Green Infrastructure in Greater Manchester Project

Phase 1 – Final Report

Contents

MAPS

SUMMARY

The Greater Manchester Green Infrastructure Project was set up by the Association of Greater Manchester Authorities to advise spatial planning as part of the consultation on the Regional Spatial Strategy. This report sets out the results of Phase 1 of the Project, which aimed to:

1. Examine existing datasets to assess which would be of value is drawing up a Green Infrastructure Plan for the County
2. Map the existing Green Infrastructure resource and the functions it performs

Datasets from a wide range of sources were assessed, with information provided by the individual Districts being of particular importance.

The study found that sufficient datasets exist (or are readily created) to enable a working analysis of Green Infrastructure to be undertaken. In particular the County is fortunate to have an existing land use dataset, the Urban Morphology Types (UMTs) developed by the Centre for Regional and Urban Ecology (CURE), University of Manchester. UMTs were developed based on visual interpretation of AGMA aerial photography. By combining academically rigorous studies on the attributes of UMTs with more subjective but transparent assessments, useful mapping of Green Infrastructure functions at the County level can be carried out.

Initial mapping suggests that Greater Manchester has substantial areas where Green Infrastructure is delivering a range of benefits, including:

- Flood risk management through water storage capacity or run-off interception
- Providing facilities for recreation, so improving health and well-being
- Providing an attractive landscape, generating a positive image with associated benefits for residents, visitors and businesses
- Controlling temperatures though shade and other cooling effects
- Reducing and removing air and water pollution
- Providing habitats for animals and plants

However, there are many areas where Green Infrastructure benefits are not being fully realised, and there is potential for improving Green Infrastructure, particularly in Regeneration Areas.

The report assesses the provisional mapping and makes recommendations for Phase 2 and for future District Green Infrastructure planning.

The implications for these findings in terms of policy and future work will be addressed by Phase 2 of the Project.

1 INTRODUCTION

1.1 This report records the work undertaken as Phase 1 of the Greater Manchester Green Infrastructure Project, undertaken by Red Rose Forest on behalf of the Project Steering Group (see Appendix 1). The brief for the Greater Manchester Green Infrastructure Project was:

> To identify in spatial and functional terms, the strategic Green Infrastructure resource for Greater Manchester so as to inform spatial planning policy development for the region, sub/city regions and local districts and to support effective scoping and targeting of green infrastructure delivery programmes.

1.2 The Project identified a number of Key Tasks, initially broken down into 3 phases:

Phase 1

- assemble, collate and review available research data/studies both statistical and map based with an assessment of reliability, comprehensiveness, and compatibility, gaps and weaknesses in data etc;
- mapping of key GI locations and an initial assessment of multi functionality with any available evidence/surveys e.g. from SFRA, Ecological Framework etc;

Phase 2

- scoping and review of key strategic sub regional and local spatial planning, area masterplanning and regeneration strategies, greenspace strategies, regeneration programmes with relevance to GI planning and delivery;
- Illustrate good practice as finer grain examples at City Region, District and local area level which could include East Central Rochdale HMR Greenspace Survey, Central Salford, Media City project, Kingsway strategic employment site, Rochdale.

Phase 3

- Recognition of synergies required with other GI studies such as in Lancashire and the South Pennines;
- Identification of key recommended additional studies/assessments, targets/outputs and outcomes required in Greater Manchester to form the basis of a developing GI strategy and framework for the City Region to inform spatial planning and regeneration strategies and programmes.

1.3 It was agreed that Phase 1 would be undertaken on behalf of the Group by Red Rose Forest, and was supported by by Natural England. Phases 2 and 3 would be combined and undertaken by selected consultants, funded jointly by AGMA and Natural England.

1.4 The key tasks for Phase 1 of the project would be:

- Agree strategic functions of Green Infrastructure for Greater Manchester
- Agree a framework for dataset assessment
- Identify sources of data, including the Greater Manchester Ecology, Geology and Archaeology Units
- Review datasets
- Map functions (e.g. in terms of core areas/hot spots, gaps/omissions, anticipated areas of opportunity), ensuring links can be followed back to the raw data behind the mapped data.

2. REVIEW OF KEY TASKS

2.1 Strategic Functions

2.1.1 The Group identified the following Strategic Functions for the project to examine:

- Flood risk management
- Conservation and enhancement of an ecological framework and associated sites and habitat networks
- Creation and enhancement of strategic recreational routes and corridors/gateways
- Assisting historic environment and landscape character conservation
- Principal river and canal corridor management
- A positive image and environmental quality as part of a sustainable strategic road and rail network
- A positive role for existing and new greenspace in planning and developing strategic urban regeneration areas (which could include a combination of previous functions)

2.1.2 The Group also considered whether Climate Change adaptation and remediation should be considered as a separate Strategic Function, given the prominence this subject has received in other GI studies (e.g., Gill et al 2007, NWGITT 2007, ECOTEC 2007). However, it was decided that for Phase 1 it would be preferable to look at current climate-related benefits as part of the above functions (e.g., rainfall interception, temperature moderation through shade or evapotranspiration) and consider climate change as a Key Policy Driver under Phase 2, affecting not only climate management but also health, ecological networks, tourism/leisure, etc.

2.2 Dataset Assessments

2.2.1 PROGRESS/ ACTIONS UNDERTAKEN

2.2.1.1 Draw up framework for assessment: An assessment framework in tabular format, with a graphic indication of potential relevance, was drawn up and revised following input by the Steering Group.

2.2.1.2 Assess data held by RRF: The Red Rose Forest has a substantial amount of accumulated GIS data and assessment of this enabled the project to make significant early progress.

2.2.1.3 Compiling information from Districts: An initial email request was sent to all members of the Spatial Planning SPIGlet, introducing the project and requesting relevant information on CD. It became evident from the wide variety of responses that this email could have been clearer, and so further requests were made direct to identified officers for specific types of data.

2.2.1.3 Trawl gateways: GIS and mappable data are available from a wide range of internet sites e.g. MAGIC, Office of National Statistics, Natural England. These were used to help draw up a 'long list' of datasets to be assessed.

2.2.1.5 Greater Manchester Units: The Steering Group identified that substantial amounts of relevant work had already been undertaken by the Greater Manchester Geological, Ecology and Archaeology Units. In particular, the recent GMGU constraint study had involved compiling many datasets, and this study was examined before obtaining those GIS datasets identified as of potential use. Meetings were also held with the Ecology and Archaeology Units to look at current work.

2.2.1.6 Discuss with colleagues in RRF/Mersey Forest: Red Rose and Mersey Forests have been involved in Green Infrastructure work from an early stage and have developed expertise in developing the approach at a number of geographical scales. Colleagues have provided much useful information on mapping, categorising and assessing Green Infrastructure.

2.2.1.7 Meet with Manchester University re Urban Morphology Types: At an early stage in the project it became apparent that the Urban Morphology Types (UMT) dataset developed by the University of Manchester Centre for Urban and Regional Ecology (CURE) had significant potential for GI mapping. Sarah Lindley, Co-Director of CURE, provided substantial assistance in accessing and using the UMTs, both through meetings and email.

2.2.2 ISSUES ARISING

2.2.2.1 Greenspace vs Green Infrastructure: Because Green Infrastructure is a relatively new concept, it became apparent that very few datasets have been developed with this approach in mind – most are more suited to the more traditional 'greenspace' approach, auditing public open spaces to identify recreational facilities, large areas of habitat or landscape character. Assessment had therefore to focus on whether these datasets could be adapted or interpreted to a GI approach.

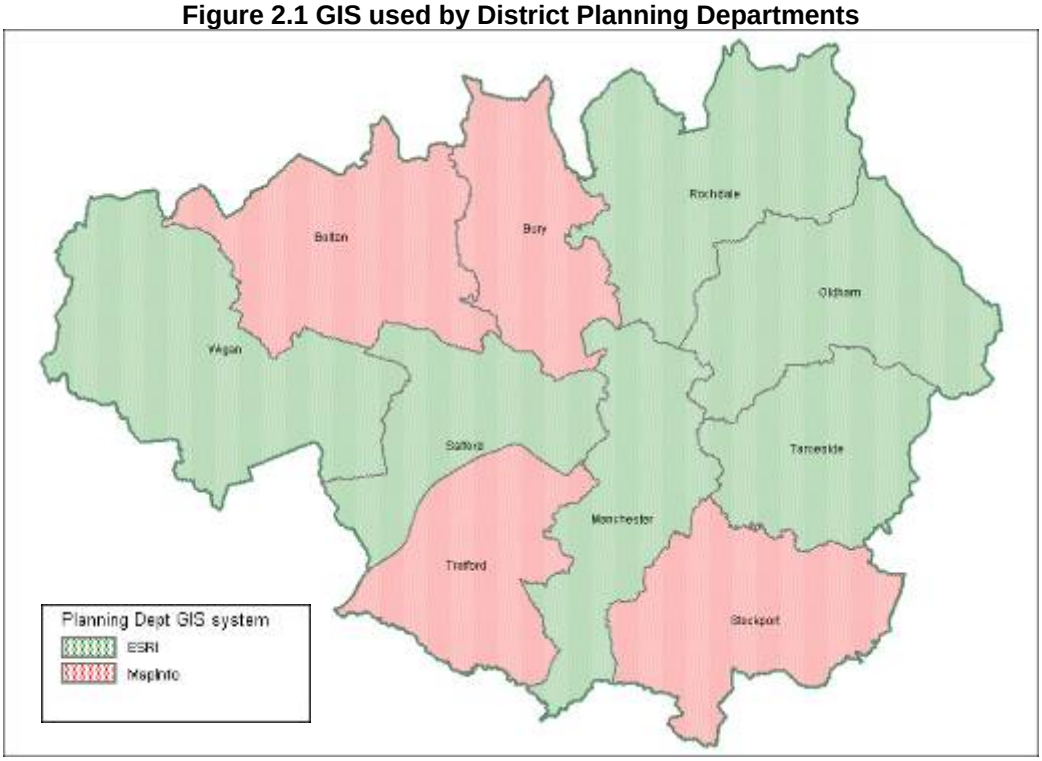
2.2.2.2 Scale: Working at a County level means many datasets are not readily usable due to scale – sites are too small to be seen at a Greater Manchester scale, or are so few in number as to provide little useful information. In addition, some datasets are at too high a resolution, becoming indistinct and often taking an unacceptable time to load on computer. This is a particular problem in selecting a Green Infrastructure base or 'fine-detail' layer. An assessment of three main options for this layer – OS Mastermap, district Greenspace Audits and UMTs – is set out below:

Table 2.1 Options for GI base layer

Option	OS Mastermap	Greenspace Audits	UMTs
Coverage of GM	Complete	Incomplete	Complete
Level of interpretation	Low	Some	Substantial
Coverage of components of GI	Covers all key components of GI though some reservations on accuracy	Does not usually include key components of GI e.g gardens, grounds, porous surfaces etc.	Includes generalised info on key components of GI
Most suitable for:	Local green infrastructure planning	District green infrastructure planning	County green infrastructure planning

2.2.2.3 Format: Datasets were identified in a number of formats, including different GIS programs, Excel spreadsheets and Access databases. Even among the Planning Departments of the Districts, data is held in two different GIS formats, MapInfo tables and ESRI shapefiles, as shown below.

Figure 2.1 GIS used by District Planning Departments



2.2.2.4 Data Structure: Districts have provided information with widely differing data structures, ranging from holding all UDP data in 7 theme layers to having over 50 layers of information. This means that assessment has to be approached on a district-by-district basis, and direct comparison is often very difficult.

2.2.2.5 Coverage: Datasets were identified with national, regional, and county coverage, all of which were potentially useful for this project. In addition, several datasets were based on project area (especially Red Rose and RRF/Mersey Forest areas) – while most of these did not have any detail outside the project area, and so were assessed as not suitable, some (e.g. RRF Strategic Access Project) did contain some information across the county and were used.

2.2.2.6 Duplication/overlap: Some datasets, particularly those already held at Red Rose Forest, have substantial duplication/overlap with other datasets – for example, four datasets of Motorway data were assessed, all with slightly different information. This has required some time checking to see which versions are the most appropriate, and on some occasions required composite layers to be created.

2.2.2.7 Metadata: 'Metadata' is data about data – e.g. who produced it, when it was produced, how it was produced, why it was produced, where it covers, any reservations about accuracy, whether it is complete or not. Best Practice in GIS management is to maintain metadata for all layers, but in reality this is rarely done, and so there can be considerable uncertainty about datasets. An advantage of ESRI datasets is that metadata can be incorporated in the files themselves, and all ESRI datasets produced or modified by Phase 1 of this Project have metadata forms completed.

2.3 Mapping of Green Infrastructure Functions

2.3.1 PROGRESS/ ACTIONS UNDERTAKEN

2.3.1.1 Obtain datasets: Where datasets had been identified as useful from paper or other non-GIS maps, the oirginal datasets were obtained, completing any licence documentation as required**.**

2.3.1.2 Convert to ESRI shapefiles: While the relevant datasets were in MapInfo and ESRI formats in roughly equal proportions, and files can readily be converted between formats, it was decided that ESRI offered the greatest potential for processing and analysis of the data.

2.3.1.3 Combine datasets to form Key Layers: For ease of processing and analysis, Key Layers were generated from other datasets, particularly the District data.

2.3.1.4 Trial mapping of UMTs: In order to explore how the UMTs could be used to show various aspects of green infrastructure, some time was spent experimenting with techniques for sorting, filtering and colouring the UMTs by various attributes.

2.3.2 ISSUES ARISING

2.3.2.1 Functions: While the Strategic Functions identified by the Steering Group were sufficiently clear for the purposes of assessing datasets, when approaching how to begin mapping it was necessary to explore them in greater detail (as set out in Appendix 3: Green Infrastructure Functions – Discussion). It became clear that there are certain key benefits of relevance to this study (either explicit or implicit in the Strategic Functions set out at 2.1.1 above), some of which apply to the whole of Greater Manchester, and some which apply only in certain geographical areas as summarised in the table below:

Table 2.2 GI Benefits and Areas for study

Benefit	**Geographical Areas to be examined**				
	GM-wide	Strategic recreational corridors/ gateways	Principal river/canal corridors	Strategic road and rail corridors	Strategic urban regeneration/ development areas
Flood risk management	●		●		●
Biodiversity	●				●
Improved transport sustainability		●		●	●
Improved health & wellbeing (esp. through recreation)		●	●		●
Positive Image/ Landscape character / sense of place/		●	●	●	●
Conservation of historic environment and landscape character	●				●
Water quality management			●		●
Air Quality Management		●		●	●
Temperature management				●	●

2.3.2.2 Mapping functions with UMTs: As discussed in 'Dataset Assessments' above, the UMTs offer the most appropriate fine-detail layer for mapping of GI functions. Some of the qualities of the UMT categories have already been examined in academic studies, including:

- Surface cover
- Proportion of evapotranspiring surface based on surface cover
- Maximum summer temperatures based on energy exchange model using surface cover data

This data can be used to produce thematic maps, with colour ranges based on either natural divisions within the data (Jenks Natural Breaks), on quantiles or on equal ranges. For the purposes of this project natural breaks have been used.

However, many of the qualities of interest in mapping GI functions have not been examined academically. While some of these can be derived from existing academically-rigorous analyses (e.g. using building cover data to assess UMTs with greater/lesser flood storage capacity), others cannot, and the only option within the timescale of the project is to apply subjective analysis.

The criteria used for the subjective assessments are set out below. Three levels have been chosen for most qualities as a compromise between providing detail and avoiding spurious accuracy. An analysis of the biodiversity importance of greenspaces by Kazmierczak (unpublished) assigns greenspace UMTs to 3 categories of 'naturalness' based on management intensity and function, and these categories have been used to provide a 5-point scoring system, recognising the biodiversity importance of gardens as identified in recent studies (e.g. BUGS – Biodiversity in Urban Gardens in Sheffield).

Table 2.3 Subjective analysis of UMT qualities

Quality	**Scoring**		
	1	**2**	**3**
Landscape score	• Little greenspace/ vegetation, buildings generally of little architectural value, presence of eyesores	• Greenspace/ vegetation limited or unmanaged, buildings often of some architectural value	• Large amount of managed greenspace/ vegetation
Access score	• Generally no access	• Generally some access through area	• Open access
Usability score	• Little or no access	• Limited public access and/or greenspaces of limited size	• Substantial public access and greenspaces of substantial size
Exercise score	• No opportunities for walking/ cycling/ other activity	• Some opportunities for walking/ cycling/ other activity •	• Primary function for recreation • opportunities for walking/ cycling/ other activity
Air quality score	• Substantial pollutant generation • Little or no tree cover • Little or no open areas	• Some pollutant generation • Some tree cover • Some open areas	• Little or no pollutant generation • Significant tree cover • Significant open areas

	1	**2**	**3**	**4**	**5**
Biodiversity score - Categories from Kazmierczak (unpublished)	• Largely buildings/ car parking • little landscaping	• Some landscaping • Feeding resources (e.g. mown grass, refuse) • Small areas of gardens and open space	• Category 3 greenspace • Significant areas of gardens and open space	• Category 2 greenspace • Very significant areas of mature gardens	• Category 1 greenspace

Table 2.4 Subjective analysis of UMT qualities (CHECK THIS AGAINST THE MASTER SHEET IN UMT FOLDER, Y drive)

	Landscape score	Access score	Usability score	Exercise score	Air quality score	Biodiversity score
1.1 Improved Farmland	3	2	2	2	2	3
1.2 Unimproved Farmland	3	3	2	2	2	5
2.1 Woodland	3	2	2	2	3	5
3.1 Mineral workings and quarries	1	1	1	1	1	2
4.1 Formal Recreation	3	3	3	3	2	3
4.2 Formal open space	3	3	3	3	2	4
4.3 Informal open space	3	3	3	3	3	4
4.4 Allotments	3	1	2	3	2	3
5.1 Major Roads	1	3	1	1	1	1
5.2 Airports	1	1	1	1	1	2
5.3 Rail	1	1	1	1	2	2
5.4 River, Canal	3	2	2	3	2	5
6.1 Energy production/ distribution	1	1	1	1	1	1
6.2 Water storage and treatment	2	1	1	2	2	2
6.3 Refuse disposal	1	1	1	1	1	2
6.4 Cemeteries and crematoria	2	3	3	2	2	3
7.1 High density Residential	1	2	2	2	1	2
7.2 Medium density Residential	2	2	2	3	2	3
7.3 Low density Residential	3	2	1	3	2	4
8.1 Schools	2	1	2	3	2	2
8.2 Hospitals	2	1	1	2	2	2
9.1 Retail	1	3	2	1	1	1
9.2 Town centre	1	3	2	1	1	1
10.1 Manufacturing	1	2	1	1	1	1
10.2 Offices	1	2	1	1	1	2
10.3 Storage and distribution	1	2	1	1	1	1
11.1 Disused and derelict land	2	3	3	2	2	4
13.1 Remnant countryside	3	3	3	3	3	5

2.3.2.2 Variability in District Data: The Districts have been very helpful to the project in providing large amounts of information to a very tight timescale. However, there is considerable variability in terms of:

- **Data held:** While some of the core elements of the UDPs are sufficiently similar to allow direct comparison, there are major differences between many of the UDPs, particularly in relation to aspects such as wildlife corridors or recreation sites.
- **Data provided:** Because of the short duration of the project, it was impractical to visit each district to view and discuss the information held. Gathering of data has therefore relied largely on general or individual email requests, with inevitable variability in how those requests were interpreted. In addition, variability in data provided was not always picked up in time to request further information.
- **Data structure** (as referred to in 2.2.2.4 above):
- **Mapping techniques used:** When compiling layers from existing maps, there have been some problems because of different choices of mapping technique e.g. using polygons to map linear features, multiple small sites being drawn as parts of a single polygon.

Where this variability is thought to be of major significance this has been indicated on the relevant GI Mapping.

2.3.2.2 Generalisation of UMT-based mapping: The purpose of mapping the GI resource in Greater Manchester is to give broad indications of what currently exists and what functions it performs rather than to give detailed information of precise locations. The resolution at which the UMTs are drawn allows quite small sites and detailed boundaries to be identified, suggesting a level of accuracy which cannot be supported. This could be resolved by using techniques to 'generalise' the data, removing/combining smaller polygons and softening/smoothing boundaries.

2.3.2.2 Farmland: Of the 1300 km^2 that make up Greater Manchester, the UMT methodology has identified over 500 km^2 of improved or unimproved farmland, and many of the individual polygons that make up these classifications are very large. For these reasons, farmland can be so visually dominant on maps as to make it difficult to see other classifications and any patterns they form. As so much of this farmland is covered by existing Green Belt policy, there is an argument for removing farmland from mapping to enable other data to be more readily seen. However, given recent discussions on the future of Green Belt - e.g. Social Market Foundation (2007), Natural England (2007) - it is important that GI planning informs Green Belt planning. The most appropriate approach would seem to be including farmland is some analyses (e.g. overall permeable surface for flood management mapping) and excluding it in others (e.g. UMTs contributing to landscape quality in strategic road/rail corridors).

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 General

3.1.1 Phase 1 has found that sufficient datasets exist (or are readily created) to enable a working analysis of Green Infrastructure in Greater Manchester to be undertaken. In particular UMTs are a valuable resource which places the County at an advantage over other sub-regions which do not have a consistent land-use dataset at an appropriate scale. By combining academically rigorous studies on the attributes of UMTs with more subjective but transparent assessments, useful mapping of Green Infrastructure functions at the County level can be carried out.

Recommendation 3.1.1.1: While the UMTs offer a good starting point for District-level GI Planning, detailed ground-truthing of important UMTs would be required to identify any anomalies due to misclassification or land use change since the aerial photography was undertaken.

Recommendation 3.1.1.2: AGMA may wish to consider commissioning periodic revisions of the UMT dataset, based on its newest aerial photography, to track land use change and provide data for County and District planning.

Recommendation 3.1.1.3: AGMA may wish to consider commissioning academically rigorous studies into the most important of the UMTs attributes covered by the subjective assessments in section 2.2.2.2, to allow for more robust GI planning either at the GM level or by the Districts.

3.1.2 An aspect of GI which merits further attention is mapping of 'areas of activity' – information on where current GI-linked environmental activity is already going on. While many datasets of this type of information are available, Phase 1 did not find an approach that mapped this type of data successfully, as polygons were mostly either too small to be visible at GM scale (e.g. Green Tips) or were too general (e.g. Green Streets applying to all of Manchester, Trafford and Salford). However, this data is clearly of great importance and could perhaps be best mapped when key GI UMTs are identified, highlighting areas where conservation or improvement could be easily achieved and where more work would be required. Example of key datasets are the proposed Regional Parks, the Mosslands Vision produced by Salford, Wigan and Warrington, the Newlands programme, Green Streets action zones and the Green Tips project.

Recommendation 3.1.2.1: Phase 2, as part of its work to "highlight specific plans, strategies and programmes (both existing and developing)", should explore how mapping of existing areas of activity can contribute to GI planning.

3.2 Flood risk management

3.2.1 This is a Strategic Function where Climate Change could have significant impacts.

Recommendation 3.2.1.1: Implications of Climate Change for Flood risk management should be reflected in the Phase 2 exploration of Key Policy Drivers.

3.2.2 Any analysis of the main GI flood risk management functions of flood storage and run-off interception needs to be linked to the ongoing Strategic Flood Risk Assessment being conducted on behalf of AGMA by Scott Wilson.

Recommendation 3.2.2.1: Phase 2 should ensure that any relevant information produced is shared with Scott Wilson via the Environment SPIGlet.

3.2.3 Map 1.1 shows UMTs by proportion of building surface cover (as a proxy for flood storage capacity). Flood storage is of key importance in the Flood Zone 3 areas themselves, but in Map 1.1 the whole UMTs overlapping the Flood Zones are shown, giving a misleading impression of the area of importance.

Recommendation 3.2.3.1: Generalisation of UMT mapping as described in section 2.3.2.2 should be undertaken to restrict the areas of UMTs shown to within the boundaries of the Flood Zones.

3.2.4 While Flood Storage information is available from a number of other types of mapping, GI planning is of particular relevance to run-off interception as GI performs a very important function in this area. Map 1.2 shows UMTs by surface permeabililty, on a GM-wide basis on the presumption that run-off interception is of importance throughout catchments and not just in the immediate proximity of watercourses. Gill et al (2007) stress the importance of considering soil infiltration capacity as well as surface permeability, and produced a UMT-based dataset that could be of particular value. Datasets

were also obtained for Major Aquifer and Source Protection Zones (SPZs) – while these were not included in Phase 1 mapping, they would be of particular relevance when mapping current/potential SUDS locations, and surface cover attributes within SPZs may be of interest.
Recommendation 3.2.4.1: The Strategic Flood Risk Assessment may find the mapping of UMTs by surface permeability of value, particularly when combined with soil infiltration capacity analysis as undertaken in Gill et al (2007). This data will also be of relevance for SPZ mapping.

3.3 Conservation and enhancement of an ecological framework and associated sites and habitat networks

3.3.1 Map 2.1 shows designated Sites of Biological Importance (SBIs), wildlife corridors/green corridors designated by Districts and UMTs by Biodiversity Score. Perhaps the most striking feature is the linearity of much of the lower Biodiversity Score UMTs, reflecting the prevalence of industrial/commercial and high-density residential land use along road/rail and to a lesser extent river/canal corridors. A possible implication is that improving these UMTs for biodiversity could have very significant impact on the movement of some forms of wildlife.
Recommendation 3.3.1.1: Future GI work, both in Phase 2 and in District studies, may wish to explore the potential for improving biodiversity in 'low-biodiversity corridors'.

3.3.2 This is a Strategic Function where Climate Change could have significant impacts.
Recommendation 3.3.2.1: Implications of Climate Change for ecological framework/networks should be reflected in the Phase 2 exploration of Key Policy Drivers.

3.3.3 The AGMA-sponsored Ecological Framework study being undertaken by Aleksandra Kazmierczak (of the Research Institute for the Built and Human Environment, University of Salford) has explored mapping of ecological aspects, including the use of UMTs to some extent. The output datasets were not available during the period of Phase 1 but should be available for Phase 2 and be useful for further exploration of this Strategic Function. The Ecological Framework study is based on kilometre squares and so is not immediately comparable with the UMT-based analysis illustrated in Map 2.1 – however, 'generalisation' of the kilometre square data to produce 'fuzzy polygons' may allow easier correlation of the two studies.
Recommendation 3.3.3.1: Phase 2 should investigate the outputs of the Ecological Framework study to examine how correlations and connections can be drawn between it and the GIGM project.

3.3.4 There is considerable lack of consistency between Districts in how 'wildlife corridors' or 'green corridors' are identified. The ability to map 'permeability' of areas to wildlife movement is very important, particularly in relation to Climate Change, and while UMTs can offer this to some extent (through mapping of their vegetation cover or other attributes), identification of wildlife corridors along rivers, canals, railways, power transmission routes, green routes and other features would be advantageous.
Recommendation 3.3.4.1: Districts should be encouraged to identify wildlife corridors to an agreed set of broad criteria to allow compatibility in future planning.

3.3.5 There is potential for developing an additional layer of information showing sites which are currently below SBI status but which have plans or potential for developing habitats of significance – for example, the Mossland Heartland sites in Salford, identified in the Mosslands Vision report.
Recommendation 3.3.5.1: Phase 2, as part of its work to "highlight specific plans, strategies and programmes (both existing and developing)", could explore with the Districts and other partners the extent of non-SBI areas of biodiversity importance, possibly linked to the 'Areas of Activity' mapping referred to in Recommendation 3.1.2.1.

3.3.6 At a District level, the UMTs may provide a useful indication where 'Partial habitats' – locations low in permanent biodiversity but providing important benefits for wildlife, e.g. playing fields as feeing grounds, street trees as roosting sites - may be found.
Recommendation 3.3.6.1: Districts should use UMT mapping combined with local expert knowledge to identify where GI provides 'partial habitats' of significance.

3.4 Creation and enhancement of strategic recreational routes and corridors/gateways

3.4.1 Although Strategic Sites datasets were not obtained from all Districts, and there was some lack of consistency in those datasets provided, a workable set was generated using recreational sites over 10ha. Similarly, while there is some variation in the strategic route datasets a workable set has been generated from data provided. However, having broadly consistent data would aid future planning, and these should be relatively easy datasets to generate.
Recommendation 3.4.1.1: Districts should be encouraged to identify Strategic Routes and Strategic Recreational Sites to an agreed set of broad criteria to allow compatibility in future planning.

3.4.2 It has become clear that some of the Strategic Recreational Route data incorporated into the dataset contains proposed as well as existing routes.
Recommendation 3.4.2.1: Phase 2 should recheck Strategic Recreational Route data with the Districts (and with datasets already held, e.g the Forest Gateway Study) to ensure existing and proposed routes are differentiated.

3.4.3 Map 3.1 shows Strategic Recreational Sites and Strategic Recreational Routes with UMTs by landscape score. It was decided not to restrict the UMTs to those overlapping the routes in order to see areas of potential links. The main feature of note is the high proportion of recreation routes passing through areas of low landscape score, indicating there may be many areas for improvement.
Recommendation 3.4.3.1: Future GI work, both in Phase 2 and in District studies, may wish to explore the potential for improving landscape quality along Strategic Recreational Routes.

3.4.4 Map 3.2 shows Strategic Recreational Sites and Strategic Recreational Routes with UMTs by access score. It is apparent there are many large recreational sites which are not connected to strategic recreational routes, and this mapping suggests some of these may be able to be linked through UMTs of mid- to high-access score.
Recommendation 3.4.4.1: Future GI work, both in Phase 2 and in District studies, may wish to explore the potential for linking Strategic Recreational Sites to the Strategic Recreational Route network.

3.4.5 As Map 3.3 attempts to show, while there are relatively few Strategic Recreational Sites in or adjacent to the areas of highest deprivation (top 3% of IMD), many of these areas are on or near a Strategic Recreational Route, with obvious implications for the 'Health and Well-being' agenda. In these areas, GI may play a very important role in helping people access the routes. In addition, GI mapping could help identify potential links from areas of high deprivation to Strategic Recreational Sites nearby.
Recommendation 3.4.5.1: Future GI work, both in Phase 2 and in District studies, may wish to explore the potential for improving access to Strategic Recreational Routes and Sites as part of the Health and Well-being agenda, a Key Policy Driver.

3.4.6 The Second Local Transport Plan (LTP2) produced by AGMA and the Greater Manchester Passenger Transport Authority includes Actions for Walking and Cycling which could have important links to GI planning.
Recommendation 3.4.6.1: Phase 2, as part of its work to "highlight specific plans, strategies and programmes (both existing and developing)", could explore how GI mapping could link to LTP2.

3.5 Assisting historic environment and landscape character conservation

3.5.1 Of the seven Strategic Functions, this has been the least successful, due primarily to the lack of consistent datasets. In particular, the lack of a consistent approach to Landscape Character Assessment across Greater Manchester has made mapping of this Strategic Functions very difficult. However, some sub-sets of Districts offer useful opportunities for showing how GI mapping might work, for example Salford, Bolton and Bury all have broadly compatible LCAs, and Salford and Wigan have worked with Warrington on the Mosslands Vision.
Recommendation 3.5.1.1: Phase 2 could include a demonstration of how GI planning could work for conservation of historic environment and landscape character by using sub-sets of Districts.

Recommendation 3.5.1.2: Districts who have not undertaken a LCA should be encouraged to do so to a standard/comparable methodology before drawing up any Green Infrastructure plan in their Local Development Frameworks.

3.5.2 The Greater Manchester Archaeological Unit has begun a major project undertaking Historic Landscape Characterisation for the whole of Greater Manchester, to be completed in 2010. This data, especially when combined with LCAs, will be of importance in contributing to Green Infrastructure planning.
Recommendation 3.5.2.1: Districts should use the GMAU Historic Landscape Characterisation project in local GI planning if timescales permit.

3.6 Principal river and canal corridor management

3.6.1 This is a Strategic Function where Climate Change could have significant impacts.
Recommendation 3.6.1.1: Implications of Climate Change for river and canal corridor management should be reflected in the Phase 2 exploration of Key Policy Drivers

3.6.2 The Environment Agency was asked to provide any information on flood warning areas in the Mersey Catchment; locations of flood storage basins; location of Sustainable Urban Drainage Systems (SUDS); and watercourse water quality. Unfortunately they have not yet provided any information, and while hopefully the Scott Wilson study will address most of these issues, watercourse water quality would not be covered. GI may perform a useful water quality management function by intercepting run-off (preventing it picking up pollutants from roads and other hard surfaces) or by filtering polluted run-off/minor watercourses before it enters larger watercourses.
Recommendation 3.6.2.1: When water quality data is obtained, mapping of UMTs by surface permeability and proportion of vegetated cover may produce useful results.

3.6.3 Many of the UMTs which have some of their area within the 100m buffer used for selection are very large, and so Phase 1 mapping gives a misleading impression of the scale of river/canal corridors and of the relative importance of many of the UMTs.
Recommendation 3.6.3.1: Generalisation of UMT mapping as described in section 2.3.2.2 should be undertaken to restrict the areas of UMTs shown to a set distance from the river/canal

3.7 A positive image and environmental quality as part of a sustainable strategic road and rail network

3.7.1 The datasets on Strategic Roads provided by the Districts (mostly taken from UDPs) were found to be too extensive, and so a new layer was generated containing only the larger and more important main roads, based on subjective local knowledge. This may not include some roads felt by Districts to be of key importance.
Recommendation 3.7.1.1: As part of consultation with Districts Phase 2 should check the GIGM Strategic Roads dataset does not omit any roads Districts feel are strategic corridors.

3.7.2 Many of the UMTs which have some of their area within the 100m buffer used for selection are very large, and so Phase 1 mapping gives a misleading impression of the scale of road/rail corridors and of the relative importance of many of the UMTs.
Recommendation 3.7.2.1: Generalisation of UMT mapping as described in section 2.3.2.2 should be undertaken to restrict the areas of UMTs shown to a set distance from road/rail.

3.7.3 Map 6.1 shows UMTs overlapping Strategic Roads and Rail by landscape score. It indicates that while GI is contributing to positive image along some strategic transport corridors, most run through mid- to low-score UMTs and there may be substantial potential for enhancing the contribution GI plays.

3.7.4 Map 6.2 shows Air Quality Management Areas (AQMAs) UMTs by tree cover. This indicates there may be potential for substantial improvements in GI (especially street trees) to improve air quality along strategic transport corridors. Some work on this field is currently being undertaken by CURE and the proposed I-Tree project (to be run by Red Rose Forest and CURE) would explore this further.

3.7.5 This is a Strategic Function where Climate Change could have significant impacts.
Recommendation 3.7.5.1: Implications of Climate Change for road and rail network management should be reflected in the Phase 2 exploration of Key Policy Drivers

3.8 A positive role for existing and new greenspace in planning and developing strategic urban regeneration areas (which could include a combination of previous functions)

3.8.1 Regeneration Areas as zones of rapid change will be key locations for GI planning, and as such most of the GI benefits identified are of relevance. This will provide a major challenge in terms of mapping multi-functionality, showing which UMTs are providing or could provide multiple GI benefits in a clear and understandable way.

3.8.2 Map 7.1 shows UMTs overlapping Regeneration Areas by Landscape Score. It is not surprising that much of the areas is of mid- to low-score, but the mapping does indicate the presence of many areas of high score which could form cores of quality landscape around which improvements could take place.

3.8.3 Map 7.2 shows UMTs overlapping Regeneration Areas by proportion of buildings (as a proxy for flood storage capacity) and proportion of impermeable surface. Most Regeneration Areas have UMTs with high proportion of impermeable surface and may include Flood Zone 3 areas. Again, this is not surprising given the likelihood that Regeneration Areas will include industry and high-density housing, and that much industry in decline will have been located on rivers. It does, however, indicate the potential there is in Regeneration Areas for making significant contributions to Flood Risk Management through appropriate GI planning.

3.8.4 Map 7.3 shows AQMAs and UMTs overlapping Regeneration Areas by tree cover. It is apparent that many Regeneration Areas overlap AQMAs, and that there is potential for improving air quality in these areas through increasing tree cover (alongside other approaches). It would be interesting to add health data to this map (e.g. hospital admissions or mortality due to respiratory illness, available as MSOA level from the NW Public Health Observatory).
Recommendation 3.8.4.1: Phase 2 could explore how GI mapping could include health data, as a Key Policy Driver.

3.8.5 Map 7.5 shows UMTs overlapping Regeneration Areas by modelled current (1961-1990) maximum summer temperatures, taken from Gill et al (2007). This is based on an energy exchange model using surface cover attributes. It is apparent that Regeneration Areas have high maximum summer temperatures, due to their location in urban areas (with associated heat island effects) and to their low level of vegetated cover. Modelled future temperatures from Gill et al (2007) could also be mapped to show the impacts of altering GI in these areas.
Recommendation 3.8.5.1: Implications of Climate Change for Regeneration Areas should be reflected in the Phase 2 exploration of Key Policy Drivers.

3.8.6 A mapping exercise that could be conducted would be to look at UMTs by Landscape/Access and Strategic Recreational Routes in Regeneration Areas, with a view to identifying gaps in routes that could be closed through regeneration activity, increasing the access of deprived populations to recreation facilities.
Recommendation 3.8.6.1: Future GI work, both in Phase 2 and in District studies, may wish to explore the potential for improving access to Strategic Recreational Routes in Regeneration Areas.

3.8.7 While there are inconsistencies in many types of data provided by the Districts, and there are clear inconsistencies between regeneration data supplied by the districts. These may reflect real differences in policy or in data supplied but it has not been possible to address these within the Phase 1 timetable.
Recommendation 3.8.7.1: As part of the Policy Review Phase 2 should check Regeneration areas against Provisional Mapping.

APPENDICES

APPENDIX 1: GREATER MANCHESTER GREEN INFRASTRUCTURE PROJECT STEERING GROUP - MEMBERSHIP

Fran Comyn	Rochdale MBC (Chair)
Jeff Lee	AGMA
Marion Raines	Salford CC
David Hodcroft	Bury MBC
Simon Talbot	GMGU
Derek Richardson	GMEU
Martin Moss	Natural England
Tony Hothersall	Red Rose Forest

APPENDIX 2: BACKGROUND TO URBAN MORPHOLOGY TYPES

The Urban Morphology Types used in this project were developed by the University of Manchester's Centre for Urban and Regional Ecology (CURE) as part of its work on the 'Adaptation Strategies for Climate Change in the Urban Environment' (ASCCUE) study, funded by EPSRC under the 'Building Knowledge for a Changing Climate programme' (see Gill *et al*, 2007) (GR/S19233/01).

The UMT polygons were identified in 2004 by visual analysis of the Cities Revealed 1997 aerial photography, assigning areas to 29 different land use types, although one of these – Defence – does not occur in Greater Manchester. A further UMT derived from NLUD, Rural Settlement, was also not used for Greater Manchester.

The UMTs identified from the 1997 aerial photography were then reassessed using updated information, including:

- Raster OS maps at 1/50 000 scale
- 2001 aerial photographs
- Documents and other input from the ten Districts of Greater Manchester (both GIS files of areas of changes and paper maps and tables)

As a result, 262 UMTs were changed, 72 with no changes in the structure of the UMTs and 190 with a change of structure.

A detailed description of the UMT methodology, including information on how uncertainties and 'borderline' cases were addressed, is given in CURE (unpublished).

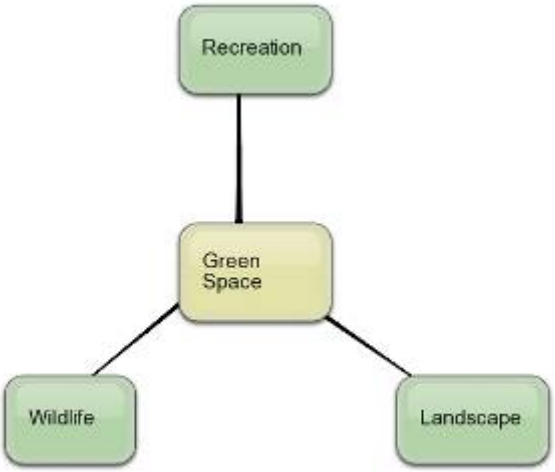
The most recent version of the dataset is dated July 2007(although the land-use data contained within the dataset refers to a base year of 2004).

Although the UMTs were provided to the Districts for checking and many polygons were reassigned or restructured, with local knowledge it is still possible to identify some anomalies in the July 2007 dataset, for example schools, hospitals and halls of residence falling within 'Offices', or planned and managed informal open spaces ('urban countryside') falling within 'Disused and derelict land'. These may be due to genuine changes in land-use or misclassification. However, for the purposes of this project these anomalies can be disregarded, as the visual analysis on which the UMTs are based is heavily influenced by their GI character – the proportions of mown or rough grass, tree cover, amount of hard surfacing, scale and density of building, etc. At the level of District GI planning, detailed land use assessment would be required to identify and remove these anomalies.

APPENDIX 3: GREEN INFRASTRUCTURE FUNCTIONS - DISCUSSION

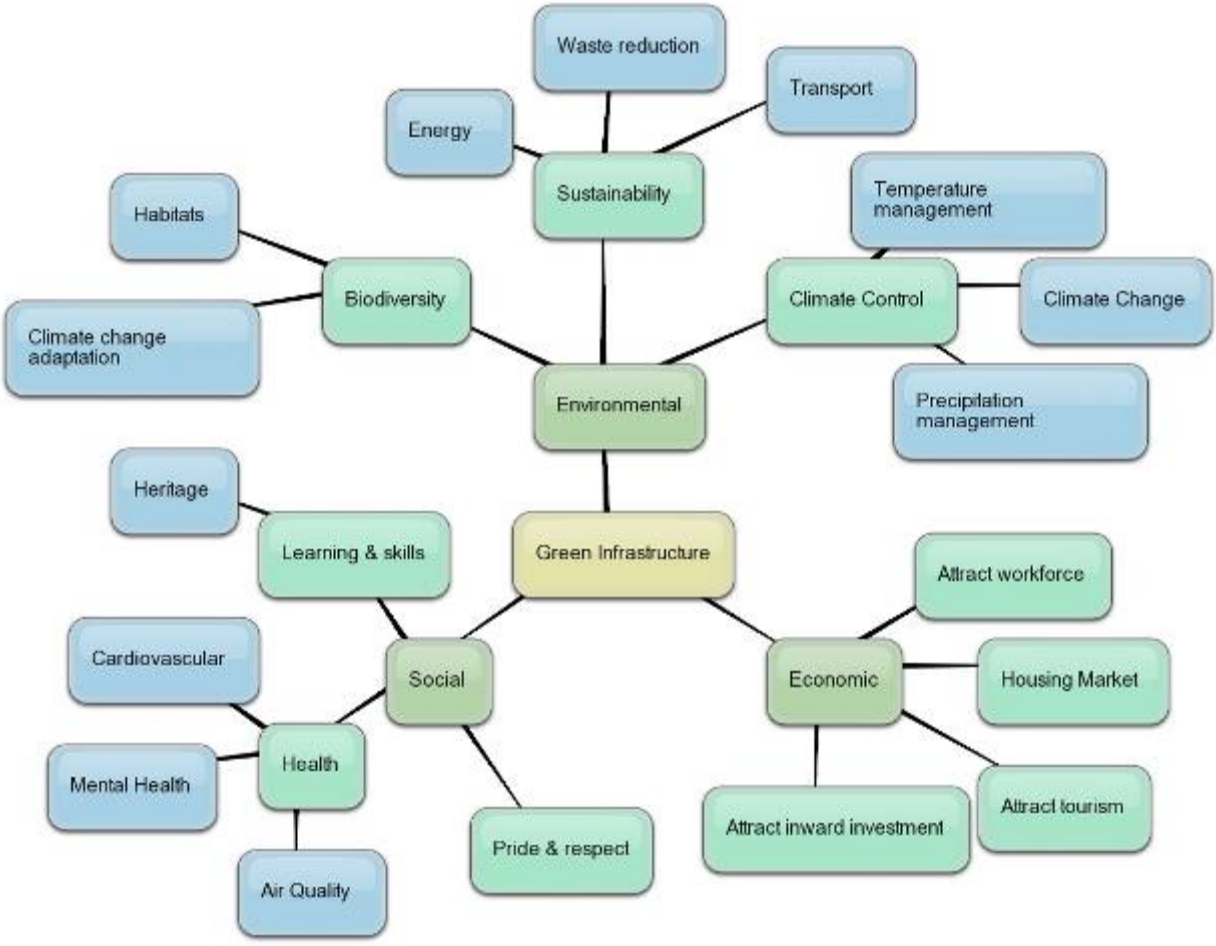
Until recently, 'greenspace management' was the main approach to assessing and planning green elements in the landscape. Typically this would involve a 3-way assessment of greenspaces.

Figure A.1 3-way assessment of Greenspaces



The key difference of the Green Infrastructure approach is that is considers a much wider range of functions/benefits, derived from a much wider range of landscape components. While not intending to be prescriptive, the North West Green Infrastructure Guide (NWGIG 2007) gives two similar lists of GI functions (p8 and p13). These can be structured around a Social, Economic and Environmental approach to show the range and scope of GI:

Figure A.1 Green Infrastructure approach



From this point it is possible to start seeing what Green Infrastructure can deliver for communities, and it has proved helpful to reconsider the 'functions' from NWGIG as 'benefits', as the example below shows:

BENEFITS What does GI provide to the community?	**FUNCTIONS** How does/can GI achieve this benefit?	**COMPONENTS** What elements of GI perform this function?
Precipitation management	Runoff infiltration	Trees Other Vegetation Permeable hard surfaces
	Runoff storage	Watercourses Soils
	Evapotranspiration	Trees Other Vegetation Waterbodies/ fountains Green/brown roofs
Temperature management	Shade	Trees
	Shelter	Trees Shrubs

As can be seen, GI components can perform several functions, which in turn can provide several benefits.

APPENDIX 4: RELATION OF BENEFITS USED IN GIGM STUDY TO OTHER NW STUDIES

BENEFITS FROM NORTH WEST GREEN INFRASTRUCTURE GUIDE (NWGITT 2007)	BENEFITS TO BE USED IN GIGM PROJECT	ECONOMIC BENEFITS FROM ECOTEC REPORT (ECOTEC 2007)
Flood management	Flood risk management	Flood alleviation and Water Management
Air, water and soil quality	Water quality management	
	Air Quality Management	
Climate change adaptability	Temperature management	Climate Change Alleviation
	Improved transport sustainability	
Mental and physical health		
Sport and active recreation	Improved health & wellbeing	Improved Health and Well Being
Access to natural greenspace		
		Tourism, Recreation and Leisure
Image and investment		
Land and property value		Quality of Place
Landscape character / sense of place	Positive Image/ Landscape character / sense of place/	Land and Property Prices
Setting for tourism		Creating a Setting for Inward Investment
Intrinsic value of a place to a community		
Setting for culture		
Social inclusion		
Availability for social enterprises		
Education and life-long learning	Conservation of historic environment and landscape character	
Historic resource		
Biodiversity	Biodiversity	Land Management and Biodiversity
Connectivity within a network		
Food, fishery and energy production		Renewable Energy Production

APPENDIX 5: DATASETS ASSESSED AS OF LITTLE USE

Data Title	Owners	Access	Coverage	Notes
ADMINISTRATIVE				
County	OS			Only for Grid squares SD and SJ - missing East edge of GM
LAND USE				
ADAS Land Classification	ADAS	Free	National	Mapping of agricultural land into 5 agric grades, non-agric and urban areas. Each land classification is a single polygon so v large and difficult to work with
DUNL	FC/TEP		GM	The same land use data is picked up with acceptable accuracy by the UMTs
NLUD			National	All useful elements better covered by other datasets?
GLUD			National	Proportional land use by ward probably less useful than CURE UMTs and source data not available within timescale of project
Rob Wood UMTs	RRF/ Uni of Mcr		RRF	Useful data on urban trees but land use work (identifying 9 land use types) superceded by CURE UMTs
ECOLOGICAL CLASSIFICATIONS				
Land Cover Map 2000		Rough estimate £7000 for licence for whole GM?		Satellite-based assessment allocating land to one of 26 'broad habitat' target/subclasses (vector Level 2). Cost prohibitive at this stage of process
Phase 1 habitat	GMEU		GM	Inconsistent across GM - some recent surveys on GIS, some 1990s survey scanned only
Ancient Woodland Survey	FC		GM	Information better taken from FC Woodland Inventory/ SBI
TRANSPORT AND ACCESS				
Transport corridors			RRF/ Mersey Forest?	Folder of data at RRF - 3 layers, Motorways, railways (both with buffer strips) and A roads (Mersey Forest only)
Motorways	??		GM and immediate surrounds	Trace from OS maps? - has connections outside GM
LANDSCAPE				
Countryside Character Maps	CoAg/ NE	Free	National	Polygon data of Countryside Character Areas. GM has all/part of 8 - too coarse a scale to be of use?
Natural Areas	CoAg/ NE	Free	National	Polygon data of Natural Areas. GM covers parts of 4 - too coarse a scale to be of use?
HISTORIC				
Scheduled Ancient Monuments	Eng Heritage	Free	National	Point data on Scheduled Ancient Monuments. 46 in GM-only table from GMGU. Too few records to be of use on County scale and all are protected through UDP

Data Title	Owners	Access	Coverage	Notes
WATER/FLOOD				
Manchester Rivers	Mersey Basin?	Free	GM/ Mersey catchment ?	River and River corridor polygons for major waterways in GM, though some rivers unnamed. Useful unless better dataset obtained eg from Environment Agency. Corridors appear to be fixed-distance buffers, applied to certain waterways only - not of great use)
Waterways	??	free	GM and immediate surrounds	Major watercourses and water bodies (labelled) - as all watercourses are on Manch Rivers layer only Waterbodies are of use
Strategic Flood Risk Assesment	AGMA		GM	Will not be available in time to be used in Phase 2 of the project, but clearly will be of great importance in future GI planning (see Section 6 of SFRA brief)
OTHER				
Doorstep Greens	CoAg/ NE	Free	National	Point data on location of doorstep greens, only 5 in GM
Millennium Greens	CoAg/ NE	Free	National	Point data on location of Millennium greens, only 8 in GM
Countryside Stewardship agreements, NW England	DEFRA	Free	National	Polygon data of Countryside Stewardship agreements. Relatively few in GM, no details of agreements to allow for analysis
Forestry Commission Sites	FC	Free	GM?	Polygon data on FC-owned sites, only 4, all Wigan (layer predates Newlands project)
LA WGS Woods	RRF	Free	RRF	Polygon data for Woodland grants schemes, by District. Several tables, appears to be partial
WGS/WIG info	FC		GM	Most useful data (accessible woods) picked up through Woods For People?
Woodland trust Sites	WT			Polygon data on WT sites ~ 12 in GM, mostly relatively small
Existing Woodlands Merged		Free	RRF only	Polygon data from studies carried out by EW&Co and Salford GIS, showing location of existing woodlands over ??Ha with timber assessment. FC Woodland Inventory more useful
RRF Forest Plan	RRF		RRF	Not GM-wide
RRF Landscape Assessment	RRF		RRF	Not GM-wide
RRF Forest Plan	RRF		RRF	Not GM-wide
Green Flag sites 2007	Civic Trust		National	Not yet put on GIS but will be at some point this year.

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