which are the components of the AGMA Governance Structure which are most directly relevant to the consideration of green roofs for the conurbation (refer to Chapter 10 for more information on the Commissions).

5.3 This research activity spans climate change, natural environment and sustainable consumption and production themes and is being carried out under a range of academic and commercial consultancy arrangements.

5.4 This research activity broadly includes:

Research Project	Commissioned by	Delivered by	Current Status	Broad Scope
CROSS CUTTING				
PLUREL: peri-urban land use relationships	European Commission	CURE	In progress; completion at Manchester International conference June 2010	Looks across environment / climate, social & economic dimensions of peri-urban hinterland of GM.
Eco-region NW	SNW on behalf of Biffaward	CURE	NW baseline complete 2006, now being followed up with One Planet Economy Network	Provides full database & modelling tool 'REAP' for analysis of direct & indirect climate / resource impacts of all production & consumption. Follow on work focuses on the institutional economy actions needed to achieve the CCC 80% target.
Climate Change				
Eco-cities	Bruntwood	CURE / MARC	Started Jan 09	Provides networking & intelligence for all climate impacts / adaptation issues across GM.
Mini Stern	Environment Commission and Manchester Enterprises	Deloitte	Proposed AGMA response Autumn 2008.	Considers economic impact to GM of failing to adapt to climate legislation and regulation.

Research Project	Commissioned by	Delivered by	Current Status	Broad Scope
PEPESEC	Trans-national partnership including Oldham MBC and MCC, in conjunction with M:KC	M:KC, MCC and Oldham MBC	Research phase is underway. GM Energy Planning to commence Nov 2008. EU project will complete in June 2010	Aims to develop a strategic energy framework for GM + detailed energy plans for Oldham and Manchester.
ASCCUE (Adaptation Strategies for Climate Change in the Urban Environment)	Engineering and Physical Sciences Research Council (EPSRC).	CURE: University of Manchester and partners	Completed in 2006	To develop tools for the analysis of adaptation options in urban areas, with a particular emphasis on heat and human comfort in the built environment using GM as a conurbation case study
SCORCHIO (Sustainable Cities: Opportunities for Responding to Climate Change Impacts and Outcomes)	EPSRC	CURE (leading wider consortium)	Work on the project began in March 2007 and research will be ongoing until early 2010.	Develop tools for the analysis of adaptation options in urban areas, with a particular emphasis on heat and human comfort in the built environment.
AGMA PPS1 study	AGMA planning officers in collaboration with Environment Commission team members	Urbed, Faber Maunsell& Quantum	Consortium appointed and study underway, due for completion Spring 2009	Study to inform spatial planning requirements for decentralised energy and delivery of zero carbon buildings. Additional detailed work on energy mix may be commissioned by ME to complement this.
Changing Behaviour	Trans-national partnership including M:KC and SURF (Salford University) for the Environment Commission	M:KC and SURF	Research phase is underway. Design of a GM pilot project in conjunction with GM ESTAC is underway and due for launch in Spring 2009. A UK/Eire workshop on demand-side energy management projects took place at the Bridgewater Hall on 5th March 2009	Will deliver considerable learning for GM / NW / EU on successful energy behavioural change interventions and a pilot project for GM maximising climate change awareness and uptake of ESTAC services.
Low carbon cities project – focuses on how to create a low carbon city rather than on evidence building.	MCC, on behalf of GM Environment Commission, The carbon Trust and Energy Saving Trust	AEA Tech-nology	Phase 1 completed; Phase 2 under development.	Information from Phase 1 being collated onto a bespoke website.

Research Project	Commissioned by	Delivered by	Current Status	Broad Scope
Work on developing ESCOs (including feasibility study) ("ESCO work")	Manchester: Knowledge Capital on behalf of GM Environment Commission	TNEI	Report finalised July 2007.	Manchester City Council is exploring ESCO models for use in own estate and in developments. Some concerns about the baseline data used.
Renewables for incubators and SME	Manchester Enterprises, NWDA	TBC (subject to tender)	Underway	A feasibility study to look at retrofitting renewables and energy efficiency measures in mill conversion in Oldham (new deal for communities area) specifically for occupancy by emerging incubator business and SME's. Outcomes could outline opportunities to seek capital funding and offer unique selling point/ETS focus.
Energy saving Trust 1:1 Programme	ESTAC/EST	ESTAC	Live - with support for Oldham, Rochdale, Stockport, Bolton	Project looking to reduce carbon emissions associated with local authority estate including housing stock etc. Will also support N1 185 and 186 - For Oldham there are also direct links to PEPESEC and community energy planning.
CONCERTO bid – call for proposals to be developed into a bid for European funding for an exemplar project using renewable energy.	Commission for Economic Development, Employment & Skills (CEDES)	Carbon Descent	Awaiting decision in January	Will provide a bank of other projects for possible future development. If it goes ahead, £4 million investment in Oldham town centre (low carbon innovation zone).
Natural Environment				
Towards a Green Infrastructure Framework for Greater Manchester	Natural England and AGMA planning officers in collaboration with Environment Commission team members	Phase 1 by Red Rose Forest Phase 2 by TEP	Phase 2 Final report published. Phases 3 and then 4 being developed	NB: Green infrastructure as formally defined in RSS and also widely accepted by DCLG. Informal definition: "A network of planned, managed and multifunctional green areas/spaces and other green elements such as street trees and gardens".

Research Project	Commissioned by	Delivered by	Current Status	Broad Scope
Strategic Flood Risk Assessments (SFRA)	AGMA planning staff for the Planning & Housing Commission	Scott Wilson	Report signed off. Discussions underway about approach to level 2 work where required.	Linked to additional New Growth Point work.
Surface Water Management Plans bid	AGMA planning staff for the Planning & Housing Commission		Bid submitted to DEFRA to become a pilot area in October 2008.	Linked to SRFA Level 2 work. Likely to be conducted in collaboration with the EA and UU. Also required for NGP work.
Water Cycle Study	New Growth Point for the Planning & Housing Commission		Required for NGP programme of development.	
Air quality assessments	New Growth Point for the Planning & Housing Commission		Required for NGP programme of development.	
Sustainable Production and Consumption				
Study on the capacity to develop green (technology) Infrastructure in the sub-region	AGMA planning officers in collaboration with Environment Commission team members	Mersey Basin Business Foundation	Underway - reporting Autumn 2008	NB: Green infrastructure in this context means a network of 'green' projects including energy.
The Corridor: Energy Infrastructure Study	The Corridor	MWH Global	Due to be published end of June 2009	Identifies options for future heat and power investment in a way which minimises carbon emissions. Also considers the impact that behavioural change can have on power demand.

Source: GM Environment Commission Transition Team (supplemented by Steering Group Members)

5.5 The capacity of both the Planning and Housing Commission and the Environment Commission to conduct further research should be noted. The following extracts from an AGMA account of Commission research requirements are pertinent. In respect of the Planning and Housing Commission:

> *At present there are no dedicated resources at sub-regional level and much work is either undertaken by districts or if undertaken at GM level commissioned from consultants and project managed by district planning managers. Some support is provided by a research officer within the AGMA Policy Unit in terms of data management. There may be some potential for existing group structures to be reconfigured to provide greater coherence to the management and delivery of sub-regional requirements.*

5.6 In the respect of the GM Environment Commission, the following summary is provided:

> *The sub-regional capacity for environmental research to be delivered in-house is extremely limited, as are funds to commission work from consultants. Efforts continue to secure additional research capacity and funding via European and regional programmes. There is a particular gap in terms of capacity to provide sustainability input into relevant work by partners…..and a suggestion is that graduate trainees may be able to provide some capacity in this regard.*

5.7 It seems clear, therefore, that the prospects of a substantial research and awareness-raising project to be delivered directly through the research capacity of the AGMA governance architecture is very limited. That said, there are several notable academic activities underway into which the role of green roofs would seem to provide a highly relevant component. In particular:

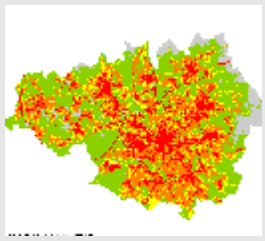
- **Eco-cities** which seeks to provide Manchester, by the end of 2010, with its first blueprint for an integrated climate change adaptation strategy. This will be based on leading scientific research, extensive stakeholder engagement, and best practice examples of new programmes successfully piloted during a three-year period
- **SCORCHIO** which aims to develop good impact assessment tools for adaptation appraisal of urban and city environments under a range of climate scenarios, with a particular emphasis on heat.

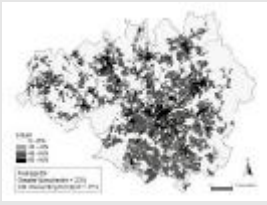
http://www.sed.manchester.ac.uk/architecture/research/ecocities/

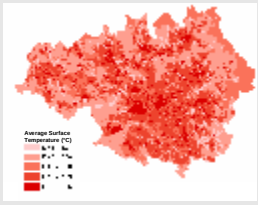
http://www.sed.manchester.ac.uk/research/cure/research/scorchio/

5.8 It is recommended that further consideration is given to the extent to which green roofs research can play a role in Greater Manchester in responding to climate change (and related commercial and quality of life) impacts. In particular, there are two relevant PhD placements at the University of Manchester:

- The first, which has recently commenced, is funded by the UK Energy research Council and is concerned with the impact of a range of green space typologies, including green roofs, on the energy consumption profiles of buildings.
- The second, which is scheduled to commence in October 2009, is funded by the Natural Environment Research Council, and is focused specifically on quantifying the benefits of green roofs.







Extracts from ASCCUE and SCORCHIO mapping showing spatial relationship with urban morphology and heat.

5.9 Both of these placements, as far as possible and appropriate, should be integrated with these broader academic considerations of the GM urban environment and climate change such as Ecocities and SCORCHIO to ensure mutually-informative advantages.

5.10 The undertaking of academic research into the impact of green roofs will not, however, be sufficient to generate awareness across the conurbation of their benefits, limitations and installation requirements, and in particular to audiences that are not linked closely into the academic sector. A different approach will be needed in this respect, which is outlined in respect of skills development in Chapter 9 on the parameters of a work programme.

Schedule of Green Roofs

5.11 The table overleaf lists those existing or planned green roofs that have been identified during the course of this Feasibility Study. It should not be assumed that the schedule is exhaustive.

Schedule of green roofs in Greater Manchester

Location	Building type	Approx Roof area (sq m)	Green roof type	Completion date	Principal objectives
MERCi, Bridge 5 Mill, Ancoats	Community		Intensive	2008	Biodiversity
Unicorn Grocery, Chorlton	Community		Intensive	2008	Biodiversity
BDP Offices, Piccadilly Basin	Commercial		Extensive	2008	Biodiversity
Guest St, New Islington	Domestic		Extensive	2007	Multiple benefits
Eco House, Miles Platting	Domestic			April 2008	
Manchester Business School, University of Manchester, Oxford Rd	Commercial			2008	
South Drive, Chorltonville	Domestic				
The Birches, Nell Lane, West Didsbury	School				
Great Ancoats Street / Old Mill Street, Ancoats	Commercial				
Homes for Change [No. 1, 41 Old Birley St, Hulme]	Community				
Hulme Community Garden Centre	Community	21.6		March 2009	
Reddish Vale Community Garden, Reddish Vale Community Vale, Stockport	Community		Extensive	2004	Biodiversity
Ackroyd Road Allotments, Gorton North	Allotment	11.5		Sept 2008	Biodiversity + Aesthetics
Number One, First Street	Commercial	486	Extensive	March 2009	Multiple benefits
Boggart Hole Clough	Community	30		Sept 2008	Biodiversity + Aesthetics
Wythenshawe Park	Community				
Cob House, Wythenshawe Park	Community				
Wellington Rd Allotments, Fallowfield	Allotment			Planned	
Plymouth Grove/ Birch Lane, Longsight, M13 0LX	Commercial			Planned	Amenity
Land bounded by Lever Street, Warwick Street, Spear Street, Faraday Street, Manchester	Commercial			Planning approved	
13-17 Rochdale Road, Ancoats, M4 4HS	Commercial			Planning approved	Amenity
Land at Tib St/Church Street, Manchester	Commercial			Planning approved	
Wilmslow Park Phase 3, Rusholme Place, Rusholme	Commercial			Planning approved	
New York St/45 Mosley St, Cit	Commercial			Planning approved	
Rear Of Coach House, 60B Wood Road, Whalley Range	Commercial			Planning approved	
10 Linden Court, The Beeches, M20 2BG	Domestic			Planning approved	

Location	Building type	Approx Roof area (sq m)	Green roof type	Completion date	Principal objectives
High Lane, Chorlton	Domestic			Planning approved	
71 Cavendish Street, Hulme, Manchester, M15 6BN	Commercial			Planning pending	
Homes for Change [N. 2, 41 Old Birley St, Hulme]	Community			Planned	Food production
Phillips Park, Bowlers	Community				
Alexandra Road Allotment Society	Allotment				
North City Library, Harpurhey	Community				
Newall Green Primary School	School				
Skate Park, Ardwick	Community				
Abbey Hey Primary School	School				
56-58 Dale St, 3 China Lane, Piccadilly	Commercial		Extensive	Planning approved	Biodiversity
Weatherby Surestart Centre, Bradford	Community				
Northridge School, Higher Blackley	School				
Crumpsall Surestart Centre	Community				
St Kentigerns RC Primary School, Bethnall Drive, Fallowfield	School				
The Hive, Manchester	Commercial				Multiple benefits
Part of the New Islington Millennium Community [the CHIPS development]	Domestic		Extensive		Multiple benefits
Part of the New Islington Millenium Community [land bhounded By Tariff Street, Rochdale Canal And Marina, Piccadilly Basin]	Domestic		Extensive		Multiple benefits
Islington Wharf, Ancoats	Domestic		Extensive		Multiple benefits
Piccadilly Pavilion, Piccadilly Gardens	Commercial		Extensive		Multiple benefits
Pollard Street/ Great Ancoats Street	Domestic				Multiple benefits
Ponsonby House, Edward Street, Stockport, SK1 3UR	Commercial	135	Extensive?	Planning approved	Multiple benefits
Stockport College, Wellington Road, Stockport, SK1 3UQ	Education	Up to 7927	Extensive?	Planning approved	Multiple benefits

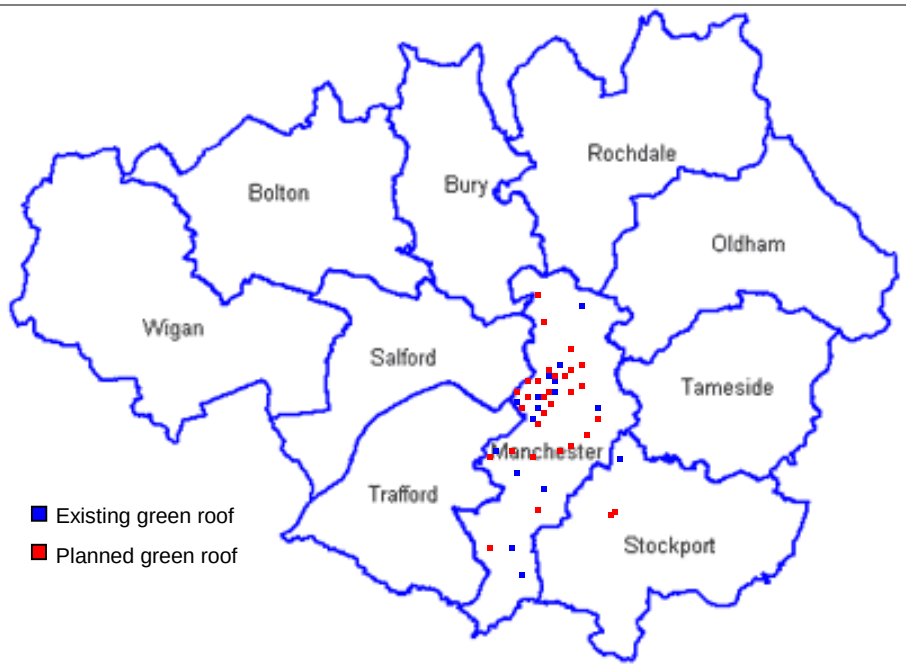


Figure 5.1 - Approximate Location of Green Roofs in Greater Manchester

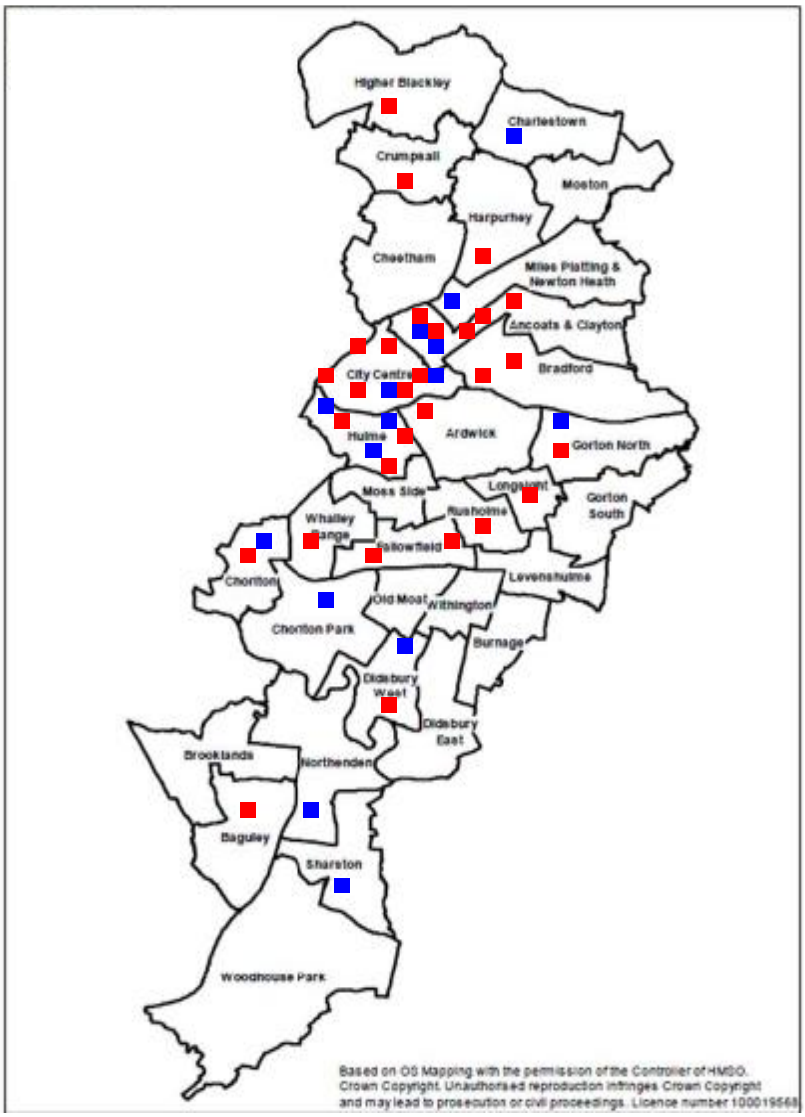


Figure 5.2 - Approximate Location of Green Roofs in City of Manchester

5.13 There are number of notable themes which can be deduced, albeit that there is a good deal of information missing which has not been determinable within the scope of this initial Study:

- All but three of those green roofs identified are within one local authority area – the City of Manchester. There are three green roofs in Stockport. Whilst this is unlikely to be a comprehensive reflection of reality, it does prompt questions about the relatively advanced situation within Manchester compared to the remainder of the sub-region.
- It appears that this may be a result of the time and financial resources that have been invested in Manchester, including its partnership with Red Rose Forest.
- A significant proportion of existing green roofs are located on community buildings and are relatively small. However, of those green roofs planned, a significant proportion are commercial buildings within the conurbation core. This represents an interesting shift and suggests that local policy and perceived market demand for 'green buildings' is beginning to effect greater traction for green roofs as a component of sustainable development strategy.
- Few of the green roofs identified are 'intensive' suggesting that the principal drivers for those installed and planned is biodiversity and aesthetics, rather than functional benefits for building occupiers (such as reduced energy costs).

5.14 Two broad but key questions arise from these themes, assuming that the schedule is broadly representative of the reality:

- Given that green roof delivery is so much more advanced in the City of Manchester as a result of greater investment, why has this approach not been adopted elsewhere? Why are outlier Boroughs so far behind in realising green roof benefits?
- What conditions need to be in place to effect the delivery of intensive green roofs, rather than extensive?

6. Case Study Portfolio

6.1 A small number of green roof case studies have been compiled to illustrate pertinent challenges and delivery solutions. It is recommended that these be incorporated into the Green Roof Guidance delivered under Part 3 of this commission.

Number One, First Street, Manchester

Location	Owner/Developer	Building Type	Green Roof Type
Whitworth Street West, Manchester	ASK Developments	Commercial Office	Extensive

6.2 Number One First Street is a refurbished office building forming the first phase of the First Street scheme by Ask Developments. It has just been awarded its 2006 BREEAM "Post Construction" certificate of Excellent. It is the first office building in the North West to achieve this level of accreditation and only the 7th building to achieve this in the UK.

6.3 The 486 sqm green roof was installed in early 2009 at a cost of £150 per sqm. Whilst the vegetation is slowly establishing itself, the plants will turn brown over the summer months reflecting the cycle of vegetation that provides a habitat for invertebrates and insects.

6.4 A 638 sqm green wall, accommodating approximately 37,000 plants, is also due to be installed with each panel measuring 11m by 29m. The green wall replaces glass, plastic and metal cladding with greenery.

6.5 The green wall irrigation system, which will have the ability to be controlled remotely, will deliver 1 to 3 applications per 24 hour period to 9 separate individually controlled zones. The system also uses rain/storm water run-off to irrigate green roofs and walls. Moreover, the First Street green wall planting system includes a material called 'Grodan' which soaks up the water and vastly reduces the water consumption compared to other green wall systems. The overall cost of the wall will be £400,000.

Extensive green roof at First Street , Manchester, both during and after installation.

Artist impression of green walls at First Street.

BDP Studios, Piccadilly Basin, Manchester

Location	Owner/Developer	Building Type	Green Roof Type
Ducie Street, Piccadilly, Manchester	Town Centre Securities	Commercial Office	Extensive

6.1 BDP and developer Town Centre Securities have created Manchester's first office "living roof" at its new studios in Piccadilly Basin.

6.2 The roof was completed at the end of summer 2008 and forms part of the first naturally ventilated office building in Manchester to receive a BREEAM Excellent rating, for which it was awarded a Manchester City Council Built in Quality Award.

6.3 The roof is the first in Manchester to be implemented in conjunction with Greater Manchester Biodiversity and aims to attract black redstarts, one of the UK's rarest species of bird.

6.4 In order to improve the ecological value of the new building the team consulted livingroofs.org on the ecology habitat mix. The roof uses recycled rubble and gravel taken from the building's own construction site which has been seeded with the black redstarts favoured vegetation. It also requires little maintenance with only two sessions required per year.

The Town Centre Securities development at Ducie Street, Piccadilly Basin is now occupied by architectural practice, BDP.

Barbican Estate, City of London

Location	Owner/Developer	Building Type	Green Roof Type
City of London	Corporation of London	Residential/Commercial	Intensive

6.5 The Barbican Estate is a post-war modernist Grade II listed estate covering 14 hectares, designed by Chamberlin, Powell and Bon and opened in 1969.

6.6 The podium level is constructed on a reinforced concrete deck and functions as a park. Although dominated by paving, the roof includes large planters with trees and shrubs and a series of ponds. The ponds have been improved for biodiversity and include wetland planting and common frog.

6.7 Although the Barbican Estate has been derided as a labyrinthine and for being windswept, its car-free podium deck level is enjoyed by residents and provides accessible open space in a very densely developed district, which includes 42 storey towers.

Key Challenges

6.8 The area of paving greatly exceeds the areas given over to planting or ponds. Paving is more than adequate for the relatively light pedestrian traffic. Consideration should be given to changing this balance in the future in order to provide more summer cooling and wildlife habitat.

Location of the intensive green roof at the Barbican Estate.

Horniman Museum Extension, South London

Location	Owner/Developer	Building Type	Green Roof Type
Forest Hill, South London	Horniman Museum	Museum/Classroom	Extensive

6.9 The Horniman Museum Extension is a demonstration building designed by Architype with advice on roof greening from Gary Grant. It was built in 1992 with the primary purpose of roof being to provide evaporative cooling. The roof was modelled on the traditional Scandinavian turf roof but with a modern waterproof membrane. A commercial turf was plug-planted with wildflowers. There is a marked contrast between the vegetation on the drier south facing slope and the wetter north facing part.

6.10 A survey commissioned by Natural England of several green roofs in London found this one to be the most bio-diverse.

Key Challenges

6.11 The roof was originally designed to be irrigated in order to boost the evaporative cooling function, however the system was abandoned after algae from the reservoir pond blocked pipes. Although the designers had advised that mowing is unnecessary the owner does mow this roof on an annual basis.

Sihlpost Platform Canopies, Zurich Railway Station

Location	Owner/Developer	Building Type	Green Roof Type
Zurich, Switzerland	Swiss Railways	Railway Canopies	Extensive

6.12 When plans to extend the station for the 'Bahn 2000' railway improvement initiative were assessed, the affected track bed was found to support protected wall lizards and rare invertebrates. The solution was to create suitable replacement habitat on the platform canopies. Where extra substrate depth was required to provide overwintering habitat for reptiles, this was placed over columns which can bear more weight. Lizard 'ladders' constructed from gabions at the platform ends enable the animals to move to and from the roofs. Stony substrate supports an arrested pioneer community similar to those found on some brownfield sites.

6.13 Roofs have integrated well with the station's SuDs systems.

ACROS, Prefectural International Hall, Fukuoka, Japan

Location	Owner/Developer	Building Type	Green Roof Type
Fukuoka, Japan	Dai-Ichi Mutual Life Mitsui Real Estate	Commercial/Public/Exhibition	Intensive

6.14 This building's 10,000m^2 terraced green roof effectively extends the area of the adjacent Tenjin Central Park. Designed by Emilio Ambasz and opened in 1994 the roof is privately owned but accessible. Substrate depth varies between 250 and 500mm. 35,000 shrubs and trailing plants were planted and there is a series of water features, gardens and viewpoints.

6.15 The roof gardens have brought prestige to the city are now used as part of the annual Don Taku festival. As the vegetation has matured it has improved the appearance of the building. The owners claim to have lower air conditioning costs than conventional commercial buildings of the same size.

Key Challenges

6.16 Although no figures are available it is assumed that the maintenance costs are substantial.

Peter Merian Haus, Basel, Switzerland

Location	Owner/Developer	Building Type	Green Roof Type
Basel, Switzerland	Die Schweizerische Post	Commercial	Extensive

6.17 Opened in 2004, these office buildings have bio-diverse extensive living roofs in order to comply with Basel canton regulations which require local substrates of sand and gravel seeded with a local wildflower seed mix. Substrate depth is varied to encourage a variety of invertebrates to colonise and find places to overwinter. Substrate depth varies from 80 to 150mm. The total area of green roofs is 6000m^2.

6.18 Monitoring by the university has confirmed high biodiversity value.

Key Challenges

6.19 The local sand/gravel substrate is heavier than industry-standard green roof substrate and does not absorb water as effectively.

Westfield Living Wall, London

Location	Owner/Developer	Building Type	Green Roof Type
Shepherds Bush, London	Westfield	Shopping Centre	Living Wall

6.20 Designed by EDAW AECOM and opened in 2008 the wall was designed to provide an attractive noise barrier between a new large shopping centre and adjacent residential area. The wall is approximately 140m long and 4m high. Plastic modules have been planted with ferns and woodland wildflowers which are designed to thrive in the north facing situation and to provide seasonal variety. The wall uses plastic modules which have an integrated irrigation and drainage system. The modules make replacement of individual plants (should this be necessary) straightforward.

6.21 It has been reported by the developer that take up of adjacent restaurants has been boosted by this feature. Furthermore, the modular living wall has proven to be less prone to planting failure than alternative rockwall/mesh systems.

7. The Key Issues

7.1 The baseline analysis of policy, existing research and activity, and comparator cities, coupled with input from a range of stakeholders, has confirmed a range of interrelated issues which are impeding the delivery of green roofs in Greater Manchester, and the UK more widely.

7.2 These were discussed at a Stakeholder Workshop held on 6 May 2009 in order to confirm the severity of their perceived impact. The table below summarises the key issues and draws out a number of important nuances.

Significant, reinforcing connection

ISSUE / IMPEDIMENT	IMPACT SEVERITY
Lack of knowledge and awareness in respect of benefits	HIGH
This is perhaps the most significant barrier. The persistent knowledge deficit amongst key actors (architects, planners, building owners and occupiers etc) means that green roofs are either not considered as part of any development or refurbishment project, or discounted at an early stage through 'value-engineering' because of underestimated commercial and operational benefits. This situation is reinforced by the perceived lack of available data to robustly quantify green roof benefits, even in respect of energy performance enhancements arising from thermal efficiencies.	
Lack of skills and delivery capacity	MEDIUM
There is in fact a good deal of expert knowledge on green roofs and a number of credible product suppliers and installers. The key issue is that these are both 'niche' areas which have not yet penetrated mainstream policy-makers and practitioners so demand remains isolated. Lack of expertise, or even basic knowledge, amongst development control officers has been cited as a particularly important obstacle.	
Perceptions of high cost and maintenance liability	HIGH
Many perceive green roofs to incur both substantial capital expenditure and significant maintenance liabilities. This is genuinely the case in some circumstances, but is highly dependent on the characteristics of each individual green roof. In many cases, establishment costs are relatively low and have very short-term payback periods, and are almost entirely self-sustaining. Moreover, the presence of a green roof provides protection to the roof structure and can significantly reduce the maintenance burden thereof. The life expectancy of roof structures can be doubled in many instances.	
Lack of political will	HIGH
There are no high-profile, recognised champions of green roofs in Greater Manchester, particularly amongst local politicians and business leaders. This is reflected in the weak policy position on green roofs across all local authorities.	
Lack of local demonstration projects	HIGH
There are several green roofs installed within the conurbation. However, access to these is generally limited and they are not promoted to a wide audience as demonstration projects. In particular, there is not a sufficient body of local examples to demonstrate the dynamic benefits of intensive and extensive green roof systems. *The experiences of Sheffield suggest that making green roofs accessible for educational visits can have a profound effect on the willingness of policy and development control officers to encourage and facilitate their inclusion on development projects.*	
Perception of risk (e.g. health and safety, fire hazard, structural loading etc)	HIGH
Perceived risks include heightened fire risk, impacts on building integrity arising from excessive structural loading, health and safety risks associated with maintenance, public access and the possibility of falling debris during extreme weather events. This is	

ISSUE / IMPEDIMENT	IMPACT SEVERITY
considered a persistent and major impediment to green roof delivery. *Some of these perceived risks arise from a lack of knowledge: in most cases, for example, green roofs improve the resilience of the building to fire, and in Germany discounted insurance premiums for buildings with green roofs reflects this. In addition, structural loading is an additional cost rather than a risk – a green roof cannot be erected under existing building regulations if the structure does not have sufficient strength. In other respects, as with all aspects of the built environment, risks are genuine but can be avoided or substantially reduced through careful design and management.*	
Misleading terminology	LOW
Some stakeholders have highlighted the terminology of 'green roofs' as being an issue in itself, and particularly because it can be misleading in many cases due to seasonal variations in roof appearance. Whilst this is not considered to be major impediment to green roof delivery, alternative terminology – such as 'Building Integrated Vegetation' – may be more helpful.	
Absence of definitive standard for green roofs	LOW
This is often cited as a key impediment to the greater take-up of green roof policies and delivery projects, but in many respects this can be considered a 'red-herring'. There can be no 'standard' approach to green roofs, each of which should be designed and installed to meet the particular requirements of the building, its context and the requirements of the client. That said, there are plans emerging for the development of a British Standard for Green Roofs and some form of 'quality mark' accreditation for installed schemes may be a useful tool for generating trust in green roof technology and concepts.	
Weak policy framework: nationally	MEDIUM
The absence of robust national policy is a significant issue in so far as it dilutes the impetus for local policies to be developed which require green roofs to be installed on new buildings. In the main, however, it is the local policy framework which impacts directly on the design of new developments.	
Weak policy framework: locally	HIGH
The absence of robust local planning policy for green roofs is a major barrier to their implementation. Despite the range of commercial and public benefits that can be delivered by green roofs, these remain poorly understood by the majority of developers, building owners and occupiers. Greater policy emphasis, with robust enforcement, would have a significant impact on green roof delivery in the context of new developments, as the Linz (Austria) example illustrates in the previous chapter.	
Lack of funding	MEDIUM
In respect of new buildings, perceptions of limited funding acting as a barrier to delivery implies that green roofs require significant capital expenditure above standard build costs. This is not necessarily the case, especially if a whole-life costing approach is adopted, with energy and water management benefits of green roofs taken into account. *It is definitely the case, however, that the limitations of available funding for capital works impedes the retro-fitting of green roofs to existing buildings, particularly as it can be difficult to monetise the revenue-saving benefits of green roofs in respect of, for example, reduced cooling loads.* *A key question in respect of both new and existing buildings however, is the extent to which broader funding programmes can be aligned to effect green roof delivery, particularly those concerned with regeneration and growth (a point considered in more detail in subsequent sections of this report).*	

7.3 These impediments operate individually and in combination. It is clear then, that any Green Roof Programme for Greater Manchester must seek to unlock these barriers using a suite of integrated tools and measures.

8. Resources and Funding Potential

Delivery capacity

8.1 There is an extensive network of 'green infrastructure' organisations and initiatives working in the quasi-public and voluntary sectors across Greater Manchester to which the delivery of green roofs would appear to be relevant. Recent research undertaken by The Mersey Basin Campaign on behalf of the GM Environment Commission attempts to map this capacity against a number of themes. This is shown in the table below, together with an indicative view of their respective potential roles in contributing to the objectives of a GM Green Roof Programme.

	BODY TYPE			OPERATIONAL SCALE					MODE					FOCUS										ANNUAL FUNDING			POSSIBLE RELEVANCE TO GM GREEN ROOF PROGRAMME				
	ORGANISATION	INITIATIVE	PARTNERSHIP	NATIONAL	NORHTWEST	MANCHESTER CITY REGION	PARTIAL CITY REGION		STRATEGY	INFLUENCE	DELIVER	ENABLING	RESEARCH	NATURAL ENVIRONMENT	BUILT ENVIRONMENT	CLIMATE CHANGE & ENERGY	ENVIRONMENTAL REGENERATION	RESOURCE EFFICIENCY	ENVIRONMENTAL INNOVATION	TRANSPORT	CULTURAL HERITAGE & EDUCATION	ACCESS		< £250K	£250K-£1m	£1M >	POLICY	DELIVERY	AWARENESS RAISING / CAMPAIGNING	POSSIBLE FUNDING SUPPORT	RESEARCH
100 MONTHS CLUB		■					■			■						■								■					■		
ACTION FOR SUSTAINABLE LIVING			■				■			■		■							■					■				■			
ACTION IRWELL			■				■				■						■							■				■			
ACTION MANCHESTER WATERWAYS			■				■				■						■							■				■			
BOLLIN VALLEY PARTNERSHIP			■				■				■			■							■				■			■			
BRIDGEWATER CANAL TRUST	■						■				■			■			■				■			■							
CLIMATE CHANGE AGENCY	■					■			■	■		■				■								■			■	■	■	■	
CROAL IRWELL REGIONAL PARK		■					■				■	■		■			■				■			■			■				
DESIGN FOR SUSTAINABILITY		■					■				■	■		■			■				■			■							
ENVIROLINK	■				■					■		■							■							■			■		
ENWORKS	■				■						■							■								■					
ESTAC GREATER MANCHESTER	■			■			■				■					■									■				■		
GM ARCHAEOLOGY UNIT	■						■				■		■		■						■			■							
GM ECOLOGY UNIT	■						■		■		■			■	■									■			■		■		
GM GEOLOGY UNIT	■						■				■		■	■	■									■							
GMWDA	■						■		■	■	■							■								■					■
GREEN INFRASTRUCTURE		■					■		■	■				■	■		■							■					■		
GROUNDWORK NORTHWEST	■				■				■	■		■					■								■		■		■	■	
GROUNDWORK MSSTT	■						■		■		■	■					■								■				■		
GROUNDWORK BURY & BOLTON	■						■				■	■					■								■				■		
GROUNDWORK OLDHAM & ROCHDALE	■						■				■	■					■								■				■		
GROUNDWORK LANCASHIRE WEST &	■						■				■	■					■								■				■		
IRWELL CITY PARK		■					■				■						■							■							
JOULE CENTRE			■			■							■				■			■						■					
LOW CARBON CITIES		■		■					■	■							■							■	■						
MANCHESTER ENTERPRISES	■						■		■	■							■									■	■		■	■	
MANCHESTER IS MY PLANET		■				■			■	■			■				■	■	■					■			■		■	■	■
MANCHESTER SALFORD PATHFINDER			■				■				■		■		■		■									■	■		■	■	
MAPAC			■			■			■	■			■	■												■					
MERSEY BASIN CAMPAIGN			■			■			■	■	■	■		■			■								■		■	■	■		
NATURAL ECONOMY NORTHWEST		■			■				■	■			■	■	■											■	■		■		■
NEWLANDS		■			■						■			■	■		■							■			■			■	
PENNINE EDGE FOREST			■				■				■			■			■							■			■	■		■	
PENNINE PROSPECTS			■				■				■			■			■							■							
RED ROSE FOREST	■		■				■		■		■	■		■	■	■	■	■	■		■			■			■	■	■	■	
SUB-REGIONAL FLOOD RISK ASSESSMENT		■				■			■	■			■	■	■		■														■
WEST PENNINE MOORS PARTNERSHIP			■				■				■	■		■							■	■		■				■	■		
WIGAN GREENHEART REGIONAL PARK		■					■				■	■		■			■							■				■	■		
GMPTA / GMPTE	■					■			■		■									■				■		■					
SPIGS (PLANNING)		■					■								■									■			■				
WATERWAYS WORKING GROUP (CANALS)		■					■										■							■							
LOCAL AUTHORITY CARBON TRADING		■					■				■					■								■							
MANCHESTER AIRPORT	■				■						■									■				■		■		■			
PEAK DISTRICT NATIONAL PARK	■						■				■			■							■			■				■	■		
SURF	■			■									■	■			■							■				■			■
NWDA	■				■				■	■		■	■	■	■	■	■	■	■	■	■	■		■		■		■	■	■	■	■
HOMES AND COMMUNITIES AGENCY	■			■					■	■	■	■	■	■	■	■	■	■	■	■	■	■		■		■		■	■	■	■	■
GONW	■				■				■	■				■	■	■	■	■	■	■	■	■		■		■	■					
BRITISH WATERWAYS	■			■					■					■	■		■		■	■	■	■		■		■		■		■		
BTCV	■			■					■		■			■	■		■							■		■		■		■		
CABE	■			■					■	■				■	■		■							■		■	■				■	
CARBON TRUST	■			■					■	■	■													■		■			■	■		
DEFRA	■			■					■	■			■	■	■	■					■			■		■	■			■	■	
ENCAMS	■			■					■	■				■	■									■		■	■		■			
ENGLISH HERITAGE	■			■					■	■			■	■	■									■		■						
ENVIRONMENT AGENCY	■			■					■					■	■		■		■		■			■		■	■		■	■		
NATURAL ENGLAND	■			■					■					■								■		■		■	■		■	■	■	■

Adapted from The Mersey Basin Campaign (2009) for the GM Environment Commission

8.2 Intelligence on this conurbation-wide capacity is supported by feedback from delegates who attended the recent Stakeholder Workshop. Each delegate was asked to indicate their potential interest or role in contributing to the proposed objectives of the Green Roof Programme. Responses are summarised below.

Potential Interest or Role	Organisation
Demonstration Sites Use of buildings within ownership for the installation of green roofs to act as demonstration projects	Bruntwood MMU Whitworth Art Gallery
Technical Assistance Technical design, feasibility, modelling different building solutions	Faber Maunsell [AECOM] Arup
Research and Guidance Developing the evidence base, project management, training coordination	Red Rose Forest MMU University of Manchester University of Salford
Championing through Policy Green roof policy development, political support, influencing Building Regs.	Local Authorities AGMA
Championing the Practical Actions Incorporating green roofs into Biodiversity Action Plans, roll out of delivery through local networks, retrofitting commercial property, support via potential new development projects.	Red Rose Forest GM Biodiversity Project Groundwork Manchester Great Places Housing Group
Enabling Working with contractors, reduced water charges (UU)	Stockport MBC United Utilities

8.3 It is clear that there is significant potential capacity and will across Greater Manchester to contribute to the delivery of the proposed Green Roof Programme objectives. However, this is largely uncoordinated and there are no organisations or initiatives which are focused specifically on green roof delivery.

Funding

8.4 Similarly, there is no distinct funding stream which has a specific purpose of facilitating green roof installations. There are however, a range of environmentally-focused grants for greenspace and green infrastructure implementation which could be exploited to realise green roofs within the conurbation, although this will largely be restricted to relatively small-scale, individual projects. There is certainly no distinct funding stream that could be used to underpin mass delivery of green roofs in Greater Manchester, particularly in respect of existing buildings.

8.5 Potential funding opportunity can be distinguished between four principal categories, as the table below (incorporating a non-exhaustive list of funding examples) illustrates:

Funding Category	Examples
Green Infrastructure Project Funding	*Big Lottery Fund Community Spaces (Groundwork UK)* The Community Spaces programme, run by Groundwork UK, opened on 19 March 2008. It funds community groups who want to improve local green spaces. There are currently four types of grants available: Small grants from £10,000 -£25,000 (available until Jan 2011) Medium grants from £25,001 - £49,999 (available until Jan 2011) Large grants from £50,000 - £100,000 (now closed) Flagship grants from £100,001 - £450,000 (now closed)

Funding Category	Examples
Green Infrastructure Project Funding (continued)	*Big Lottery Fund Ecominds (Mind)* The Ecominds programme, run by Mind, opened on 18 September 2008. This programme is for a range of groups who want to encourage people with experience of mental distress to get involved in environmental projects, such as improving open spaces and wildlife habitats, designing public art and recycling. Grants available: Small - up to £20,000 Medium – from £20,001 up to £60,000 Large – from £60,001 up to £150,000 Flagship – from £150,001 up to £250,000 (approximately five grants will be awarded within this category). The following England based groups may apply to Ecominds: Mental health, environmental, and community groups, commercial organisations running projects on a not-for-profit basis, including Community Interest Companies (CICs) and Social Enterprise companies where project profits are reinvested solely into the Ecominds project. This programme will not fund individuals, statutory authorities (although applications from organisations working collaboratively with such bodies will be welcomed), projects aligned with or co-funded by pharmaceutical companies and applicants and projects based outside of England.
	Countdown 2010 Biodiversity Action Fund (Natural England) This £5.5 million fund was launched on 22 May 2008 to help achieve the UK government's commitment to halt the loss of biodiversity by 2010, through supporting the recovery of priority species and habitats in England.
	Aggregates Levy Sustainability Fund Grant Scheme (Natural England) The broad purpose of the Fund is to reduce the effects of aggregates extraction on the environment and local people. They will award grants in support of projects which involve and will deliver clearly defined benefits in terms of one or more of the following general themes: Landscape & Nature Conservation Access & Informal Recreation Health and Wellbeing Education and Understanding Evidence Gathering Applicants must be able to demonstrate a clear link between the project and the negative impacts of aggregate extraction on the community and environment. It will therefore only be applicable in limited areas of the conurbation. THE APPLICATION PERIOD FOR THE 2009-11 SCHEME CLOSED IN APRIL 2009
	Landfill Communities Fund (SITA Trust) The Landfill Communities Fund (formerly the Landfill Tax Credit Scheme) is a funding scheme for community and environmental projects close to landfill sites. The fund enables landfill operators to contribute 6.6% of their landfill tax liability to not-for-profit environmental bodies for allocation to eligible projects. SITA UK provides this funding to SITA Trust, who support community and environmental improvement projects through the LCF. The are several funds under LCF, including Enriching Nature 2009. This provides grants for biodiversity projects within 10 miles of a landfill site, with the following grants available: Small Fund: projects up to £25,000 - projects of this value should ideally meet national and regional priorities for species and habitats, but local priorities will also be considered. Large Fund: projects up to £175,000 - projects of this value must meet national priorities for species and habitats.
	NWDA Single Pot The NWDA funds a wide range of sustainable economic development activities, including the delivery of the buildings and infrastructure. There is a bespoke NWDA Sustainable Buildings Policy against which eligible projects must be compliant, and towards which the incorporation of green roofs into development projects could contribute. Future reviews of this policy are likely to focus more significantly on climate adaptation than is currently the case.

Funding Category	Examples
Carbon Reduction Project Funding	*Carbon Trust Grants* Up to £250k grants for innovative projects to reduce greenhouse gases.
	Enhanced Capital Allowances ECAs provide a tax relief mechanism where 100% of Capital Expenditure on approved (energy and water efficient) plant and machinery can be recovered. Although administratively burdensome, this has can have major, positive implications for the commercial viability of delivering new build and refurbishment projects to higher environmental standards, thereby avoiding pressure on short-sighted value engineering at the expense of quality delivery. This is not currently a valid form of funding for green roofs because only internal fittings and services are approved within the scheme. However, there is growing support for the extension of the ECA scheme to include improvements to building fabric which deliver energy and water efficiency benefits. This may therefore become a valuable form of funding in the future for tax-paying organisations.
Strategic Environmental Funds	*LIFE + (European Commission)* The LIFE+ Programme is implemented by the European Commission on the basis of annual calls for proposals. Around 78 per cent of the funding will be used for project grants in Member States, with 50 per cent of this dedicated to "Nature" and "Biodiversity". At least 15 per cent of the total allocated to project grants will fund transnational projects. The remainder of the funding will be used for operational expenses and to fund activities that have a more trans-European character, such as support for NGOs. There are several components to the LIFE+ Fund, including: LIFE+ Biodiversity - co-financing demonstration or innovation projects that contribute to the implementation of the Commission's Communication "On halting the loss of biodiversity by 2010 – and beyond". LIFE+ Environment Policy and Governance - contributing to the development of innovative policy approaches, technologies, methods and instruments and the building up of the knowledge base regarding environmental policy and legislation. LIFE+ Information and Communication - co-financing projects dealing with dissemination of information, raising awareness and developing specific skills on environmental issues. LIFE+ funding may be a significant source of funding for strategic elements of the Work Programme, particularly if a transnational dimension can be drawn, perhaps with one or more cities identified in Chapter 4 of this Report.
	Seventh Framework Programme (FP7) FP7 supports research and development activities in the EU, including those within the 'Environment (including climate change)' and 'Food, Agriculture and Fisheries and Biotechnology' themes.
Area-Based Initiatives	*Housing Growth Point (Communities and Local Government)* To deliver an appropriate mix of additional housing across Greater Manchester - initially focused on the Cities of Manchester and Salford and the Boroughs of Bolton and Trafford. This will be through public funding to tackle a range of different development constraints that will assist homebuilders to provide the types and numbers of homes that Greater Manchester requires. The timescale for the Growth Point is expected to extend to March 2017, and particularly in the current housing market, will involve Councils working closely with a full range of partners from both the public and private sector to stimulate and co-ordinate delivery. In theory, funding is dependent on a number of critical evidence bases being established, including in relation to flood risk and water cycle management.
	Housing Market Renewal (Communities and Local Government) £2bn worth of investment to parts of Oldham and Rochdale over the next 15 years, to create a better choice of homes in thriving neighbourhoods. Work will include: Building thousands of modern, well-designed new homes. Demolishing some derelict, poor quality or outdated homes and properties that are in unpopular areas of housing. Refurbishing some existing homes. Improving areas of open green space. Helping to create jobs, reduce crime and improve the area's prosperity and attractiveness.

Funding Category	Examples
Area-Based Initiatives (continued)	*Corridor Manchester* £1.5bn of funding to enhance the economic performance of the Oxford Road corridor extending from the vicinity of Manchester Town Hall through to the University and the University Hospital. The programme includes specific emphasis on improving environmental quality and green spaces, and all five building feasibility studies to be conducted as part of this Feasibility Study are located within the Corridor.

8.6 The major opportunity, therefore, rests in the potential to integrate the delivery of green roofs as an outcome of large-scale regeneration and growth programmes, with green roofs integrated into the wider green infrastructure of these programmes of physical renewal and change. This will be a major challenge though, and will rely on a concerted effort of awareness raising and capacity-building amongst those responsible for the delivery of programmes, and particularly to ensure that a robust approach is taken on the requirement of green roof installation as part of commercial and residential Development Briefs, and Terms of Reference for projects procurement with public capital.

8.7 This gives weight to a view expressed at the recent Stakeholder Workshop that there is a particular need for a coordinating role (a “Green Roof Tsar”) across the city region to ensure that best use is made of all available funding sources, and particular those in areas of area-based physical change.

9. Parameters of a Work Programme

9.1 This Feasibility Study has shown clearly that, whilst there appears to have been a recent notable increase in the number of green roof installations on new commercial buildings in the City of Manchester, there remains a lack of coherence and at-scale delivery across the conurbation generally. To this end, and taking account of the range of issues, impediments and opportunities identified in this element of the Feasibility Study, a Greater Manchester Green Roof Programme is proposed which seeks:

> *to substantially increase the installation of green roofs on new and existing buildings across Greater Manchester, ensuring a conurbation that is resilient to the impacts of climate change, a model of low-carbon economic transition, whilst affording excellent quality of life and environmental benefits.*

9.2 This broad aim, which has been endorsed by the Study Steering Group and delegates at the recent Stakeholder Workshop held to inform the Study, is supported by the following core objectives:

	GM Green Roof Programme Objective
1	Strengthen the leverage of sub-regional and local policy frameworks to deliver green roofs through economic and property development activities
2	Optimise the use of the public sector estate as a demonstrator of green roof interventions
3	Position Greater Manchester as a UK leader in the use of green roofs as an intelligent response to social, economic and environmental pressures
4	Realise at-scale green roof delivery as an infrastructural component of mainstream regeneration and growth programmes
5	Prioritise intervention where the potential for public benefit delivery is greatest
6	Enable the installation of green roofs through use of fiscal incentives
7	Improve knowledge of green roof benefits of policy-makers, developers and property investors across the conurbation.

9.3 A GM Green Roof Programme should therefore incorporate a number of integrated workstreams which respond directly to these core objectives. Whilst it is not within the scope of this Feasibility Study to establish a detailed implementation strategy for such a Work Programme, it is incumbent on the Study to establish the broad scope.

9.4 The schedule overleaf sets out a range of workstreams and component outputs which are considered appropriate and necessary for the coherent and balanced approach to green roof delivery across Greater Manchester.

	Programme Objective		Key Task / Output	Timescale	Possible Lead	Major Resource Implications
	Programme Management and Monitoring	(i)	Secure core funding for a Programme Manager post, combining (where possible) private sector support with strategic investment streams from the city-region, Europe and national government.	By Oct 2009	Manchester City Council GM Environment Commission	
		(ii)	Appoint fixed-term Programme Manager, initially for three-years. Principal function of role is to act as the *GM Green Roof Tsar*: connect activity, identify opportunity, disseminate knowledge champion benefits, thought leadership etc.	By Oct 2009	Groundwork Northwest Red Rose Forest GM Climate Change Agency Local Authority	Core salary funding and on-costs (c. £ 60K per annum).
		(iii)	Commission independent review of progress against each of the Programme Objectives on an annual basis.	By Sept 2010	GM Environment Commission	Consultancy fees – budget estimate of £12K per annum for three years
1	Strengthen the leverage of sub-regional and local policy frameworks to deliver green roofs through economic and property development activities	1a	Publish GM Green Roof Guidance. Seek endorsement from RIBA, Landscape Institute, TCPA, RTPI and RICS.	July 2009	Commission for the New Economy, GM Planning & Housing Commission, GM Environment Commission (jointly)	Publication costs
		1b	Monitor and align policy development to the Code of Practice being developed by the Sheffield Green Roof Centre.	By Dec 2009	Programme Manager	
		1c	Work with each of the ten AGMA authorities to incorporate the Green Roof Guidance and related Code of Practice into statutory planning policy.	Oct 2009 – Sept 2010	Programme Manager on behalf of GM Planning & Housing Commission	
2	Optimise the use of the public sector estate as a demonstrator of green roof interventions	2a	Identify programme of civic estate refurbishment across the ten local authorities, as well as any collaborative public sector partners, and devise related green roof viability schedule and implementation plan.	Oct 2009 – March 2010	Programme Manager with the support of LA Corporate Services teams	
		2b	Incorporate green roof specification into Manchester Town Hall Extension Development Brief as flagship opportunity.	As soon as possible	Manchester City Council	
		2c	Establish and introduce 'standard' green roof clauses for incorporation into public procurement frameworks and contracts for capital works.	By April 2010	Programme Manager working with Local Authority Procurement Managers	
3	Position Greater Manchester as a UK leader in the use of green roofs as an intelligent response to social, economic and environmental pressures	3a	Develop Communication Strategy for dissemination of Greater Manchester green roof activity to external audience		GM Environment Commission working with Marketing Manchester	
		3b	Seek to host the International Green Roof Congress http://www.greenroofworld.com/	May 2012	GM Environment Commission working with Marketing Manchester and Manchester City Council	
		3c	Develop and maintain the schedule of existing and planned green roof projects across Greater Manchester	Ongoing	Programme Manager working with LA planning and environmental services departments	

	Programme Objective		Key Task / Output	Timescale	Possible Lead	Major Resource Implications
4	Realise at-scale green roof delivery as an infrastructural component of mainstream regeneration and growth programmes	4a	Explore the viability of incorporating Green Roof delivering into the terms of reference for a GM or LA ESCO (widen remit to create MUSCO)	Oct 2009	GM Climate Change Agency	
		4b	Design and establish a GM-wide revolving fund for green roof retrofits, including the use of national and European funding for set-up where possible (use energy & drainage savings as basis of repayment)	April 2010	GM Climate Change Agency (or other relevant delivery body) on behalf of GM Environment Commission	£5m seed fund (to be confirmed to reflect targets developed under Task 5a)
		4c	Establish green roof position statement and implementation policy for Manchester Growth Point (incorporate into design briefs for specific development schemes – link to Task 2b)	Oct 2009	Housing & Planning Commission (+GM Environment Commission) working with the HCA, CLG and GM Growth Point	
5	Prioritise intervention where the potential for public benefit delivery is greatest	5a	Establish green roof delivery targets for new and existing buildings that are aligned directly to the following green infrastructure investment priority areas: Climate change adaptation Housing & economic growth Urban renaissance Areas of accessible natural green space deficit	By Oct 2009	GM Housing & Planning Commission and GM Environment Commission	Consultancy budget of £15K
		5b	Reflect spatially-defined delivery targets in local authority planning policy (link to Task 1c)	Oct 2009 - Sept 2010	Programme Manager on behalf of GM Planning & Housing Commission	
6	Enable the installation of green roofs through use of fiscal incentives	6a	Engage with United Utilities to explore the potential for water rates reductions for properties with installed green roofs (especially intensive roofs)	As soon as possible		
		6b	Lobby government to extend the Enhanced Capital Allowances scheme to incorporate building fabric measures into the approved list of eligible expenditure.	By March 2010	AGMA + commercial property partners	
		6c	Engage with the British Property Federation and other relevant bodies in the consideration of additional fiscal incentives for green buildings. Seek delegated authority to reflect green roof installations in Council Tax and Business Rates.	Immediately	Drivers Jonas LLP	
		6d	Engage with the Green Roof Centre, GRO and other relevant bodies to influence the Association of British Insurers to accept reduced insurance premiums for Code-compliant green roof installations.	To be determined	Programme Manager	

	Programme Objective		Key Task / Output	Timescale	Possible Lead	Major Resource Implications
7	Improve skills and knowledge of green roof benefits of policy-makers, developers and property investors.	7a	Establish a GM sub-directory of 'approved' suppliers and contractors for the installation and maintenance of green roofs, highlighting those that are based within the conurbation http://www.greenroofstoday.co.uk/index.php?id=directory	By December 2009 + ongoing maintenance	GM Climate Change Agency (or other relevant delivery body) on behalf of GM Environment Commission	
		7b	Establish GM Green Roofs website, based on the sector-based structure anticipated of the Green Roof Guidance document but as a 'live' portal for case studies, evidence, notification of funding opportunities etc.	By April 2010 with ongoing maintenance		
		7c	Measure the impact of future green roof installations on building revenue costs (using the five feasibility studies as a minimum)	Ongoing	Programme Manager, GM Environnent Commission	
		7d	Deliver green roof training (in association with the Green Roof Centre where appropriate) targeted at the following key groups: Architects, developers and development control officers Policy officers and public procurement officers Building owners and occupiers	Annual programme 2009-11	Programme Manager	
		7e	Establish exchange visits with key cities (Sheffield and London in the first instance) to share good practice and provide opportunity for demonstration site visits	Annual programme 2009-11	Programme Manager, LDA, Green Roof Centre (Sheffield)	
		7f	Establish a network of local, accessible green roof demonstration projects	By April 2010 with ongoing maintenance	Programme Manager + public, private and voluntary sector partners.	

10. Governance

10.1 Getting the governance arrangements right for the GM Green Roof Programme will be critical to its traction, particularly with mainstream regeneration and growth programmes.

10.2 The emerging AGMA governance arrangements, predicated on a system of semi-independent thematic Commissions reporting to the AGMA Executive Board (as shown in the diagram below), provide a sophisticated but ultimately challenging governance context within which the Programme would operate.

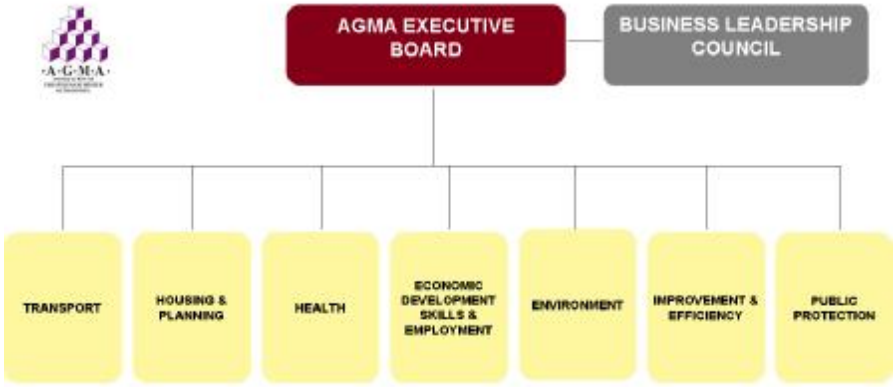


Figure 10.1 - AGMA Governance Structure

10.3 There is no question, however, that the Green Roof Programme should form part of the work programmes of one or a number of the AGMA Commissions. Its conurbation-wide scale and the resonance of the programme with a wide range of strategic policy goals, not least in relation to low-carbon transition and climate change adaptation, mean that it would be inappropriate for it to be 'hived-off' as an activity peripheral to the city-regions core policy and interventionist activities.

10.4 The key question is which of the AGMA Commissions should most appropriately assume the lead role for the Programme. The following would appear to be the principal options:

- **Commission for the New Economy**: the Programme would sit well with the city-region's aspirations to deliver deep emissions cuts in the built environment as a fundamental component of low-carbon economic transition, and would also deliver a number of economic benefits. However, these are not likely to be sufficient in their own right to force the programme towards the fore of the Commission's agenda, and there would be a potential risk of programme slippage and under-investment were this to be the case.
- **GM Environment Commission**: perhaps the most obvious and natural home given the incorporation of natural environment (incorporating green infrastructure) and climate change resilience into the work programme of the Commission. There are also indirect synergies with the sustainable consumption and production elements of the Commission's programme. Perhaps most significantly, the principal alignment of the GM Climate Change Agency to the Environment Commission provides the potential for a close, symbiotic relationship for delivery-focused activity, in addition to that of the policy elements of the programme. However, it is important to be realistic about the political 'weight' of the Environment Commission and the extent to which it can seriously catalyse traction with major, 'mainstream' investment programmes such as the Growth Point and the Manchester Corridor.

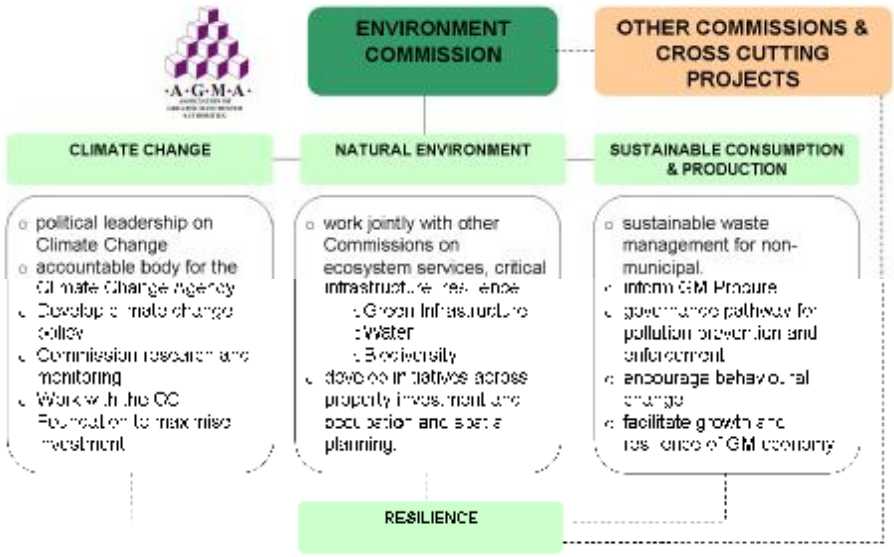


Figure 10.2 – Scope of the GM Environment Commission work programme

- **Housing & Planning Commission**: the need to secure planning policy support for green roof installation across the ten AGMA authorities makes this Commission an important agent in the success of the programme, particularly in respect of new development. However, the capacity of the Commission to effect delivery in the case of retrofitting may be limited.

10.5 Ultimately, each of these three Commissions offers advantages and limitations, and are pertinent to varying elements and objectives of the proposed Green Roof Programme. It is helpful, therefore, to consider the Work Programme in two distinct – but interrelated – elements: *developing policy* and *enabling delivery*.

10.6 It is suggested that, **in respect of developing policy, the Housing and Planning Commission would the most appropriate lead Commission**, **whilst the GM Environment Commission would be more directly attuned to the delivery aspects of the programme**, albeit that this would probably need to be implemented through a delivery agent, such as, for example, the GM Climate Change Agency, Red Rose Forest or Groundwork Northwest.

10.7 The GM Climate Change Agency, in particular, is seen as the natural delivery agent for the AGMA Commissions structure for a programme of this nature, given its direct alignment in governance terms and the strength of political focus on its role in enabling low-carbon transition across the conurbation.

10.8 The need for a coordinated, independent appraisal of annual progress against the Work Programme objectives (as proposed in Chapter 9) would also be important. This could be commissioned to independent advisors by the Environment Commission acting in a scrutiny capacity for the overall programme.

Appendix One: Stakeholder Workshop Delegates

Name	Organisation
Frank Addison	University of Manchester
Alex Alarcon	Drivers Jonas LLP
Hannah Bartlett	Great Places Housing Group
Jo Beggs	Whitworth Art Gallery
Corin Bell	Green City Team
Eriola Bocaj	Unviversity of Manchester
Dave Boughen	United Utilities
Nick Buck	Drivers Jonas LLP
Maynard Case	University of Manchester
Matt Cawley	Drivers Jonas LLP
John Forrester	MMU
Jane Frearson	Great Places Housing Group
Martin Gizzie	Bruntwood
Ruth Groarke	Great Places Housing Group
Frank Hayes	EDAW AECOM
Chris Hewson	University of Manchester
John Hindley	MMU
Fran Mchale	Bury Borough Council
Tony Hothersall	Red Rose Forest
Ros Howell	MMU
Philip James	Salford City Council
Angie Jukes	Stockport Council
Andrew Karvonen	University of Manchester
Eric Larmett	Arup
Susan Lee	University of Manchester
Nick Linder	Groundwork MSS TT
Jon Lovell	Drivers Jonas LLP
Lucy Lush	Greater Manchester Biodiversity Project
Brian Morris	Beverley Clifton Morris (BCM)
Martin Moss	Natural England
Kate O'Donnell	Tameside Borough Council
Mei Ren	Faber Maunsell AECOM
Gordon Richardson	Arup
Daniela Ripa	Trafford Metropolitan Borough Council
Mike Robinson	Arup
Nicholas Roche	The Mersey Forest
Zoe Rushton (on behalf of Hannah Hill)	Manchester City Council - Property Strategy
Jonathan Sadler	Manchester City Council
Alison Salter	Great Places Housing Group
Cynthia Skelhorn	University of Manchester
Claire Smith	University of Manchester
Jeff Sorrill	The Green Roof Centre
Jessica Thompson	Red Rose Forest
Steve Turner	Manchester Enterprises Ltd
Matthew Westbrook	Trafford Metropolitan Borough Council