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environment landscape planning



Natural England and the Wildlife Trusts
6Cs Growth Point
Biodiversity Opportunity Mapping
Pilot Study



June 2009



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Approved

A handwritten signature in black ink, which appears to read 'D. Watkins', is enclosed within a hand-drawn oval. The signature is written in a cursive, somewhat stylized script.

Dominic Watkins

Position

Director

Date

24 June 2009

Version

Final

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EXECUTIVE SUMMARY

Overview

This technical report presents the results of a pilot study commissioned by Natural England and the Wildlife Trusts for the East Midlands, and undertaken by Chris Blandford Associates, to test the “Green Infrastructure For The Three Cities: A Methodology For Biodiversity Opportunity Mapping” developed by Natural England and the Wildlife Trusts in the East Midlands.

The purpose of the pilot study was to test the methodology using data related to real places and situations. The report describes the steps taken in running and testing the methodology. Any variation from the methodology has been documented and includes a series of recommendations for refining the methodology, which could help in enhancing the value of the outputs.

Key Conclusions

Overall, it is concluded that the methodology, although requiring some refinement, is workable at the regional and sub-regional scale. In relation to the application of this approach at a local scale, it is essential that the invested knowledge of Natural England, the Wildlife Trusts and other nature conservation organisations are involved in the process of using the opportunity mapping outputs to identify habitat creation or species conservation opportunities.

The key findings of the report are:

- That a standard method is developed between the Wildlife Trusts and Natural England to record Biodiversity Action Plan habitat data with common attributes and standard nomenclature, to ensure that the data is directly comparable and allows for cross boundary interrogation at a sub-regional and regional scale;
- That the British Geological Survey’s soil-parent material database is comprehensively assessed for its potential value in mapping site suitability for habitat creation. If suitable, it is recommended that the site suitability scoring system is revised to relate habitat site suitability with the relevant parameters in the database. Also, if suitable, it is likely that this database would replace the need for separate soils and geological data as part of the Site Suitability Scoring system; and
- That an assessment of all available peer reviewed literature is undertaken to provide a comprehensive data source on species migration and dispersal in the landscape that will enable a

broader approach to calculating buffer widths and potentially, a greater degree of accuracy in predicting species dispersal.

Key Recommendations

Habitat Data

- Undertake a review of the currency and accuracy of existing habitat data is undertaken by the Wildlife Trusts and Natural England;
- Develop a standard method is developed between the Wildlife Trusts and Natural England to record Biodiversity Action Plan habitat data with common attributes and standard nomenclature, to ensure that the data is directly comparable and allows for cross boundary interrogation;
- Consider the development of a standardised hierarchical scale to which habitats within each site can be attributed (in relation to Figure 2 of the Methodology) within each of the Wildlife Trusts' or Natural England's datasets. The application of this scale by the data holders would reduce the potential for the data to be inaccurately interpreted by data users outside these organisations;
- The Wildlife Trusts and Natural England should identify common standards for habitats of local biodiversity interest that may not conveniently fall within standard Biodiversity Action Plan habitat descriptions. In particular, it is clear that mineral extraction (both mining and quarrying), as well as other industrial landscapes have given rise to ecologically valuable habitats within the three counties, which should be accurately represented within this methodology.

Soil Data

- The creation of an accurate soil dataset that:
 - Distinguishes between levels of permeability;
 - Refines the relative pH of broad soil types to distinguish between mildly and highly acid / alkaline soil types;
 - Provides a more detailed description of soil types to apply at the local (e.g. city wide) scale; and,
- In conjunction with the refined soil dataset, it is recommended that the Site Suitability Scoring system is refined to include a more subtle approach to soil type requirements for each habitat. In particular, this should apply to the acid grasslands and heathlands, and the calcareous grassland habitat types.

Geology Data

- The British Geological Survey's soil-parent material database (currently under development) should be comprehensively assessed for its potential value in mapping site suitability for habitat creation. If suitable, it is recommended that the site suitability scoring system is revised to relate habitat site suitability with the relevant parameters in the database. Also, if suitable, it is likely that this database would replace the need for separate soils and geological data as part of the Site Suitability Scoring system.

Agricultural Land Classification Data

- The Agricultural Land Classification data should be retained as one of the parameters for identifying site suitability. Moreover, it is considered that the use of Agricultural Land Classification data should be extended to discriminate between areas of high and low fertility inherently preferable for a number of the habitat types, including woodland.

Environment Agency Flood Data

- Environment Agency flood data should be used to provide a strategic overview of potential site suitability for floodplain grazing marsh, wet meadows, wet woodland, reedbeds and fens. However, site selection at a local level should be undertaken in consultation with Environment Agency Area staff, amongst other interested parties;
- The Environment Agency flood data should be augmented with more comprehensive Environment Agency data, including information on springs and flushes, as well as ponds and watercourses outside the floodplain. Alternatively, Meridian data may also provide a similar coverage.

Historic Mapping

- Historic mapping should be included as part of the Site Suitability Scoring system. This may include either previous editions of the Ordnance Survey, or historic environment records held by relevant local authorities.

Buffering and Network Scaling

- As part of the pilot project, a literature review has been undertaken to identify further sources of academic study relating to species migration and dispersal in the landscape. A list of references of academic papers found to date, is included as Appendix 2. Further work should be undertaken to

distil information from these sources that will enable a broader approach to calculating buffer widths and potentially, a greater degree of accuracy in predicting species dispersal;

- The information contained within these additional data sources should be aggregated so that information relating to species typically associated with a particular habitat, is used to inform the buffer widths for that habitat type.

Moving Forward

It is recommended that further work (incorporating the above recommendations) be undertaken by Natural England and the Wildlife Trusts to develop a robust and consistent approach to biodiversity opportunity mapping in the East Midlands and potentially elsewhere. This pilot study has demonstrated the value of this approach as a key spatial planning tool to inform the delivery of Biodiversity Action Plan targets as a key contribution to green infrastructure provision.

1.0 INTRODUCTION

1.1 Background

1.1.1 Chris Blandford Associates (CBA) was commissioned by Natural England and the Wildlife Trusts in the East Midlands to carry out a pilot study in the 6Cs Growth Point to test the methodology set out in the 'Green Infrastructure for the Three Cities: A Methodology for Biodiversity Opportunity Mapping', developed by Natural England and the Wildlife Trusts in the East Midlands¹.

1.1.2 The 3 Cities and 3 Counties (aka the '6Cs') Growth Point is one of 29 areas nationally proposed under the Sustainable Communities Plan for significant growth, and is funded by the Government as one of four first round New Growth Points in the region. The 6Cs Growth Point has a population of 1.9m people and includes the three cities of Leicester, Derby and Nottingham. Proposals for significant future growth under the Government's Sustainable Communities Plan and the East Midlands Regional Plan (March 2009) in this area are focused on the three cities, plus the towns of Coalville, Hinckley, Hucknall, Ilkeston, Loughborough, Market Harborough, Melton Mowbray and Swadlincote.

1.1.3 The methodology has been developed as a decision support tool to map:

- Existing biodiversity;
- Areas where biodiversity needs to be restored in order to meet regional targets; and,
- Areas where biodiversity could most valuably be incorporated into green infrastructure enhancements.¹

1.1.4 The methodology has been developed by building on the England Habitat Network project of Dr Roger Catchpole, Natural England's Senior Spatial Ecologist, containing four main components and datasets:

- Current Status:
 - Existing Habitat;
 - Existing habitat networks.
- Identifying suitable opportunities:
 - Site suitability;
 - Habitat network enlargement areas.

¹ Murray, G., 2008. Green Infrastructure for the Three Cities: A Methodology for Biodiversity Opportunity Mapping. Natural England and the Wildlife Trusts in the East Midlands.

1.2 Aims of the Pilot Study

1.2.1 The primary aim of the pilot study is to test the methodology's ability to objectively map and identify opportunities for biodiversity enhancement and creation.

1.2.2 The study involves three key objectives / stages:

- **Stage 1** – *to provide an updated methodology for biodiversity opportunity mapping/technical review* – setting out the approach and detailed methodology used to develop the network mapping;
- **Stage 2** – *to provide an evaluation of the pilot study* – describing the lessons learnt from the testing of the pilot methodology to inform the mapping of biodiversity networks as part of the GI strategies elsewhere in the country by:
 - testing its practicality;
 - identifying any issues or limitations in terms of both inputs and outputs;
 - evaluating its success in delivering the aims of Stage 3 below.
- **Stage 3** – *to provide a 6Cs growth point biodiversity network mapping study* – identifying opportunities for new or enhanced habitats, including areas for investment in 'landscape-scale' strategic biodiversity assets by:
 - Applying the methodology to each of the 3 cities housing marketing areas (HMAs);
 - Mapping existing habitats of nature conservation importance;
 - Identifying and mapping existing 'functional' habitat networks; and,
 - Identifying and mapping opportunities for the creation of new habitat of nature conservation importance, particularly where this would enlarge or strengthen existing habitat networks.

1.2.3 A key application of the biodiversity opportunity mapping approach is to inform the development of the biodiversity component of a Green Infrastructure strategy for the 6Cs Growth Area.

1.2.4 Stage 3 of this report relates to the 6Cs GI Strategy Phase I report², which states under Section 4.2.1 "It is intended that the pilot study will provide a consistent evidence base for underpinning the biodiversity aspects of the GI Strategy. The study is assessing the functionality of existing greenspace networks and identifying opportunities to restore characteristic habitats in the context of relevant BAP targets for the 6Cs growth point."

² Chris Blandford Associates (2009). *6Cs GI Strategy: Baseline Information Review & Strategic GI Audit. Stage 1 Report – Draft*. Report prepared for and on behalf of the 6Cs Strategic GI Project Board.

1.3 Pilot Study Area

1.3.1 The methodology was applied to the 6Cs Growth Area in the East Midlands, comprising the whole of Leicestershire, and parts of south Nottinghamshire and Derbyshire and incorporating the three cities of Leicester, Nottingham and Derby, (herein referred to as the Study Area), illustrated in Figure 1.1.

1.3.2 The methodology has been piloted at two spatial scales:

- within the 6Cs growth point area; and,
- at a higher resolution using the housing marketing areas (HMAs) for Derby, Nottingham and Leicester respectively.

1.3.3 The HMA areas were selected as they provide an opportunity to test the methodology at the local scale, within the context of the 6Cs growth point sub-region.

2.0 STAGE 1 – METHODOLOGY REVIEW

2.1 General

2.1.1 Stage 1 of this report sets out how data was acquired, organised and applied to the methodology. As far as possible the review seeks to work through the methodology sequentially, describing how each stage of the process was approached. This includes identifying any revisions or alterations, and an explanation as to why such modifications were made.

2.1.2 All mapping of habitats, habitat networks and associated datasets was carried out using ArcMap v9.2

2.2 Data Acquisition and Data Organisation

Data Acquisition and Data Organisation

Existing Habitat Data

2.2.1 The pilot study has made use of the habitat data provided for the 6Cs Green Infrastructure Strategy project. A description of the habitat data insofar as it provides a description of the existing biodiversity resource is set out in Section 3.2 of the Phase I report². A description of how the data is organised and has been applied to this pilot project is set out below.

2.2.2 Terrestrial UK BAP Priority Habitats were mapped within the Study Area by combining or merging two data sets. Data on Local Wildlife Sites (non-statutory designated sites) was provided by the Leicestershire and Rutland, Nottinghamshire and Derbyshire WTs, which for most sites incorporated UK BAP Priority Habitat attributes. In Nottinghamshire and Derbyshire data was organised by site, and the primary UK BAP Priority Habitat for each site, generally the most abundant or significant habitat present within it, was used to characterise sites in terms of habitat, so each site is represented once. In Leicestershire data was organised differently, by UK BAP Priority Habitat type. This meant that those sites listed as supporting more than one habitat were represented more than once. The following UK BAP Priority Habitats were listed as occurring within the 6Cs Growth Area in the Local Wildlife Sites data set.

- Lowland Mixed Deciduous Woodland
- Wet Woodland
- Wood Pasture and Parkland
- Hedgerows

- Lowland Heathland
- Lowland Dry Acid Grassland
- Lowland Meadows
- Lowland Calcareous Grassland
- Purple Moor Grass and Rush Pastures
- Calaminarian Grasslands
- Open Mosaic Habitats on Previously Developed Land
- Coastal and Floodplain Grazing Marsh
- Arable Field Margins
- Lowland Fen
- Reedbed

2.2.3 Due to their very limited representation within the data sets (in comparison with what is likely to be present on the ground) it was decided not to apply the methodology to sites listed as supporting Hedgerows or Arable Field Margins.

2.2.4 Calaminarian Grasslands were also merged with and included under Open Mosaic Habitats on Previously Developed Land.

2.2.5 The second data set comprised NE's inventories for UK BAP Priority Habitats. The following habitats were represented within the 6Cs Growth Area.

- Lowland Mixed Deciduous Woodland
- Wet Woodland
- Lowland Heathland
- Lowland Dry Acid Grassland
- Lowland Meadows
- Lowland Calcareous Grassland
- Purple Moor Grass and Rush Pastures
- Coastal and Floodplain Grazing Marsh
- Lowland Fen
- Reedbed

2.2.6 There are no NE inventories for Wood Pasture and Parkland, Calaminarian Grasslands or Open Mosaic Habitats on Previously Developed Land, so these habitats were represented by the Local Wildlife Site data set only.

2.2.7 Where mapped habitat from the two data sets overlapped, the outer boundary of the two data sets was taken to represent the outer limit of the habitat in the merged data set.

2.2.8 A relatively large proportion of woodland included within the NE inventories was classified as Wet Woodland, although only a very small part of this occurred within the floodplains. Although it is possible for Wet Woodland to develop outside of floodplains, for example in areas with impeded drainage and around springs and flushes, following informal consultations during the Stakeholder Consultation workshops³ on the nature of the woods concerned, it was decided to include all Wet Woodland within Lowland Mixed Deciduous Woodland.

Three Tiered Habitat Class Model

2.2.9 The process of mapping habitat and identifying networks was conducted at three hierarchical or strategic levels. The first and most detailed level was that represented by the individual UK BAP Priority Habitats. The middle and strategic levels combined habitats within larger habitat categories. These hierarchical levels are described in Figure 2 of the Methodology, with relevant revisions described in Table 1 above.

2.2.10 Habitats were represented by their relevant UK Biodiversity Action Plan (BAP) Priority Habitats, as these had had the best representation or characterisation within existing data sets supplied for Phase I of the 6Cs Strategy. Table 1 below provides a summary of the habitat data rationalisation that has been undertaken in relation to Figure 2 of the Methodology:

Table 1: Habitat Data Rationalisation; Natural England and Wildlife Trust Data

NE/ WT Data	Rationalisation for the Methodology
Calaminarian grasslands	Included in the “open neutral / “open” middle and strategic levels of the 3 tier habitat class model
Open mosaic habitats on previously developed land.	Included in the “open neutral / “open” middle and strategic levels of the 3 tier habitat class model
Eutrophic Standing Waters	This habitat type has been added to the model and included in the “wet” / “wet” categories of the middle and strategic habitat class model.
Habitat Type: Wet woodland	Reclassified as “Lowland mixed deciduous woodland” due to uncertainties in the accuracy of the classification.
Habitat Type: Wood Pasture and Parkland	This habitat type has been added to the model and included in both the “wood” / “wood” and “open neutral / “open” categories of the middle and strategic habitat class model.
Ponds	Where ponds have been identified as the primary

³ 6Cs GI Strategy Stakeholder Consultations held on 29th and 30th January 2009.

NE/ WT Data	Rationalisation for the Methodology
	BAP habitat type for a site, the secondary BAP habitat type has been selected instead.
Unattributable	Approximately 5% of Derbyshire WT's data were not attributed a habitat type. These sites were therefore excluded from the exercise.

2.2.11 Figures 1.2, 1.3 and 1.4 illustrate the habitat data used and organised into the three tiers of the Habitat Class Model.

2.2.12 The methodology was not considered applicable to aquatic habitats (above and beyond providing context for those habitats classified as “wet”), including rivers and streams, standing waters and ponds, and so these were excluded from further analysis. However, Figure 1.5 illustrates the wetland data that has been used for context, prepared from Environment Agency flood data⁴, and from Meridian data.

Supporting Data

2.2.13 NSRI Soils data was received from NE⁵ (Figure 1.6). In order to meet the needs of the methodology the soil types within the dataset were amalgamated on the basis of reaction (pH or acidity / alkalinity). Figure 1.6a illustrates the distribution of the amalgamated soil types. The relative merits of using amalgamated soil data grouped as Acid, Neutral or Alkaline, in relation to identifying habitat creation opportunities is discussed in Stage 2 of this report (Sections 3.2.11 – 3.2.16).

2.2.14 Similarly, geological data⁶ supplied by the British Geological Survey (BGS) and provided by NE (Figure 1.7) shows the baseline bed rock data expressed at 1: 250 000 scale. As with the soils data, the geological data was amalgamated on the basis of reaction to meet the needs of the methodology. Figure 1.7a illustrates the geological data amalgamated according to their acidic, neutral or alkaline characteristics. The relative merits of using amalgamated geological data are discussed in Stage 2 of this report (Sections 3.2.17 – 3.2.22).

2.2.15 Agricultural Land Classification (ALC) data⁷ is shown on Figure 1.8.

⁴ EA Flood Data provided on CD by Natural England dated 4th November 2008.

⁵ NSRI Soils provided on CD by Natural England dated 4th November 2008.

⁶ British Geological Survey Data provided on CD by Natural England dated 3rd December 2008.

⁷ ALC Data provided on CD by Natural England dated 4th November 2008.

2.3 Identification of Existing Networks (Buffering & Network Scaling)

Background

2.3.1 Buffers and network scales were applied to the existing habitat data in order to identify existing networks of each of the BAP habitat types.

2.3.2 Habitat patches were buffered using the Network Scaling Distances (Table 2) developed as part of the England Habitat Network (EHN) Project⁸. These figures are intended to provide an indication of the degree of functional connectivity that might exist between habitat patches, based on the potential for movement between them by individuals and species. These are structured according to habitat type and the degree of mobility exhibited by different species. The high mobility figures were derived from maximum dispersal distances obtained from a literature review. The medium and low mobility figures for each of the different habitats are a half and a quarter of the high mobility figures respectively.

Table 2 Network Scaling Figures derived from the English Habitat Network Project⁹ (km).

Mobility	Woodland	Heathland	Grassland	Mire/Fen/Bog
Low	0.75	0.3	0.5	0.25
Medium	1.5	0.6	1.0	0.5
High	3.0	1.2	2.0	1.0

2.3.3 Each habitat patch was therefore buffered at three different widths, based on the attribution of each UK BAP Priority Habitat to its appropriate EHN habitat class, as listed in Table 3 below.

Table 3 Attribution of UK BAP Priority Habitats to English Habitat Network (EHN) Habitat Classes and Scaling Figures (see Table 2)

EHN habitat class	UK BAP Priority Habitats
Woodland	Lowland Mixed Deciduous Woodland (incorporating Wet Woodland), Wood Pasture and Parkland
Heathland	Lowland Heathland
Grassland	Lowland Dry Acid Grassland, Lowland Meadow, Lowland Calcareous Grassland, Purple Moor Grass and Rush Pastures, Coastal and Floodplain

⁸ Catchpole, R., 2006. Planning for Biodiversity – opportunity mapping and habitat networks in practice: a technical guide. Natural England Research report 687.

⁹ Catchpole, R., 2007. England Habitat Network – Briefing Note. Natural England.

EHN habitat class	UK BAP Priority Habitats
	Grazing Marsh, Open Mosaic Habitats on Previously Developed Land (incorporating Calminarian Grassland), Wood Pasture and Parkland
Mire/Fen/Bog	Lowland Fen, Reedbed

2.3.4 Networks were considered to exist where the buffers of two or more habitat patches overlapped.

2.3.5 Figures 3.1 – 3.11 illustrate the distribution of each of the BAP habitat priority habitats with the relevant mobility buffers. This is repeated for habitats grouped in the Middle Tier (Figures 4.1 - 4.5) and Upper Tier (Figures 5.1 – 5.3) habitat classes respectively.

2.4 Site Suitability Scoring

General

2.4.1 Site suitability scoring was carried out broadly in accordance with the protocol set out in Section 5.3 and the Appendix of the Methodology. Any variation in the methodology for identifying site suitability is stated. The rationale behind any changes to the methodology is evaluated in Stage 2 of this report.

2.4.2 As stated in the Methodology (Section 5.3.2), a series of criteria need to be met in order to identify land that could be suitable for the creation of each habitat type. These criteria vary between each habitat type. The methodology distinguishes between sites that exceed as well as meet the criteria threshold. For the purposes of this pilot study, however, this distinction between exceeding and meeting the threshold has not been used. Instead, any land meeting the relevant criteria threshold score is considered to be suitable.

2.4.3 The Methodology also applies a 500m grid square across the study area as a mechanism for identifying the different levels of site suitability. For the purposes of this pilot study, however, the datasets have been clipped according to each criterion for each habitat, with each layer being interrogated for each set of site suitability criteria for each habitat. The use of clipping, rather than the 500m square grid, was considered appropriate because a) land is either selected as suitable or not (Section 2.4.2 above), so there is no gradation between land suitability, and b) because it was considered to be more accurate, since the use of the grid system required judgements to be made when a single 500m x 500m square only partially contained suitable habitat.

- 2.4.4 Figures 2.1 - 2.11 show the site suitability for each of the BAP habitat types. The figures also include the distribution of the existing habitats for each type. The figures are intended to illustrate the current distribution of existing habitats in relation to land that could potentially be suitable for each type.
- 2.4.5 Site suitability maps have not been prepared for Purple Moor Grass and Rush Pasture, due to the lack of a Springs dataset.
- 2.4.6 For clarity, no effort has been made to clip any of the datasets to try and avoid urban areas or roads.

Site Suitability for each habitat type

- 2.4.7 Figures 2.1 – 2.11 illustrate the distribution of each of the BAP Priority Habitats and the areas identified as suitable for the creation of these habitats. There is considerable variation between individual BAP habitats in the consistency between the distribution of existing habitat and areas identified as suitable for their creation, possible reasons for which are discussed in Stage 2 of this report.

2.5 Network Enlargement Areas

- 2.5.1 Network enlargement areas, or buffers, were used to identify areas where the creation of new habitat would create new, or enlarge or strengthen, existing habitat networks. Network enlargement areas were identified by applying buffers of twice the width of the network scaling figures. Any habitat created partly or wholly within these areas therefore have the potential to be ‘functionally’ linked to areas of existing habitats, thereby enlarging or extending existing networks.
- 2.5.2 Because of the ease of graphical presentation on A4 plans and their greater suitability as a realistic representation of species dispersal (see Stage 2, Sections 3.4.1 – 3.4.12 below), only the low mobility buffers have been used to illustrate the distribution of the network enlargement areas.
- 2.5.3 Figures 3.1 – 3.11 illustrate the Network Enlargement Areas for each BAP Priority habitat using the Low Mobility scale, with the low mobility network enlargement buffers.
- 2.5.4 Figures 4.1 – 4.5 illustrate the Network Enlargement Areas for each habitat at the Middle Habitat Class level using the low mobility network enlargement buffers.

2.5.5 Figures 5.1 – 5.3 illustrate the Network Enlargement Areas for each habitat at the Strategic Habitat Class using the low mobility network enlargement buffers.

3.0 STAGE 2 - METHODOLOGY EVALUATION

3.1 Background

3.1.1 Stage 2 of the Report describes the lessons learnt from the testing of the pilot methodology. The evaluation includes discussion of the following elements of the pilot project:

- A test of its practicality;
- The identification of any issues or limitations in terms of both inputs and outputs;
- An evaluation of the methodology's success in delivering the aims of Stage 3 of this report

3.2 Data Acquisition and Data Organisation

Habitat Data

3.2.1 The quality of the output from a methodology such as the one applied here is dependent on the quality of the data used, in terms of both its completeness (identifying all valuable sites or habitats) and its accuracy (attributing habitat correctly).

3.2.2 Inevitably the baseline data used in applying the methodology tends to under represent the extent of habitats and habitat networks of nature conservation importance in the 6Cs area. UK BAP Priority Habitats themselves are likely to be under represented in the data sets used to apply the methodology, as a result of constraints related to survey effort. For example, there is incomplete representation of habitats within statutory designated sites (mainly SSSIs) in the study area with some sites represented only in part and some not at all. In Derbyshire a number of Local Wildlife Sites do not have UK BAP Priority Habitats attributed to them, and in the case of the Local Wildlife Site data, limitations or constraints in the designation process also lead to under representation. In addition, it is currently not possible to apply the methodology to non-UK BAP Priority Habitats that are otherwise of nature conservation importance, including some local BAP habitats, because they are insufficiently well recorded and mapped. Additionally, they would need Site Suitability Scores attributed to them.

3.2.3 In Nottinghamshire and Derbyshire there will have been both over and under representation of particular habitats as a result of the fact that the Local Wildlife Site data set is site rather than habitat based. In sites supporting more than one habitat the selection of the primary habitat to characterise the site in terms of habitat will have lead to an over representation of the primary habitat and under representation of secondary habitats.

- 3.2.4 In Leicestershire there will have been over representation of all habitats for the same reason, because the same site will appear more than once where it supports more than one habitat, although only a proportion of the site actually supports each of the individual habitats.
- 3.2.5 There are also likely to be a number of incorrect attributions of habitat within the data sets, for example as a result of inadequate or outdated data. The habitats of some sites (including all wet woodland and a small number of larger sites) were reattributed as part the application of the methodology during this pilot study (as described in Table 1 above). However, a wider evaluation of the accuracy of the attribution of habitat within the data sets was not conducted, and is only really possible with detailed local knowledge or access to good recent survey data, and so the full the extent of inaccuracy is currently unknown.
- 3.2.6 Due to uneven data, habitat quality has not been incorporated into the methodology. The quality of existing habitats is an important consideration when selecting opportunities for extending or creating new habitat, but this may best be considered at the local level, when potential new areas for habitat creation have been identified.

Recommendations – Habitat Data

- 3.2.7 It is recommended that a review of the currency and accuracy of existing habitat data is undertaken by the WTs and NE.
- 3.2.8 It is recommended that a standard method is developed between the WTs and NE to record BAP habitat data with common attributes and standard nomenclature, to ensure that the data is directly comparable and allows for cross boundary interrogation.
- 3.2.9 It is recommended that consideration is given to developing a standardised hierarchical scale to which habitats within each site can be attributed (in relation to Figure 2 of the Methodology) within each of the WTs or NE's datasets. The application of this scale by the data holders would reduce the potential for the data to be inaccurately interpreted by data users outside these organisations.
- 3.2.10 It is recommended that the WTs and NE identify common standards for habitats of local Biodiversity interest that may not conveniently fall within standard BAP habitat descriptions. In particular, it is clear that mineral extraction (both mining and quarrying), as well as other industrial landscapes have given rise to ecologically valuable habitats within the three counties, which should be accurately represented within this methodology.

Soil Data

- 3.2.11 As part of the process for piloting the methodology, it was necessary to take baseline NSRI soils data and interpret it, to broadly identify neutral, acid and alkaline soil types across the sub-region (Figure 1.6a). In reality the sensitivities of some of the habitat types in relation to soil requirements are likely to be more subtle than these three broad categories.
- 3.2.12 Soil properties such as permeability and depth are not represented and the soil data is insufficiently well resolved to pick up very localised conditions or anomalies and these were therefore not represented in the site suitability scoring system.
- 3.2.13 Importantly, it was not possible to distinguish between mildly and highly acid / alkaline soils, which also have a bearing on the types of habitats that occur, or which might be created, within particular areas.
- 3.2.14 The use of the soil data is intimately linked with the geology data (see below) in identifying site suitability for each habitat type. The combined results are discussed under section 3.2.17 – 3.2.22 below.

Recommendations – Soil Data

- 3.2.15 It is recommended that an accurate soil dataset is created that:
- Distinguishes between levels of permeability;
 - Refines the relative pH of broad soil types to distinguish between mildly and highly acid / alkaline soil types; and,
 - Provides a more detailed description of soil types to apply at the local (e.g. city wide) scale.
- 3.2.16 In conjunction with a more refined soil dataset, it is recommended that the Site Suitability Scoring system is refined to include a more subtle approach to soil type requirements for each habitat. In particular, this should apply to the acid grasslands and heathlands, and the calcareous grassland habitat types.

Geology Data

- 3.2.17 In common with the soil data, the BGS geology dataset also required extensive interpretation in order to combine a large number of rock types into acid, alkaline and neutral geology. In many respects, the use of geological data in this manner can be more misleading than the aggregation of soil types. In particular, it is not uncommon for overlying soils to exhibit a

different pH levels to that found in the underlying geological formation. Additionally, the presence of alluvial soils may reduce or mask the influence of the bedrock on pH in comparison with more weathered or exposed geological formations.

- 3.2.18 It is considered, therefore, that describing geological formations as acid, neutral or alkaline does not, in itself, provide a sufficiently refined or relevant method for identifying site suitability.
- 3.2.19 The British Geological Survey is, however, in the process of developing a soil-parent material database¹⁰. The database is a GIS application “designed to help ... assess the characteristics of the ‘near-surface’ weathered zone. In particular, the data focuses upon the material from which top soils and subsoils ... develop”¹⁰.
- 3.2.20 The user guide further states: “A ‘soil parent material’ is a geological deposit over, and within which, a soil develops. Typically, the parent material is the first recognisably geological deposit encountered when excavating beneath the soil layer. It represents the very near-surface geology ... Most users will use the ‘soil-parent material’ data as their core data source to help them model and understand soil characteristics”¹⁰.
- 3.2.21 The dataset has not been fully evaluated as part of this pilot project. However, a cursory review of the User Guide suggests that this may provide an appropriate mechanism for relating geology / soil characteristics with site suitability for habitat creation. If this is the case, it will be necessary to revise the site suitability scoring system to take account of the parameters within this dataset.

Recommendations – Geology Data

- 3.2.22 It is recommended that the BGS soil-parent material database is comprehensively assessed for its potential value in mapping site suitability for habitat creation. If suitable, it is recommended that the site suitability scoring system is revised to relate habitat site suitability with the relevant parameters in the database. Also, if suitable, it is likely that this database would replace the need for separate soils and geological data as part of the Site Suitability Scoring system.

Agricultural Land Classification (ALC) Data

- 3.2.23 The ALC data remains a valuable dataset as part of the site suitability scoring system.

¹⁰ Lawley, R. (2009). The soil-parent material database: A User Guide. *British Geological Survey Internal report*, OR/08/034.

Recommendations – ALC Data

- 3.2.24 Retain the ALC data as one of the parameters for identifying site suitability. Moreover, it is considered that the use of ALC data should be extended to discriminate between areas of high and low fertility inherently preferable for a number of the habitat types, including woodland.

Environment Agency (EA) Flood Maps Data

- 3.2.25 The EA flood maps include data relating to both defended and undefended land. This is also identified as one of the parameters required for assessing site suitability for floodplain and grazing marsh, fens and reedbeds. The EA data does not, however, allow detailed assessment of defended / undefended land in terms of its suitability for these habitat types. For example, the period and frequency of inundation would have a significant bearing on the likelihood or appropriateness of creating habitats in particular sites.
- 3.2.26 Furthermore, the use of EA data in this manner does not take into account the potential for habitat creation to provide an alternative to constructed flood protection, or the realignment of flood defences (i.e. areas of wetland habitat may perform the same function as a constructed flood bank, or may provide an opportunity to use currently defended land and remove the defences once the habitat is established).
- 3.2.27 This pilot study has applied the EA flood maps to provide an indication of the full extent of the floodplain, without trying to differentiate between defended and undefended land. It is considered that taking this approach enables the broad identification of suitable habitat at a strategic level. It is, however, recognised, that the identification of suitable sites at a local level would be best achieved through discussion with, amongst others, Area EA staff, who would have the local knowledge to help inform site selection.

Recommendations – EA Flood Data

- 3.2.28 It is recommended that EA flood data continue to be used to provide a strategic overview of potential site suitability for floodplain grazing marsh, reedbeds and fens. However, site selection at a local level should be undertaken in consultation with EA Area staff, amongst other interested parties.
- 3.2.29 It is recommended that the EA flood data is augmented with either more comprehensive EA data, including information on springs and flushes, as well as ponds and watercourses outside the floodplain. Alternatively, Meridian data may also provide a similar coverage.

Datasets not used in the methodology – Historic Mapping

- 3.2.30 The site suitability scoring system does not use historic mapping sources to identify potential sites for habitat (re)creation. The value of using historic mapping is that it provides a clear indication of where certain habitat types previously existed. For example, the historic extent of woodlands and heathlands can be identified using historic mapping sources, in particular. Whilst future decision making should not be wholly reliant on historical data sources, it should nevertheless be considered useful in informing site choice as part of the overall suite of datasets used.

Recommendations – Historic Mapping

- 3.2.31 It is recommended that Historic mapping is included as part of the site suitability scoring system. This may include either previous editions of the Ordnance Survey, or historic environment records held by relevant local bodies.

3.3 Site Suitability Mapping

- 3.3.1 Figures 2.1 – 2.11 illustrate the extent to which the methodology, as applied, is able to map site suitability for each of the BAP Priority Habitats. The extent of existing habitat of each type is illustrated on each map to illustrate the consistency between existing and potential habitat distribution. Clearly, where the existing habitats fall mostly or entirely within that predicted to be suitable, the match appears to be good. However, where existing habitats fall outside that predicted to be suitable, the match is poor and there is a need to identify the reasons for this discrepancy. Such discrepancies suggest failures in the methodology, either in the data used, or in its application.
- 3.3.2 It is likely that one of the most significant sources of discrepancy between existing and predicted habitat suitability relates to the interpretation of the soils and geology data. Specific examples are given below, however, overall it is likely that amalgamating soils and geology data into three broad categories reduces the sensitivity of the methodology.

Individual BAP Priority Habitats

- 3.3.3 **Coastal and floodplain grazing marsh** – Although in general there is a good fit between existing and predicted distribution it is evident that there are areas of existing floodplain grazing marsh in the Trent and Dove valleys that fall outside the predicted range of site suitability. It is likely that this is attributable to the soils/ geology mapping, such areas being mapped as non-neutral (and therefore unsuitable for the creation of coastal and floodplain grazing marsh..

- 3.3.4 **Lowland mixed deciduous woodland** – as might have been predicted, the whole of the 6Cs area is suitable for the establishment of lowland mixed deciduous woodland. On this basis, the more important consideration will be the selection of an appropriate species mix for and new woodland creation. Low soil fertility is also a useful indicator of likely nature conservation value in the creation of woodland, and therefore the use of the ALC may be useful in this regard.
- 3.3.5 **Wet woodland** – the distribution of existing wet woodland, as defined in the original dataset, was mapped, although elsewhere this dataset has been combined with the lowland deciduous woodland data. There is considerable variation between the existing habitat and that predicted to be suitable for it. Reasons for this are likely to include:
- Errors in the classification of woodland types;
 - Variations in local conditions that are too subtle for the datasets to pick up; and,
 - There are errors in the classification of woodland types.
- 3.3.6 **Dry meadows** – there is little correlation between the distribution of existing dry meadows and the areas identified as being suitable for them. It is considered that the most likely reason for this is variation in local soil / geology conditions that are not accurately reflected in the amalgamated soil types (as discussed in Sections 3.2.11 – 3.2.22 and 3.3.2).
- 3.3.7 **Wood pasture and parkland** – as with lowland mixed deciduous woodland, the creation of wood pasture and parkland is likely to be more restricted by the acquisition of land and the time it takes for such habitats to acquire their characteristic features and species, rather than issues relating to growing conditions.
- 3.3.8 **Dry acidic grassland / lowland heathland** – there is good correlation between the datasets for both these habitat types. However, given the extent to which the 6Cs growth area as a whole appears to be suitable for these habitats due to the apparently widespread presence of acidic soils. This may be an instance where the use of historic mapping may be used in conjunction with the mobility and network enlargement buffers, to fine tune the selection of suitable sites for habitat creation.
- 3.3.9 **Calcareous grassland** – as discussed previously, it is considered that the discrepancy shown in Figure 2.8 is attributable to the limited sensitivity in the soil / geology mapping.

- 3.3.10 **Wet meadows / lowland fens / Reedbeds** – there is generally a good fit between the existing and predicted distribution of these habitats. Any variance is attributable to the presence of areas of suitable habitat outside the floodplain.

3.4 Buffering, Network Scaling and Network Enlargement Areas

Buffering and Network Scaling

- 3.4.1 The Network Scaling Figures (as set out in Table 1 and Table 2 of the Methodology) used to buffer habitat patches and to identify habitat networks are derived from a literature review of maximum dispersal distances of species of nature conservation concern. However, the evidence base for the figures is very limited. Maximum dispersal distance data was found for only 28 out of a total of 1245 species, and of these 28 species, for example, 16 species are butterflies.
- 3.4.2 The Network Scaling Figures are intended to apply to the movement of individuals through favourable habitat, such as a woodland species through woodland or scrub. The application of uniform buffer widths around habitat patches in this methodology does not take account of the differing movement costs of individuals or species through different and less favourable habitat types.
- 3.4.3 There was also no variation in buffer width in relation to habitat patch size. There is no reason to believe (other things being equal) that individuals dispersing from small patches will move less far than those from large patches. However, larger patches will tend to support larger populations, and therefore the number of individuals dispersing from them will also tend to be larger, and the frequency of dispersal events will also be higher. The number or frequency of long(er) distance dispersal events originating from larger patches will also therefore be greater. Larger patches also tend to support a larger number of species than small patches, and therefore a larger pool of potential dispersing and colonising species. The uniform buffer width takes no account of the different contribution small and large habitat patches are likely to make to dispersal and colonisation of other habitat patches, both in terms of the number or frequency of dispersal/colonisation events per species and the range of species.
- 3.4.4 Overall therefore, the application of uniform buffer widths (both in relation to Network Scaling distances and Network Enlargement Areas) will tend to overestimate the degree of connectivity between habitat patches, and therefore the occurrence and extent of functional habitat networks, especially when applying the high mobility buffers. The buffers should therefore be seen as offering an indication of the degree of connectivity between habitat patches or within networks, and should be interpreted cautiously.

- 3.4.5 It is acknowledged that the methodology does not attempt to relate landscape permeability with species dispersal and migration. Furthermore, the methodology does not seek to ascribe network scales proportional to the size of each habitat patch. The recommendations set out below, however, are an attempt to identify further opportunities for incorporating a greater degree of realism into the assumptions without the requirement for complex algorithmic methods for predicting species dispersal.

Recommendations – Buffering and Network Scaling

- 3.4.6 As part of the pilot project, a literature review has been undertaken to identify further sources of academic study relating to species migration and dispersal in the landscape. A list of references of academic papers found to date, is included as Appendix 2.
- 3.4.7 It is recommended that further work is undertaken to distil information from these sources that will enable a broader and more representative approach to calculating buffer widths, and potentially, a greater degree of accuracy in predicting species dispersal.
- 3.4.8 It is recommended that the information within these additional data sources is aggregated so that information relating to species typically associated with a particular habitat, is used to inform the buffer widths for that habitat type.

Network Enlargement Areas

- 3.4.9 Figures 3.1 – 5.3 provide an illustration of the Network Enlargement Areas for the three habitat classes. These figures do not include the distribution of areas of habitat suitability, for each habitat and for each habitat class. This is for graphical representation purposes at the sub-regional scale. Nevertheless, the figures do provide an indication of the level of connectivity between habitat types, and at each spatial scale. The Figures prepared for Stage 3 of this report include the site suitability areas.
- 3.4.10 Figures 3.1 – 3.11 illustrate the distribution of each of the BAP priority habitats, with their low mobility buffers and corresponding network enlargement buffers.
- 3.4.11 Figures 4.1 – 4.5 repeat the same process for the middle tier habitat class.
- 3.4.12 Figures 5.1 – 5.3 illustrate the network enlargement buffers for the strategic (upper) tier habitat class.

4.0 STAGE 3 - 6C GROWTH POINT BIODIVERSITY NETWORK MAPPING

4.1 General

4.1.1 In order to illustrate the full application of the methodology to the 6Cs growth point, in terms of targeting habitat creation in areas with the greatest potential benefits, it has been trialled in the three cities housing marketing areas (HMAs). These areas were selected principally to provide a more detailed level of resolution in the mapping process for illustrative purposes, within this report. There is no reason why the methodology should not be applied across the 6Cs sub-regional scale, however, the graphical representation of these opportunity areas becomes more dense and complex at the larger scale.

4.2 Mapping Habitat Opportunities

4.2.1 The application of the methodology to each city's respective HMA was undertaken for each of the Priority Habitat types. Each habitat type, with its respective low mobility buffer and corresponding network enlargement area buffer, were applied to each HMA. The Site Suitability data was then overlain to provide a comprehensive illustration of each element of the methodology.

4.2.2 Figures 6.1 – 6.11 illustrate habitat opportunity areas for the Derby HMA, Figures 7.1 – 7.11, Nottingham HMA and Figures 8.1 – 8.11 for Leicester.

Recommendations – Mapping Habitat Opportunities

4.2.3 Notwithstanding the recommendations set out in Stages 1 and 2 of this report, it is likely that the most effective method for assessing the viability of this mapping would be for ground truthing to be undertaken by local NE or WT staff. It is therefore recommended that the plans are assessed using local knowledge to identify the accuracy and feasibility of these maps.

4.2.4 Furthermore, it is recommended that the findings of the ground truthing are used to inform and refine the methodology, where such findings may be useful in the genesis of a methodology that is applicable at the regional scale.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Overall Conclusions

5.1.1 Overall, it is concluded that the methodology, although requiring some refinement, is workable at the regional and sub-regional scale. In relation to the application of this approach at a local scale, it is essential that the invested knowledge of Natural England, the Wildlife Trusts and other nature conservation organisations are involved in the process of using the opportunity mapping outputs to identify habitat creation or species conservation opportunities.

5.2 Key Findings

5.2.1 There are broadly three key findings that would help to refine and add value to the methodology, as it currently stands.

- The requirement for a standardised method, to be developed between the Wildlife Trusts and Natural England, to record Biodiversity Action Plan habitat data with common attributes and standard nomenclature. This would ensure that data is directly comparable and allows for cross boundary interrogation at a local, sub-regional and regional scale;
- An assessment of the British Geological Survey's soil-parent material database to understand its potential value in mapping site suitability for habitat creation. If suitable, the site suitability scoring system could be revised to relate habitat site suitability with the relevant parameters in the database. Also, if suitable, it is likely that this database would replace the need for separate soils and geological data as part of the Site Suitability Scoring system; and,
- A requirement to develop a more robust dataset, using currently available peer reviewed literature, to provide a comprehensive data source on species migration and dispersal in the landscape. This would enable a broader approach to calculating buffer widths and potentially, a greater degree of accuracy in predicting species dispersal.

5.3 Key Recommendations

Habitat Data

- Undertake a review of the currency and accuracy of existing habitat data is undertaken by the Wildlife Trusts and Natural England;

- Develop a standard method is developed between the Wildlife Trusts and Natural England to record Biodiversity Action Plan habitat data with common attributes and standard nomenclature, to ensure that the data is directly comparable and allows for cross boundary interrogation;
- Consider the development of a standardised hierarchical scale to which habitats within each site can be attributed (in relation to Figure 2 of the Methodology) within each of the Wildlife Trusts' or Natural England's datasets. The application of this scale by the data holders would reduce the potential for the data to be inaccurately interpreted by data users outside these organisations;
- The Wildlife Trusts and Natural England should identify common standards for habitats of local biodiversity interest that may not conveniently fall within standard Biodiversity Action Plan habitat descriptions. In particular, it is clear that mineral extraction (both mining and quarrying), as well as other industrial landscapes have given rise to ecologically valuable habitats within the three counties, which should be accurately represented within this methodology.

Soil Data

- The creation of an accurate soil dataset that:
 - Distinguishes between levels of permeability;
 - Refines the relative pH of broad soil types to distinguish between mildly and highly acid / alkaline soil types;
 - Provides a more detailed description of soil types to apply at the local (e.g. city wide) scale; and,
- In conjunction with the refined soil dataset, it is recommended that the Site Suitability Scoring system is refined to include a more subtle approach to soil type requirements for each habitat. In particular, this should apply to the acid grasslands and heathlands, and the calcareous grassland habitat types.

Geology Data

- The British Geological Survey's soil-parent material database (currently under development) should be comprehensively assessed for its potential value in mapping site suitability for habitat creation. If suitable, it is recommended that the site suitability scoring system is revised to relate habitat site suitability with the relevant parameters in the database. Also, if

suitable, it is likely that this database would replace the need for separate soils and geological data as part of the Site Suitability Scoring system.

Agricultural Land Classification Data

- The Agricultural Land Classification data should be retained as one of the parameters for identifying site suitability. Moreover, it is considered that the use of Agricultural Land Classification data should be extended to discriminate between areas of high and low fertility inherently preferable for a number of the habitat types, including woodland.

Environment Agency Flood Data

- Environment Agency flood data should be used to provide a strategic overview of potential site suitability for floodplain grazing marsh, wet meadows, wet woodland, reedbeds and fens. However, site selection at a local level should be undertaken in consultation with Environment Agency Area staff, amongst other interested parties;
- The Environment Agency flood data should be augmented with more comprehensive Environment Agency data, including information on springs and flushes, as well as ponds and watercourses outside the floodplain. Alternatively, Meridian data may also provide a similar coverage.

Historic Mapping

- Historic mapping should be included as part of the Site Suitability Scoring system. This may include either previous editions of the Ordnance Survey, or historic environment records held by relevant local authorities.

Buffering and Network Scaling

- As part of the pilot project, a literature review has been undertaken to identify further sources of academic study relating to species migration and dispersal in the landscape. A list of references of academic papers found to date, is included as Appendix 2. Further work should be undertaken to distil information from these sources that will enable a broader approach to calculating buffer widths and potentially, a greater degree of accuracy in predicting species dispersal;

- The information contained within these additional data sources should be aggregated so that information relating to species typically associated with a particular habitat, is used to inform the buffer widths for that habitat type.

5.4 Moving Forward

5.4.1 It is recommended that future work (incorporating the above recommendations) be undertaken by Natural England and the Wildlife Trusts to develop a robust and consistent approach to biodiversity opportunity mapping in the East Midlands and potentially elsewhere. This pilot study has demonstrated the value of this approach as a key spatial planning tool to inform the delivery of Biodiversity Action Plan targets as a key contribution to green infrastructure provision.