# YEOVIL ECOTOWN

# BIODIVERSITY

# BASELINE AND SCOPING REPORT

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## Summary of Initial Findings

Following a bid to government Yeovil has achieved funding from government for the development of an Ecotown. Three options are being considered around Yeovil as to where the Ecotown development should be located. These Areas of Search (AoS) are:

- Brympton & Coker;
- Keyford & Barwick; and
- East Yeovil & Over Compton.

The Planning Policy Statement 1 on Ecotowns (PPS1) states that '*Ecotowns should demonstrate a net gain in local biodiversity*'. Furthermore legislation for European Protected Species requires that local authorities must ensure that populations and the habitat necessary to support those populations are maintained.

For a development of 5000 dwellings the total area required for the Yeovil Ecotown would be around 224 hectares. PPS1 states that 40% of the cent of the Ecotown's total area should be allocated to green space, of which at least half should be public and consist of a network of well managed, high quality green/open spaces, including meeting the needs of wildlife. Therefore the green space could include up to 32 hectares of potentially inaccessible areas solely for the conservation of biodiversity in the area.

An initial appraisal of the biodiversity requirements of each of the AoS has been made in this report. The key findings with regard to each of the AoS are as follows:

**Brympton & Coker**
The total area of requirement to maintain biodiversity interests for this AoS is approximately 206 hectares. The AoS is approximately 435 hectares of which 192 hectares is required to accommodate 5000 houses and associated development. Therefore, it is concluded that the area could accommodate the proposed Ecotown development by incorporating and improving features already present. However, this should be concentrated in the southern end of the AoS towards North and West Coker away from sensitive species and habitats.

**Keyford & Barwick**
The area available for development is effectively split into two areas. One towards the east is approximately 80 hectares. The other along the A37 at Keyford and towards East Coker is approximately 110 hectares in area. Two hundred and four hectares is required to accommodate 5000 houses and associated development. Therefore, it is concluded that the 40% green infrastructure requirement is unlikely to be present due to sensitive habitats and species in the central area of the AoS. Therefore, an additional area of land for housing development by should be acquired from either the adjacent East Yeovil & Over Compton AoS (112 hectares) or the Brympton & Coker

AoS (82 hectares). The western extension is preferred in terms of biodiversity as the eastern extension includes habitat likely to be used by bats, which if developed would put also put additional pressure on resources used by lesser horseshoe in the centre of the AoS.

**East Yeovil & Over Compton**
The total area of requirement to maintain biodiversity interests for East Yeovil & Over Compton AoS is approximately 113 hectares. The AoS is approximately 539 hectares of which 192 hectares is required to accommodate 5000 houses and associated development. There is also potential to enhance habitat along the watercourses in the AoS and this would occupy approximately 132 hectares, giving a biodiversity area of around 244 hectares. Therefore, it is concluded that the area could easily accommodate the proposed Ecotown development by incorporating and improving features already present.

Guidance is given for designing Masterplans for each of the AoS in order that biodiversity is maintained and enhancement is suggested.

**CONTENTS**

# 1. Overview

## Introduction

1.1 The Secretary of State's Proposed Changes to the South West Regional Spatial Strategy (RSS) suggest 11,400 new dwellings at Yeovil, of which 6,400 could be accommodated within the urban area and 5,000 within an urban extension to the town. The Government published Planning Policy Statement 1 "Eco towns a supplement to PPS1" in July 2009 and within that announced Government objectives for Ecotowns, the 4 chosen sites and the opportunities to pursue further Ecotowns through Regional Spatial Strategies and Local Development Frameworks. Following a bid to government Yeovil has achieved funding from government for the development of an Ecotown.

1.2 Demonstrating a positive outcome for biodiversity is a key challenge for Ecotown development. Biodiversity is a vital part of ensuring a sustainable natural environment for future generations. Although the consideration should be a fundamental part of any development in the case of Ecotown development biodiversity is an integral part of a sustainable development.

## Purpose

1.3 The Planning Policy Statement 1 on Ecotowns states that '*Ecotowns should demonstrate a net gain in local biodiversity*'. Furthermore legislation for European Protected Species requires that local authorities must ensure that populations and the habitat necessary to support those populations are maintained (see Appendix 3).

1.4 This report contains the first stage in developing the Yeovil Ecotown Biodiversity Strategy. It is a desk based assessment of biodiversity assets in the Areas of Search proposed for the Ecotown, scoping in '… *species and habitats of national, regional or local importance, found in or adjacent to the eco-town location at the outset...'*

1.5 The report contains the following chapters:

1. **Overview** – This chapter outlines the background and purpose for undertaking the study. It also outlines the Areas of Search and land take required to develop the Ecotown. Finally it sets out the requirement for a Biodiversity Strategy as a key element of the development.

2. **Policy Background** – This chapter gives information on the policy background for biodiversity within Ecotown development, which includes the Planning Policy Statement on Ecotowns.

3. **Potential Impacts of Ecotown Development** - As it is a requirement of Ecotown development to produce a net biodiversity gain and that legislation affecting European Protected Species requires maintenance of populations and their distribution, this chapter sets out potential impacts from the Ecotown development that will need to be considered in Masterplanning.

4. **Scoping** - This chapter is a desk based review of important ecological features, including designated sites, habitats and species, recorded as being present in each of the Areas of Search and gives mapping of the landscape use required to support these features.

5. **Appraisal** – An appraisal is made of each Area of Search in order to inform the decision on the preferred option and to identify at an early stage where an option would not result in a biodiversity gain due to impacts from development. The chapter also provides information on the requirements to maintain ecological features that need to be included in Masterplanning the Ecotown and gives suggestions for enhancements that may lead to biodiversity gain, a key aim.

6. **Next Steps: Evaluation and Assessment** – This chapter sets out the next steps that need to be undertaken in order to produce an ecological impact assessment and a Biodiversity Strategy for the development of the Ecotown. It includes a recommended methodology for ensuring no loss of biodiversity and maintenance of European Protected Species' populations. It also recommends what surveys are needed to inform further work on the biodiversity element of the Ecotown.

1.6 Appendices are included which contain information supporting the chapters outlined above.

## Yeovil Ecotown

1.7 Three options are being considered around Yeovil as to where the Ecotown development should be located. These Areas of Search are:

- Brympton & Coker;
- Keyford & Barwick; and
- East Yeovil & Over Compton.

These are shown on Map 1. The boundaries of the areas shown are approximate only.

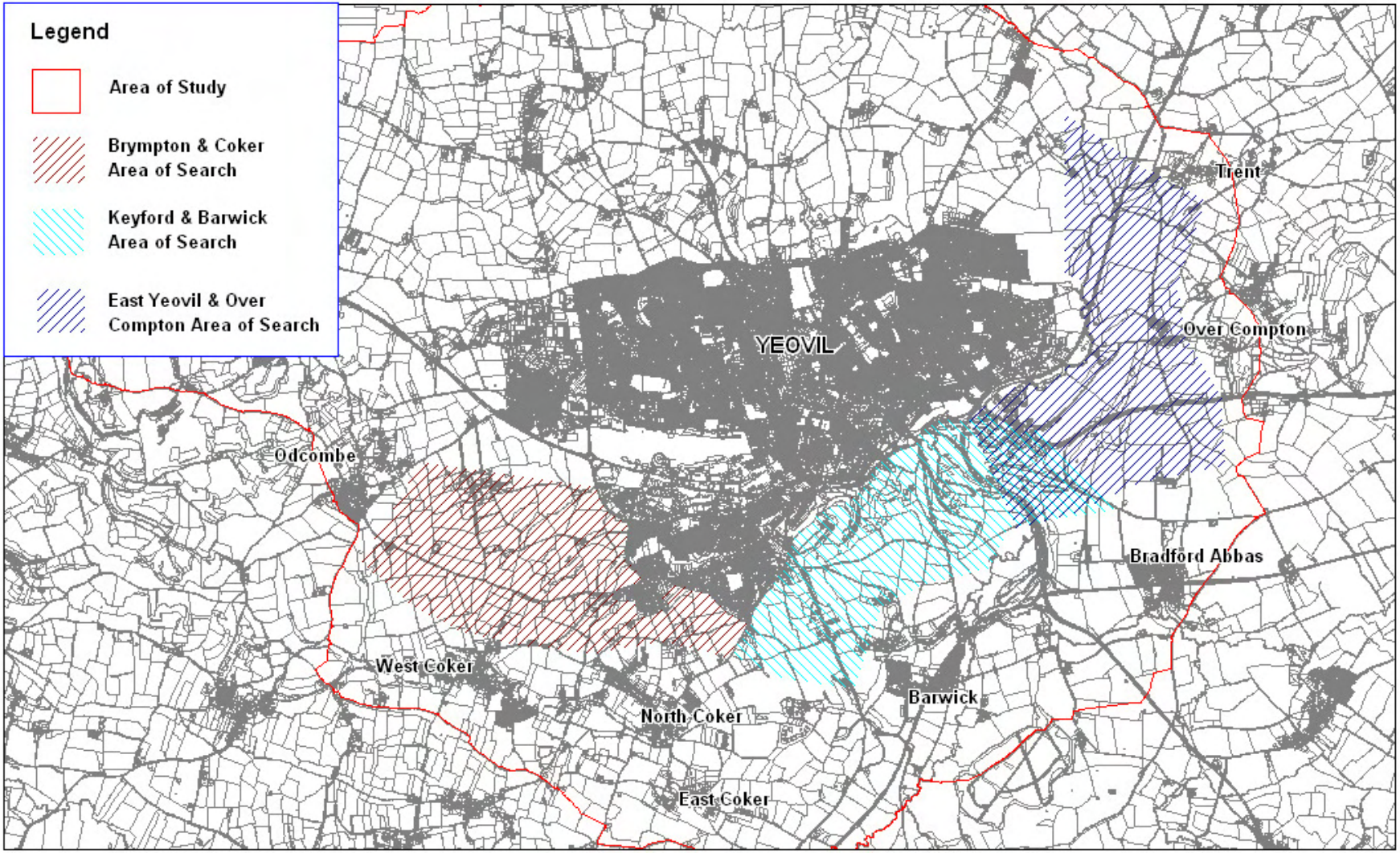
1.9 The table below shows the approximate area land required to provide 5,000 new homes along with the associated infrastructure and community infrastructure for an urban extension(s) at Yeovil.

**Table 1: Estimated Land Take**

| Land Type | Estimated Land Take - 5000 Dwellings (Hectares) |
|---|---|
| 1. Housing | 100 |
| 2. Employment | 31 |
| 3. Education | 14 |
| 4. Health Centre | 0.2 |
| 5. Local Centres/Community Facilities | 7.15 |
| 6. Energy Centre | 2 |
| 7. Strategic Road Network | 5 |
| 8. Open Space (40%) | 64 |
| **Total** | **224** |

1.10 In addition, PPS1 states that 40% of the cent of the Ecotown's total area should be allocated to green space, of which at least half should be public and consist of a network of well managed, high quality green/open spaces, including meeting the needs of wildlife. This indicates that up to 32 hectares of potentially publicly inaccessible areas solely for the conservation of biodiversity. The other 32 hectares of open space may consist of areas such as sports facilities and other amenity areas, which are likely to be poor habitat for wildlife although habitat features around these areas may be maintained and some smaller areas within this may prove valuable at a local level. Therefore, it is assumed that 192 hectares would be required for the built development,

**Map 1: Yeovil Ecotown Areas of Search Options**



**Ecotown Development and its Biodiversity Strategy**

1.11 Biodiversity must be a key theme in Masterplanning an Ecotown (TCPA, 2009). The Masterplan should identify:

- The existing key habitat areas are to be protected, enhanced and expanded as part of the plan;
- Transitional and supplementary habitats as part of a wider green space resource, sustaining more widespread habitats and species; and
- Measures for maximising the contribution of the built environment to biodiversity.

1.12 The Town and Country Planning Association [TCPA] (2009) have stated that the principle objectives for an eco town biodiversity strategy are:

- Protect and enhance the best of existing biodiversity;
- Mitigate the impact of development and secure net biodiversity gain;
- Integrate biodiversity with the built development; and
- Increasing biodiversity's resilience and ability to adapt to climate change.

1.13 The TCPA (2009) also gives guidance on what achieving net gain for biodiversity should be. A net gain is defined as, 'species and habitats of national, regional or local importance, found in or adjacent to the eco-town location at the outset, showing a sustained increase in abundance, quantity and extent. In other words, the development of the eco-town results in an increase in the area's biodiversity assets.'

1.14 All Ecotown proposals should include an Ecotown Biodiversity Strategy (ETBS). This will provide the framework to delivering net biodiversity gain; setting out what is to be achieved and the steps required achieving it. More importantly it should set out how biodiversity will be increased and enhanced before, during and after development rather than just an end of development process.

1.15 The ETBS should provide specific targets for net biodiversity gain, reflecting local priorities for biodiversity and contributing to national and regional targets where appropriate. Climate change resilience should also be taken into account.

1.16 The ETBS will be developed as an integral part of the Masterplan for the Ecotown and form part of the supporting documentation showing how net biodiversity gain will be achieved and sustained.

1.17 As afore stated, the Masterplan will need to show existing key habitat areas to be protected, enhanced and expanded including transitional and supplementary habitats sustaining widespread habitats and species. Measures for maximising the contribution of the built environment to biodiversity should also be included, such as roosts for bats and nest sites for birds.

1.18 The Bio Regional Development Group and CABE ( 2009) has stated that Ecotowns should:

'*As a minimum, developers of eco-towns should:*

- *produce a biodiversity action plan identifying the key species and presenting strategies designed to improve and increase habitat for selected species and increase their numbers.*

- *provide a green infrastructure plan demonstrating how the development proposal will feature an interconnected network of multifunctional greenspace with:*
  *-public green space representing at least 20 per cent of the overall development footprint (excluding private gardens)*
  *-a canopy cover of at least 25 per cent in residential areas and 15 per cent in mixed-use or commercial areas ; and -provision for bicycle and walking connection within the development and towards neighbouring communities*.'

# 2. Policy Background

**Planning Policy Statement: Eco-towns (A supplement to Planning Policy Statement 1)**

2.1 The Planning Policy Statement (PPS) on Ecotowns gives the following guidance on developing a biodiversity strategy.

***Biodiversity***

ET 16.1

2.2 Eco-towns should demonstrate a net gain in local biodiversity.

2.3 Planning permission may not be granted for Ecotown proposals that have a significant adverse effect on internationally designated nature conservation sites or Sites of Special Scientific Interest. This is considered in the Scoping chapter following.

ET 16.3

2.4 A strategy for conserving and enhancing local biodiversity should be produced to accompany planning applications for Ecotowns. This should be based on up-to date information about the biodiversity of the area including proposals for the management of local ecosystems and where appropriate, the restoration of degraded habitats or the creation of replacement habitats.

2.5 It should set out priority actions in line with the England Biodiversity Strategy and Local Biodiversity Action Plans, including appropriate mitigation and/or compensation measures, required to minimise adverse effects on individual species and habitats of principal importance and to enhance local biodiversity overall.

2.6 Developers should seek the advice of Natural England and other relevant statutory advisers when developing their strategies and decision-making authorities should also consult those bodies as to the adequacy of such strategies. Delivery bodies should be identified in the strategy and its implementation should proceed in parallel with the development.

***Green Infrastructure***

ET 14.1

2.7 Forty per cent of the eco-town's total area should be allocated to green space, of which at least half should be public and consist of a network of well managed, high quality green/open spaces which are linked to the wider countryside. Planning applications should demonstrate a range of types of green space, for example community forests, wetland areas and public parks. The space should be multifunctional, e.g.

accessible for play and recreation, walking or cycling safely, and support wildlife, urban cooling and flood management.

**Planning Policy Statement 9: Biodiversity and Geological Conservation**

2.8 The Government's policy for biological conservation is set out in Planning Policy Statement 9: Biodiversity and Geological Conservation (PPS9). The policies are to be used in spatial planning. The key principles of PPS9 include that planning decisions should be based on up-to-date information about the environmental characteristics of their areas including for biodiversity.

2.9 The legal circular 06/2005 supporting PPS9 states in paragraph 98 that, '*The presence of a protected species is a material consideration when a planning authority is considering development proposals, that if carried out, would likely to result in harm to that species or its habitat*.'

2.10 Circular 06/05 (paragraph 99) also states: '*It is essential that the presence or otherwise of protected species, and the extent that they may be affected by the proposed development, is established before the planning permission is granted, otherwise all relevant material considerations may not have been addressed in making the decision*'.

2.11 The Guide to Good Practice circular that accompanies PPS9 promotes that Core Strategies, of which the Ecotown would form part, should embrace an integrated approach to biodiversity and suggests two ways in which this might be achieved.

2.12 Firstly, development control policies and allocations relating to all sectors of land use should be consistent with strategic objectives for biodiversity. This should apply to the objectives of the Habitats Directive.

2.13 Secondly, Local Development Frameworks (LDF) should promote a spatial planning approach to biodiversity. The Core Strategy should provide a spatial strategy for the authority's area that incorporates objectives for biodiversity, including those of the Habitats Directive for Community species. Key diagrams can be included for the protection and enhancement of biodiversity.

2.14 The Guide to Good Practice also states that, '*The principle of LDFs should be sound in terms of evidence… requires local authorities to develop a comprehensive information base on the biodiversity… of an area*.' The guidance also states, *'… as a matter of good practice, the status and distribution of protected species, as well as priority BAP species, should form part of the evidence gathering required for the production of the LDF*'.

**Somerset Biodiversity Strategy**

2.15 The Somerset Biodiversity Strategy sets out a vision for biodiversity in Somerset. The vision includes the following statements:

- '*The diversity and functions of our landscapes, the sea, and the ecosystems they contain have been maintained and restored for the benefit of wildlife and people*'

- '*Habitats and species exist at high enough levels to ensure that they will remain viable far into the future*'.

2.16 The Somerset Biodiversity Strategy contains a number of County-wide Habitat and Species Action Plans, to which South Somerset District Council has consideration in the day-to-day functions of the South Somerset District Council, particularly in relation to development planning and policy. These include:

- Ditches & Ponds (focusing on rare plants and invertebrates)
- Gardens & Urban Greenspace
- Hedgerows & Hedgerow Trees
- Roadside Verges & Green Lanes
- Traditional Orchards
- Water & Wetlands
- Wood Pasture, Parkland & Veteran Trees
- Bats
- Lapwing
- Otter

2.17 These action plans should be reflected in the Ecotown Biodiversity Strategy.

**South Somerset Biodiversity Action Plan**

2.18 In addition to the countywide action plans South Somerset District Council also have district level Habitat and Species Action Plans that are more particular to the district due to occurrence.

- Native Wildflowers of Arable Land
- Woodland
- Heathlands
- Calcareous & Neutral Grasslands
- Purple Moor Grass & Rush Pasture

2.19 Again, these action plans should be reflected in the Ecotown Biodiversity Strategy

# 3. Potential Impacts of Ecotown Development

## Introduction

3.1 This chapter looks at potential impacts that could arise from housing and other development and its infrastructure on species and habitats. The following impacts are considered:

- Loss of Habitat;
- Habitat Fragmentation;
- Barrier Effects;
- Habitat Isolation;
- Proximity Impacts;
- Hydrological Impacts;
- Transport;
- Recreational Pressure; and
- Cumulative Effects.

## Loss of Habitat

3.2 A direct loss of habitat due to new construction or land use change is a major threat to species. It can either cause mortality or displacement of a species. In some cases survival depends on the ability of the species to find alternative habitat. The effects may be local or on a larger geographic scale. Delayed effects of habitat loss are probably common but rarely analysed in ecological impact assessments. (Treweek, 1999)

3.3 Species are not only threatened by habitat loss but also by reorganisation of land use and by reduction in size of habitat patches. (Treweek, 1999)

3.4 Although it is relatively straightforward to measure land take loss of habitat is not always easy to assess. Therefore, it is necessary to know which species an area of land supports, its quality in terms of those species' needs and the relationship between the areas proposed for development and the overall carrying capacity. Therefore, some method is needed for measuring habitat loss such as the Habitat Evaluation Procedure described later in this report. (Treweek, 1999)

## Habitat Fragmentation

3.5 Fragmentation is the breaking down of habitat units into smaller units of habitat. It is linked to changes in quality and quantity. These could include increase in edge effects, reduction in size of habitat and

changes in species composition. Habitat fragmentation can also lead to the isolation of some species by removing corridors of habitat through which it can move. (Treweek, 1999)

3.6 The reduction in habitat area would be less able to support a level of population prior to the land use change and may result in inbreeding to genetic problems and eventual local extinction.

**Barrier Effects**

3.7 Linear development, such as new roads, can form barriers, which prevent the movement of wildlife through the landscape. This is a particular problem for migrating species. Many amphibians use different habitat at different seasons of the year. Barriers can cause traffic casualties or reluctance in a species to cross it. Small mammals will not cross roads of 20 to 25 metres wide. Traffic density also forms part of the ability of species to cross roads. (Treweek, 1999)

**Habitat Isolation**

3.8 Habitat Isolation is the combined effect of habitat loss, fragmentation and isolation. It affects the genetics of a population if it cannot interact with populations elsewhere which can have a long-term effect on viability.

3.9 In general, consequences are:

- Loss of key species (species on which the ecology of other species depend); Reduction or extinction of species at newly formed edges, increased vulnerability to external influences such as disturbance, increased likelihood of invasion by uncharacteristic species;
- Inbreeding;
- Loss of characteristic species; and
- Increased vulnerability to stochastic events, e.g. climate change.

(Treweek, 1999)

**Proximity Impacts**

3.10 These are impacts on species and habitats arising from the closeness of development to a feature. They are numerous but can include:

- Disturbance effects from construction activities (including noise and lighting);

- Increased traffic impacts from construction activities;
- Increase human disturbance from use of the new site
- Increased predation from domestic cats and increases in urban living species, such as foxes, rats and corvids;
- Increased fly tipping;
- Increased levels of lighting;
- Increased random disturbance events.

(Treweek, 1999)

## Hydrological Impacts

### *Water Quality*

3.11 Many habitats are dependent upon there being appropriate water quality to support their integrity, including watercourses and estuaries and other wetland habitats, as well as less obvious habitat types (such as heathland), which may be dependent on ground water quality. Water quality can be affected by a number of factors, such as:

- Pollution from toxic chemicals, metals, oils, pesticides, etc., arising for example from accidental spills, industrial processes, run-off from urban areas; and
- Discharges from sewage treatment works, and over-flowing foul water systems at times of high rainfall and flooding.

3.12 Many of the most significant risks to water quality are as a result of agricultural activity, which largely falls outside the remit of the Ecotown. However, the development can potentially increase the risk of water quality being affected due to extra loads being placed on sewage treatment works, increased hard surfacing and hence run-off, and potential accidental spills, for example from port related activity. Diffuse pollution could result in an in combination impact. Changes in hard surface runoff may leads to changes in flow patterns in watercourses (storm water surges), and increased nutrient and sediment levels in watercourses. River, rhyne and ditch, and floodplain habitats such as alluvial forests would be especially vulnerable.

### *Groundwater Supply*

3.13 Both groundwater and surface water levels can be affected by abstraction for public water supply and for industrial and agricultural uses. Climate change is likely to lead to drier summers, which could reduce the availability of water at a time when both population growth and per capita water usage is increasing. Particularly vulnerable are those habitats dependent on groundwater

### *Flood Risk Management*

3.14 This impact may arise due to flood management schemes altering flows in river and ditch habitats. Such impacts may not necessarily be negative, especially if the flood plain is used to manage flood risk.

### Transport

3.15 Impacts from increased traffic flows arising from new developments, including:

- Increased noise impacts (volume, duration);
- Increased vehicular emissions;
- Increased road mortality; and
- Increased fragmentation impacts.

3.16 Certain floristic species can be directly and/or indirectly affected by pollutants concentrated in the air such as oxides of nitrogen (NOx), oxides of sulphur (SOx) or ammonia, or by pollutants deposited on the ground through acidification or terrestrial eutrophication via soil (deposition of nitrogen). Effects from vehicular emissions are likely to effect sensitive species of certain habitat types, particularly lichens and bryophytes.

3.17 Road mortality is likely to affect otters, bats and other species dispersing or moving across the road network. Fragmentation impacts would be particularly an issue for bats, which rely on contiguous flight lines.

### Recreational Pressure

3.18 Increased recreational pressure from urban populations, including dog walking, jogging, horse riding, mountain biking, motorbike scrambling, off road car driving and other, mostly informal, are likely to result from housing and other development.

3.19 Typical impacts of recreation include:

- Physical damage, for example from trampling and erosion;
- Disturbance to sensitive species, such as kingfishers, from walking, cycling, and water sports, resulting in increased mortality and nesting success, and displacement;
- Air pollution and disturbance from traffic; and
- Disturbance from dogs and damage from dog excrement.

3.20 In addition, recreational pressures can be exacerbated by other damaging activities described as proximity impacts above, rubbish tipping, vandalism, arson, and predation, particularly by cats.

3.21 The impacts of recreation and urban effects can affect a wide variety of habitat types. Some of the most sensitive in the Yeovil Ecotown area are watercourses, woodland and grasslands.

**Renewable Energy Schemes**

3.22 PPS1 on Ecotowns requires that over a year the net carbon dioxide emissions from all energy use within the buildings on the eco-town development as a whole are zero or below. One way of contributing to zero carbon emissions is through the use of wind turbines. However, these need to be located in the right place if impacts on sensitive wildlife and habitats are to be avoided.

3.23 Bats, which are widespread around Yeovil, in particular are potentially vulnerable to mortality from the development of wind turbines. Some species are at higher risk than others and this is discussed in Appendix 4.

3.24 There may also be other impacts as described above, such as disturbance effects, habitat loss and fragmentation.

**Cumulative Impacts**

3.25 Cumulative impacts are those where an impact in itself may not be significant, but in combination with other impacts from the plan, or from other plans and projects, may amount to a significant impact.

# 4. Scoping

## Introduction

4.1 The following sections make an initial identification of the '…*species and habitats of national, regional or local importance, found in or adjacent to the eco-town location at the outset…'* that need to be preserved and enhanced if biodiversity gain is to be achieved, for each of the three options for locating the Ecotown at Yeovil.

4.2 This chapter identifies sites designated for nature conservation within or adjacent to the three optional areas for development, including Sites of Special Scientific Interest (SSSI) and Local Wildlife Sites (LWS) [formerly County Wildlife Sites]. Important species protected under European and UK legislation are identified and the likely landscape use by these species is appraised in each of the three options. UK Biodiversity Action Plan (BAP) species are similarly considered. UK BAP priority habitats are also identified and consideration is also given to each of the areas of search in the context of the South West Nature Map.

## Country Park

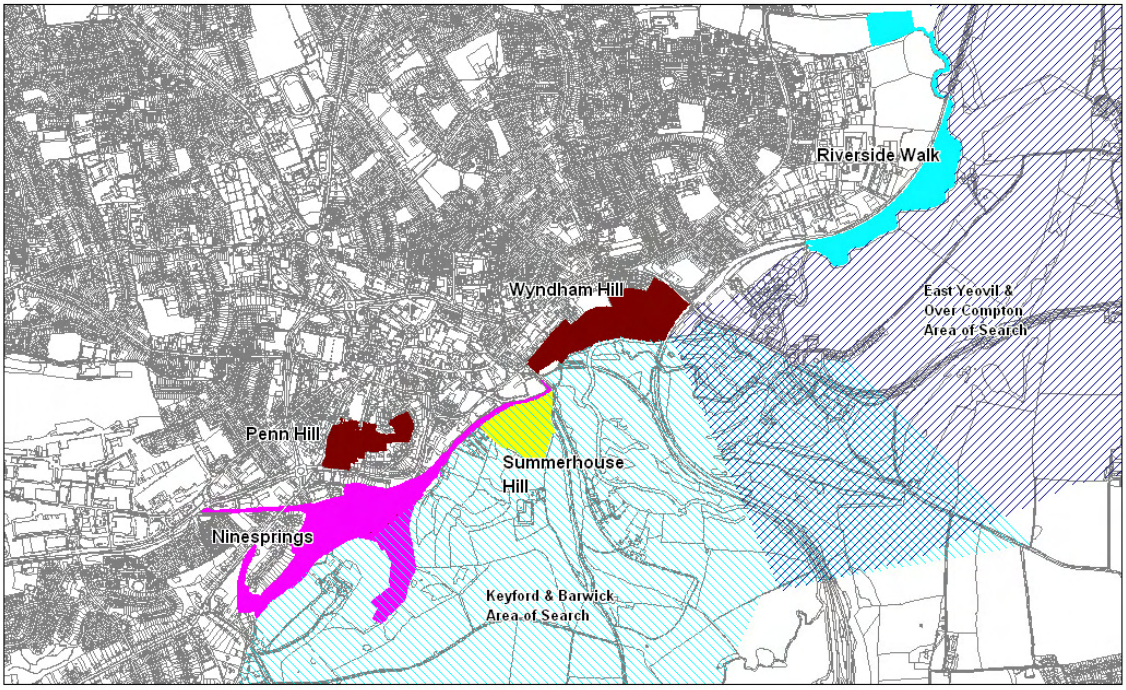
4.3 Country Parks were established as a result of the 1968 Countryside Act. In 2009 Natural England established an Accreditation Scheme to identify and recognise sites that deliver the core facilities and services expected of a Country Park. Yeovil Country Park, established in 2002, is accredited and is located along the southern edge of the urban area.

4.4 Two parts of the Country Park at Ninesprings and Summerhouse Hill are within the Keyford & Barwick AoS. A part of Riverside Walk is within the East Yeovil & Over Compton AoS. The Country Park is shown in Map 2.

4.5 There is Management Plan for the Country Park and the Yeovil and District Natural History Society produced a species list in 2008. http://www.southsomerset.gov.uk/index.jsp?articleid=693

4.6 Some of the Park units occupy sites that are also designated as Local Wildlife Sites, at Ninesprings, Summerhouse Hill and Riverside Walk, descriptions of which can be found in the following section.

**Map 2: Yeovil Country Park**




## Designated Nature Conservation Sites

### *Sites of Special Scientific Interest*

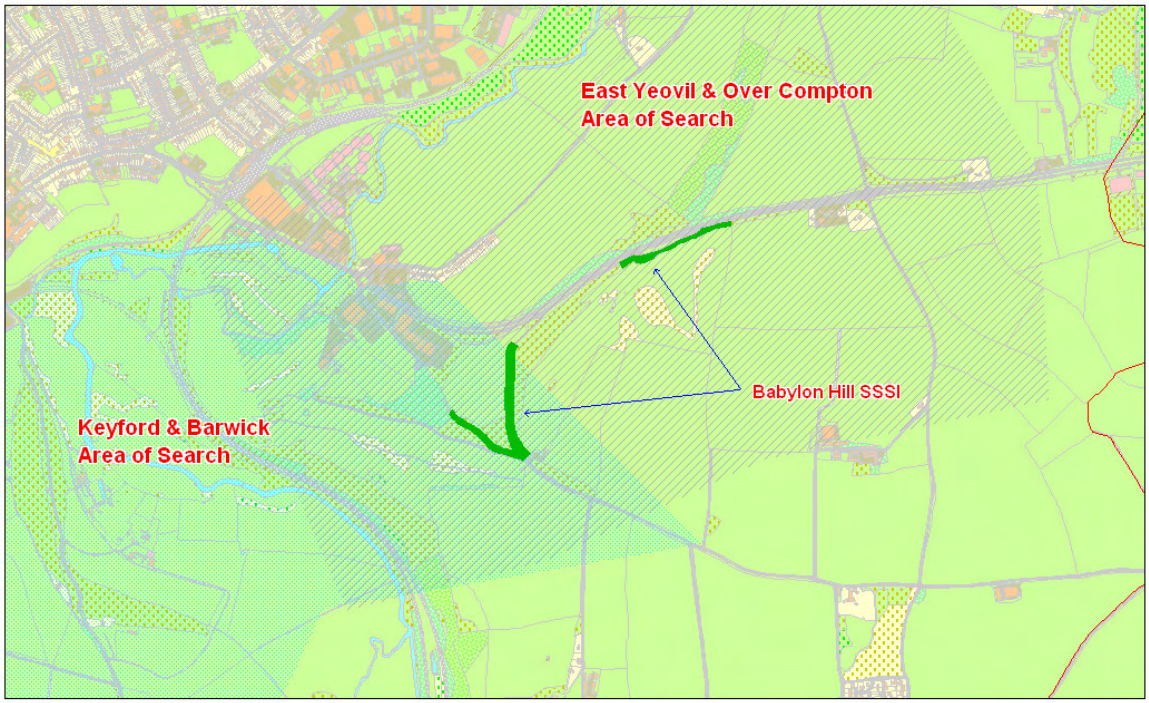
4.7 Sites of Special Scientific Interest are designated nationally for supporting the country's rarest and most threatened wildlife. SSSIs are important as they support plants and animals that find it more difficult to survive in the wider countryside. SSSI's are legally protected under the Wildlife and Countryside Act 1981, as amended, by the Countryside and Rights of Way (CROW) Act 2000 and the Natural Environment and Rural Communities (NERC) Act 2006.

4.8 There is a SSSI located within the East Yeovil & Over Compton Area of Search (AoS) and also partly in the Keyford & Barwick AoS. This comprises two separated units at Babylon Hill and is shown on Map 3. These are both geological sites.

4.9 All European designated sites, Special Protection Areas (SPA) [for birds] and Special Areas of Conservation (SAC) [for habitats and species], are also designated at a national level as SSSIs. It should be noted that an Appropriate Assessment is being carried out on proposals for housing numbers in Yeovil and potential indirect effects from increased recreation on the Somerset Levels and Moors SPA/ Ramsar sites (which are designated as SSSIs) has been identified. Therefore, as part of the proposed housing numbers will be located in

an Ecotown it is considered that it is likely that the local biodiversity be maintained, enhanced and expanded at a high quality to offset potential impacts.

**Map 3: Babylon Hill SSSI**




### *Local Wildlife Sites*

*Introduction*

4.10 A system to afford statutory protection to a network of sites hosting features of national, European and international importance has been established and operational for many years. Through the designation of SSSI, SPA, SAC and Ramsar sites a representative suite of habitats and species has been protected. Clearly this leaves out many sites that are, nonetheless, of significant value for the conservation of wildlife and geological features. Local Wildlife Sites (LWS) and Local Geological Sites (LGS) fill this gap. A Local Wildlife Site is a discrete area of land or water, which is considered to be of nature conservation significance at a county level or higher. (Somerset Environmental Records Centre, 2009)

4.11 In 2000, the Local Sites Review Group (set up by the Department of the Environment, Transport and the Regions) defined the overall objective of a Local Sites system as follows:

4.12 '*The series of non-statutory Local Sites seek to ensure, in the public interest, the conservation, maintenance and enhancement of species, habitats, geological and geomorphological features of substantive nature conservation value. Local Site systems should select all areas*

*of substantive value including both the most important and the most distinctive species, habitats, geological and geomorphological features within a national, regional and local context. Sites within the series may also have an important role in contributing to the public enjoyment of nature conservation.*'

4.13 LWS present in the three AoS options are listed in the following tables and shown on Maps 3 to 5.

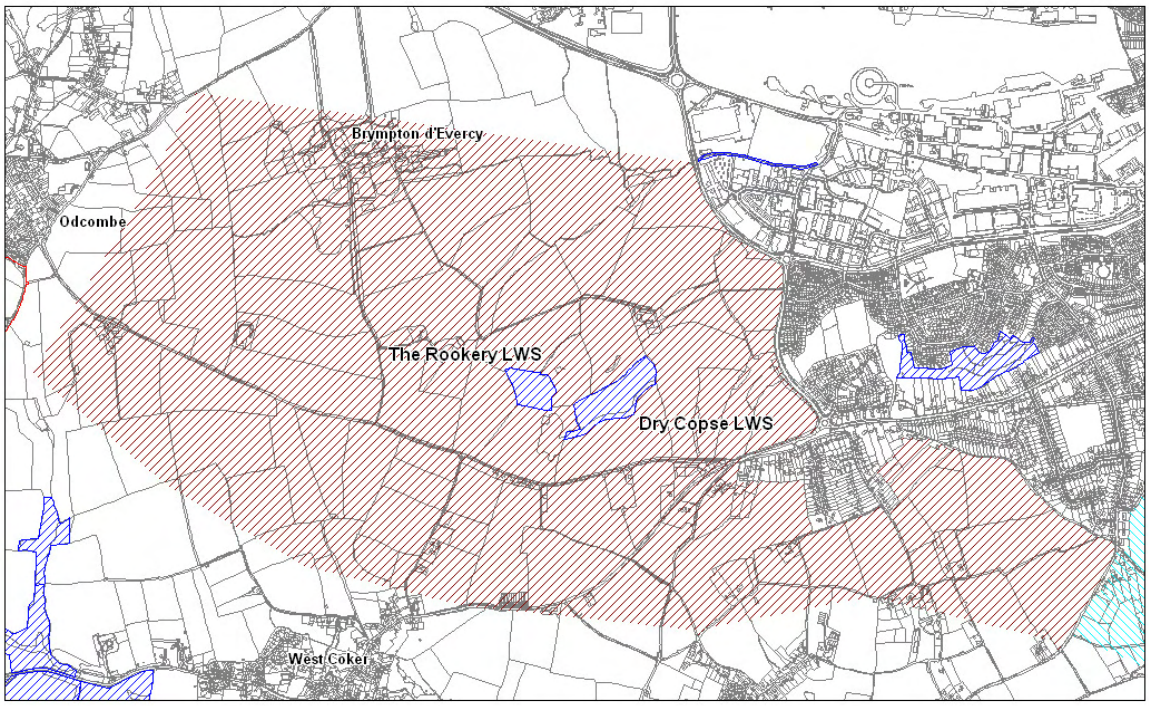
*Brympton & Coker AoS*

4.14 Local Wildlife Sites present in the Brympton & Coker AoS are listed in Table 2 and shown in Map 4.

**Table 2: Local Wildlife Sites Present – Brympton & Coker AoS**

| Reference | Local Wildlife Site | Description |
|---|---|---|
| ST51/009 | The Rookery | Ancient semi-natural wet broadleaved woodland and mixed plantation |
| ST51/010 | Dry Copse | A partly ancient woodland site with broadleaved and conifer plantation, semi-natural broadleaved woodland, bracken and scrub |

**Map 4: Local Wildlife Sites Present – Brympton & Coker AoS**




<u>The Rookery</u>

4.15 A woodland LWS which is dominated by beech and alder, with frequent occurrences of ash, sycamore, hazel, larch, English elm and wych elm, and occasional occurrences of English oak, goat willow, elder, cherry laurel, wild privet, hawthorn. Wood speedwell, hard shield fern and scaly male fern occur occasionally as ground flora.

Dry Copse

4.16 Another woodland LWS notable for occasional occurrences of wych elm and scaly male fern.

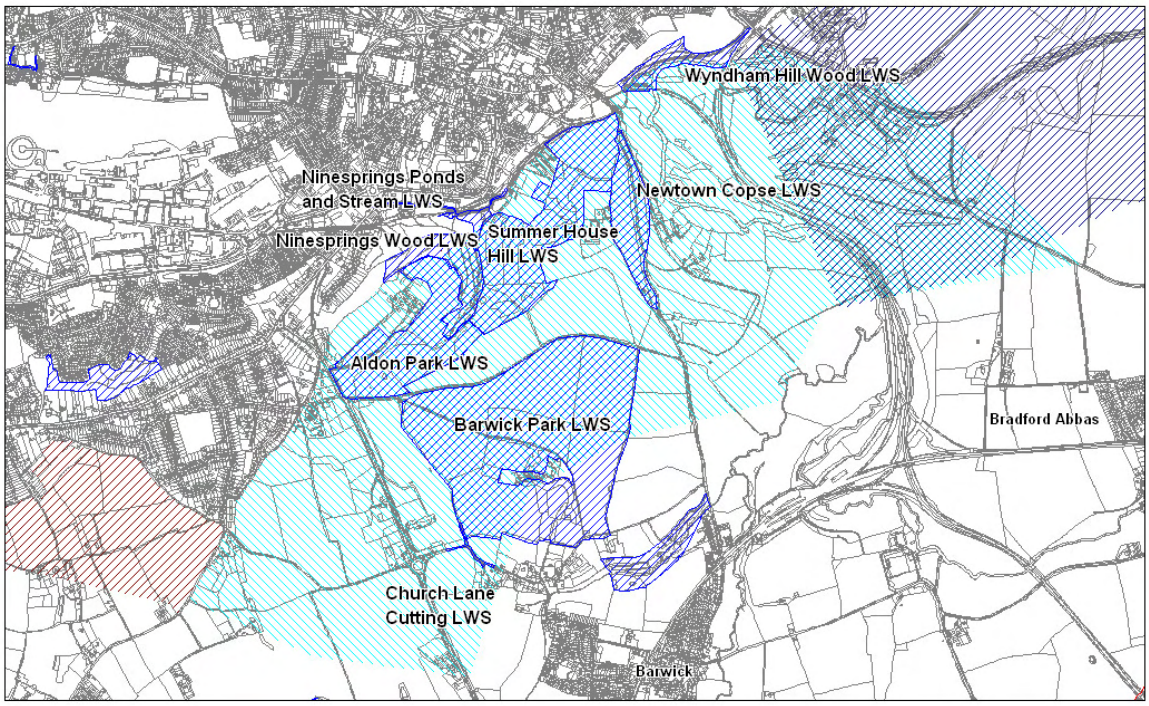
*Keyford & Barwick AoS*

4.17 Local Wildlife Sites present in the Keyford & Barwick AoS are listed in Table 3 and shown in Map 5.

**Table 3: Local Wildlife Sites Present – Keyford & Barwick AoS**

| Reference | Local Wildlife Site | Description |
|---|---|---|
| ST51/063 | Church Lane Cutting | Species rich road verge |
| ST51/108 | Barwick Park | Old parkland site now consists of arable and cattle grazed fields |
| ST51/109 | Aldon Park | Parkland with veteran trees supporting considerable amounts of dead wood |
| ST51/026 | Ninesprings Wood | Ancient woodland site predominately broadleaved plantation but some semi-natural broadleaved and conifer stands |
| ST51/005 | Summer House Hill | Unimproved and semi-improved acid grassland, ancient semi-natural broadleaved woodland and scrub |
| ST51/022 | Newton Copse | Ancient broadleaved woodland |
| ST51/070 | Ninesprings Ponds and Stream | Site with important aquatic species |
| ST51/065 | Wyndham Hill Wood | Semi-natural broadleaved woodland on steep slopes of disused railway line |

**Map 5: Local Wildlife Sites Present – Keyford & Barwick AoS**



Church Lane Cutting

4.18 This LWS is a floristically species rich road verge, including species such as scaly male fern, hard shield fern, soft shield fern, greater butterfly orchid, spurge laurel, field rose, red campion and sanicle. In 1995 lords and ladies were frequent, and moss, lichens and liverwort species were also present.

Barwick Park

4.19 The old parkland within the Keyford & Barwick AoS supports specimens of lime (*Tilia cordata x platyphyllos*), English oak, turkey oak, beech, horse and sweet chestnut, Wellingtonia, atlas cedar trees. Wych elm and spurge laurel occur in Barwick House Woods. *Rigidoporous ulmarius* and *Hericium erinaceum*, basidiomycete fungi were recorded on the site in 1977.

Aldon Park

4.20 An old parkland within the Keyford & Barwick AoS supporting beech, English oak, London plane, sweet chestnut, ash, horse chestnut and lime (*Tilia cordata x platyphyllos*). Hares were once common on the site.

Ninesprings Wood

4.21 Part of the Country Park Ninesprings Wood is an ancient woodland site supporting a rich assembly of invertebrate species. The area within the Keyford & Barwick AoS is of broadleaved woodland. Ninesprings has a range of habitats including broadleaved woodland, scattered trees, and tall herb vegetation along the edges of the stream and ponds. The woodland is of sycamore, beech, English oak, sweet chestnut, ash and silver birch more or less of equal abundance forming a more or less continuous canopy over an under storey of laurel. Ground cover is poor but for ferns with ivy and wood sorrel.

4.22 Daubenton's bats have been observed flying along the path beside the river walk in 1998. Pipistrelle bats have also been recorded in the wood. Common and water shrews are present on the site. Badgers are also present especially in the sandy lanes to the southwest. Golden stones walk contains one or two large colonies of water vole. Slow-worms, tawny owls, bullfinch, common shrews and badgers have been recorded in the woodland.

Summer House Hill

4.23 Part of the Yeovil Country Park the majority of Summerhouse Hill is of lowland acid unimproved pasture located in the Keyford & Barwick AoS. There are areas of scrub and ancient semi natural woodland on the higher slopes. Along the roadsides there are important species rich hedgerows.

4.24 Common amaranth was recorded on the northern part of the site in the 1990s. Woodland areas are likely to support similar species to that a Ninesprings Wood. *Hygrocybe chlorophana*, *H. russocoriacea*, scarlet

hood, ballerina waxcap and meadow waxcap, all basidiomycete fungi, were recorded in the grassland area of the site in 1998.

Newton Copse

4.25 This woodland LWS supports abundant English oak with frequent occurrences of beech, holly, hazel, wych elm, and occasional occurrences of hawthorn, horse chestnut, sweet chestnut and field maple. Ground flora recorded includes wood anemone, wood speedwell, meadow saxifrage and scaly male fern. Roe deer were recorded in the wood in 1991. Badgers are also present.

Ninesprings Ponds and Stream

4.26 This publicly accessible LWS is located on the northern border of the Keyford & Barwick AoS. Water voles have been recorded below the waterfall in the wood and in Ninesprings Stream at the western end of the LWS in 1999.

4.27 Daubenton's bats were present foraging over the pond in 1998. Common sandpiper have also recorded stopping at the pond during migration in May 1998. Kingfishers have been recorded nesting along the stream.

Wyndham Hill Wood

4.28 This publicly accessible LWS is located on the northern border of the Keyford & Barwick AoS. The woodland consists of English oak, ash, aspen, and field maple with an understorey of hazel, blackthorn, and hawthorn.

4.29 Corky-fruited water-dropwort is also recorded as being locally frequent in 1993. This LWS woodland supports the rare yellow figwort along the roadside. The rare monk's hood was found on the site in the summer of the same year.

4.30 Common shrews are observed as being frequent in the woods and fields of the site. Badgers are also found on the site. The site has high usage by bird species. Breeding kingfisher has been observed on the river through this site near the old railway line in 1990-1992. Nightingale and lesser whitethroat were recorded singing in May 1990. Banded demoiselle dragonflies were also observed being active on the LWS.

*East Yeovil & Over Compton AoS*

4.31 Local Wildlife Sites present in the East Yeovil & Over Compton AoS are listed in Table 4 and shown in Map 6.

**Table 4: Local Wildlife Sites Present – East Yeovil & Over Compton AoS**

| Reference | Local Wildlife Site | Description |
|---|---|---|
| ST51/127 | Riverside Walk | Riverside area of woodland on steep banks, marginal vegetation and an area of marshy grassland |
| ST52/022 | River Yeo | Aquatic habitat with associated plant, bird, mammal and invertebrate populations |

Riverside Walk

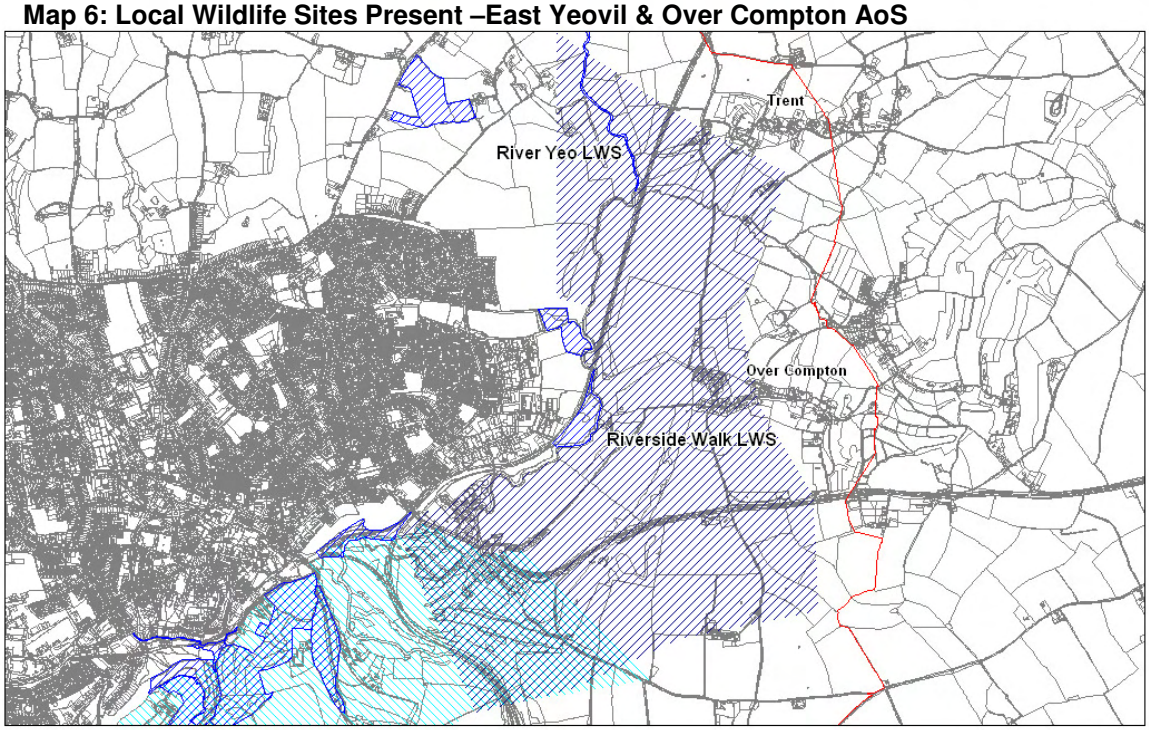
4.32 Riverside Walk lies along side the river and railway in the East Yeovil & Over Compton AoS, forming a part of the riverine wildlife corridor. The area is of semi-improved grassland, rough grassland and meadow, some of which is of high botanical interest. The site also supports a diverse mix of habitats including native broadleaved woodland and sandy riverbanks. Native trees species includes oak, ash and alder and there is an established stand of poplars on the extreme south of the site. The riverbank supports alder and willow species.

4.33 Signs of otter presence have been found along the river. Kingfishers have been recorded hunting along the river through the LWS. The rare monk's hood was found on the site in the summer of 2000. There is reed bed, although botanically poor supports reed warbler and sedge warbler territories.

River Yeo

4.34 The LWS designated for this river begins at west of Park's Plantation and goes north. American mink were observed on the section of river within the AoS in 1992. Otter are present along the river.

**Map 6: Local Wildlife Sites Present –East Yeovil & Over Compton AoS**



## Protected and Other Important Species

### *Mapping Species*

*Introduction*

4.35 The data on the distribution of species in the Study Area has been derived from records held by Somerset Environmental Records Centre (SERC) and from Dorset Environmental Records Centre (DERC).

4.36 Mapping layers have been produced to indicate the extent of landscape use by a species. The likely habitat use from species presence is shown in two mapped zones, which are explained in the following sections. These are layers for:

- Likely Habitat Use (LHU); and
- Likely Supporting Habitat (LSH).

4.37 An Estimated Home Range (EHR) for a species is used as guidance in determining the extent of habitat use extrapolated from a record(s). These are described in this section below.

4.38 The mapping methodology for the production of each of these areas is given in Appendix 1.

4.39 The requirements for these mapping layers for each species are initially a recorded identified sighting. These records are kept by Somerset Environmental Records Centre data, and derived from specialist species groups in Somerset, either independent or associated with the Somerset Wildlife Trust, the Mammal Society, the Environment Agency and similar organisations as well as reports by private individuals. Records are also sourced from Dorset Environmental Records Centre in the case of the area to the east of Yeovil. The LHU and EHR mapping layers are based on those that have been developed as part of the Somerset Econet project (Somerset County Council, 2009).

4.40 As afore stated the EHR and LHU layers are principally based on records for a species held by SERC. In the initial stages of mapping these records are checked to ascertain that they are located correctly. Old records are filtered out, for example those over ten years old but this may vary according to species. Many recordings are dependent on the number and frequency of surveys undertaken by various conservation bodies and ecologists so a generous period is used. Consideration is also given to data that is of flight only records, whether it is wintering or breeding and to the size of the population in determining what is mapped.

4.41 The following sections set out which species are present in each of the three Ecotown Area of Search (AoS) options, showing both LHU and LSH (where appropriate) and also highlighting features that are considered critical to supporting a population in the AoS for each species where it occurs. A combined map of LHU, LSH and important features is given at the end of the section. Details of species' EHR, LHU and LSH mapped are given in Appendix 2.

*Estimated Home Range*

4.42 The Estimated Home Range (EHR) shows where the species may occur based on researched home or foraging range distances from a roost, nest or resting place. Although at its centre is a record, a species has the potential to be present, if habitat conditions are suitable to support it, anywhere within it.

*Likely Habitat Use*

4.43 The Likely Habitat Use (LHU) shows where a species is likely to occur or where there is a near certain presence at least at some point in the year within the EHR. A species occurrence within the LHU may be monthly, seasonal or even annually depending on factors such as the availability of food. Some species are known to leave suitable habitat empty and return after spells of several years away (Hanski, 1999). Nor do animals spend equal amounts of time at an activity and location during a day. Feeding, drinking, resting, grooming and other activities take up different amounts of time and energy within the area of LHU. The amount of time spent on one activity does not indicate its importance to the animal, e.g. drinking may take only a few minutes yet is vital to its survival. (Morrison *et al*, 2006)

4.44 The LHU zones of some species, where it is not easy to distinguish habitat or where the species tends to be a generalist, are based on the foraging range for that species and are merely mapped as for the EHR.

4.45 Separate LHUs are formed for each record, in order that overlaps can be identified.

*Likely Supporting Habitat*

4.46 Habitats within the LHU are considered to be accessible to the species mapped. However, in the case of certain species of bats habitats that occur within a certain distances of 'accessible habitat' are identified, as prey is also mobile and loss would affect availability, e.g. to bats in particular. These habitat polygons are selected through use of a buffer from the flight line and are termed in this study as 'Likely Supporting Habitat' (LSH).

4.47 Although there may be some temporal and geographical variation it is assumed that the prey supply from habitats is constant. Some species

of insect actively forage, which includes searching for suitable patches of habitat. Other movements can be associated with searching for mates. These movements can be directional (non random) or non-directional (random) movements. They result from stimuli such as air currents; solar, lunar or astral (including polarised) light; taste and odour; gravitational; moisture; sound; water currents; or temperature. (Gullan & Cranston, 1994) Loss of prey supporting habitat due to land use change can also act as a 'sink' (Hanski, 1999) or reduce the amount of prey dispersing into bat foraging areas.

*Features*

4.48 In addition to the LHU and LSH, habitat features within the LHU that are critical to supporting a local population are highlighted. An example of these features is hedgerows used as flyways by bats.

### *European Protected Species*

*Introduction*

4.49 European Protected Species represent some of the rarest and most vulnerable species in Europe and as such have been afforded enhanced protection under European and U.K. legislation. Part of this legislation requires the maintenance of, and aims at enhancing, the populations and distribution of these species and the habitats that support them. Furthermore, the UK legislation for EPS, listed under Annex IV of the Directive, was amended by the Conservation of Habitats and Species Regulations 2010, following a European Court of Justice ruling in 2005, and now provides for a much stricter adherence to the EC Habitats Directive. Therefore, it is important in forward planning the Ecotown to have an understanding what and where populations of EPS are present in the Yeovil Study Area in order to avoid potential conflicts. Appendix 3 sets out the legislative background to the protection of EPS and their populations.

4.50 Where potential impacts occur a methodology is needed whereby compensation can be calculated in order to maintain the viability of a population and in turn the acceptability of the proposal both legally and in terms of the Government's Ecotown policy. This will be discussed later in the report.

4.51 The goals of the Habitats Directive for species conservation require two basic conditions:

- Quality of habitat (allowing enough for reproduction)
- Habitat area (to prevent extinction by accident)

(Opdam *et al*, 2002)

4.52 Master planning of the Ecotown option for Yeovil depends on information on the distribution of EPS, their habitats, and the ecological

factors that support their populations them. Given the legal requirements for 'favourable conservation status' and the aims of Ecotown development this should be used to influence the choice of option for the Yeovil Ecotown so that conflicts are avoided in the first place. Whilst site survey would give a more accurate view of local conditions, at the time of the visit, ecologists working in planning or contributing to strategic and local ecological impact appraisals and assessments generally may benefit from information disclosing longer term conditions and having a landscape or ecosystem perspective. Project level ecologists do not routinely have time or resources to assemble such background data[1].

*Brympton & Coker AoS*

4.53 The following EPS have been identified in the Brympton & Coker AoS from SERC records and other sources where available:

- Lesser Horseshoe Bat *Rhinolophus hipposideros*
- Serotine Bat *Eptesicus serotinus*
- Noctule Bat *Nyctalus noctula*
- Soprano Pipistrelle Bat *Pipistrellus pygmaeus*
- Brown Long-eared Bat *Plecotus auritus*

Lesser Horseshoe Bat

4.54 There is a hibernation roost of lesser horseshoe bats in Brympton d'Evercy.

4.55 Lesser horseshoe bats use caves, mines, tunnels, and cellars and occasionally open roof spaces to hibernate. They are active during the winter at temperatures over 5ºC, although the foraging range is about half that of the summer period.

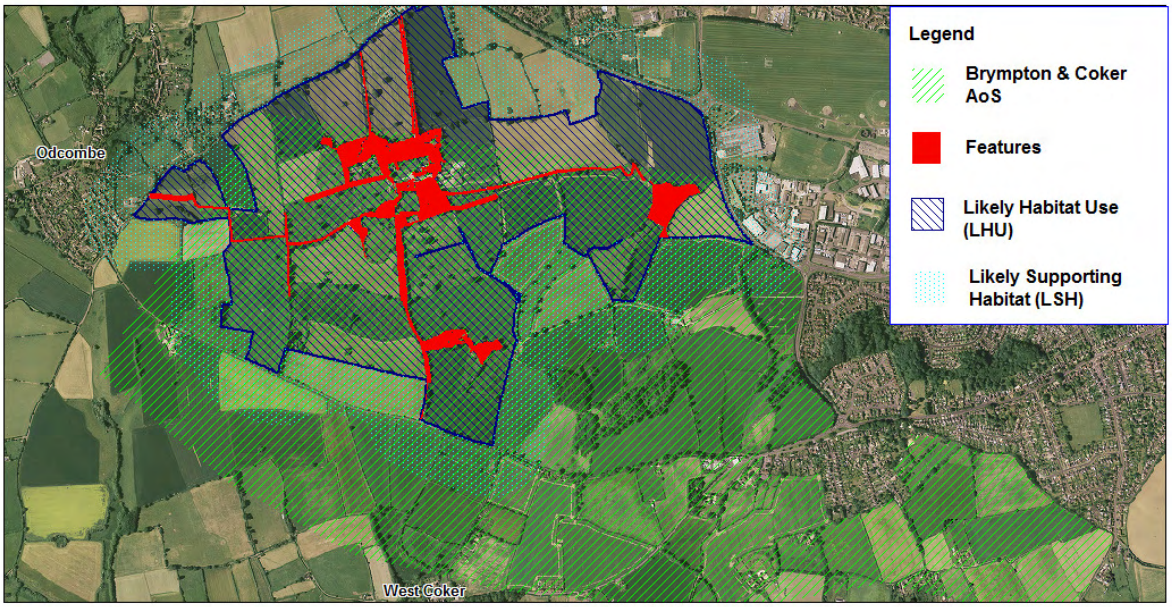
4.56 '*The primary foraging habitat for lesser horseshoe bats is broadleaf woodland where they often hunt high in the canopy. However, they will also forage along hedgerows, tree-lines and well-wooded riverbanks*.' (Schofield, 2008)

4.57 Lesser horseshoe bats are reliant on features, such as mature hedgerows, as flyways and are adversely affected by artificial lighting.

4.58 Map 7 shows the features likely to be used by lesser horseshoe bats in commuting and feeding. It would be necessary to maintain these features to maintain the viability of the roost site.

[1] http://www.fws.gov/r5gomp/gom/habitatstudy/Gulf_of_Maine_Watershed_Habitat_Analysis.htm

**Map 7: Lesser Horseshoe Bats –Brympton & Coker AoS**




4.59 See Appendix 2 for a more detailed description of lesser horseshoe bat ecology.

<u>Serotine Bat</u>

4.60 There is a maternity colony of serotine bats in the vicinity of Helena Road in Yeovil. This numbered 37 individuals at time of inspection in the mid 1990's. No visits have been made since so it assumed that roosts in this area are still be used by a maternity colony. A serotine bat colony uses at least 10 different roosts and exhibits roost switching behaviour.

4.61 There are records of serotine bats hibernating in West Coker to the south of the AoS.

4.62 In one study individual home ranges of serotine bats varied from 16 to 4758 hectares, but these were not used exclusively by one individual. Around the colonial core area and breeding roosts, home range areas were used by all individuals from a single colony.

4.63 Robinson & Stebbings (1993) investigated the diet of the serotine and found serotine bats foraged mainly over habitats such as hay meadows or grazed pasture. In most cases serotine bat foraging areas are open fields bordering woodland.

4.64 Map 8 shows the areas likely to be highly used in the Brympton & Coker AoS and would likely be required to maintain the population.

**Map 8: Serotine Bats –Brympton & Coker AoS**


4.65 See Appendix 2 for a more detailed description of serotine bat ecology.

Noctule Bat

4.66 There is a record of noctule bats foraging over the lakes at Pavyott's Farm, East Coker and further south over Sutton Bingham Reservoir. Whilst this is not within the AoS it is possible that noctule bats would be over flying the Brympton & Coker AoS. The roost sites, including maternity sites, for these foraging bats is not known. Noctule bats have been observed feeding and also roosting in a tree at Montacute Gardens to the north of the AoS.

4.67 Noctule bats prefer to roost near woodland edges, preferably using woodpecker holes. In one study in park woodland noctule bats were found to prefer the tallest and largest trees in the park. Noctule bats shift roost sites every two or three days within an area of 200 hectares. Therefore there are several other possibilities of woodland and/or parkland being used by noctule bats in the area. There is a record of woodpecker presence in Ninesprings Wood in the Keyford to Barwick AoS.

4.68 The noctule bat flies to its foraging areas from its roost site in straight lines and hunts at 10 to 40 metres, and up to 70 metres above the ground. This behaviour makes it vulnerable to collision with wind turbines if placed along commuting flight paths or in feeding areas.

4.69 Noctule bats are found over water early evening, in urban areas around streetlights and along woodland edges. It forages above meadows, lakes, refuse tips and above treetops. Noctule bat activity is high near lakes and over improved cattle pasture and low in woodlands. Villages do not support high levels of activity. Noctule bats are known to actively hunt in the winter.

4.70 The foraging range of the noctule bat can be as much as 26 kilometres from its roost site. A study of noctule bats roosting at Horner Wood in Somerset found that bats foraged a maximum of 6.3 kilometres away from the roost although one bat flew in a straight line for 23.5 kilometres (mean distance travelled was 4.23 kilometres). There is no overlap between neighbouring colonies and home range may be defined by proximity.

4.71 Noctule bats are also relatively short lived, compared to other species of bat, with an average lifespan of 2.2 years after reaching the first year. The required birth rate to maintain a population is 1.5 to 1.6 births per year. The observed birth rate for the species in central Europe is 1.4 to 1.5 births per year. Therefore, it is considered that even small increases in mortality rates can have significant effects on noctule bat populations.

Soprano Pipistrelle Bat

4.72 There is a record of a single soprano pipistrelle in Odcombe to the north west of the Brympton & Coker AoS. It is considered that the record is not significant and that habitat use by this species would be covered by that shown for other species in the AoS.

Brown Long-eared Bat

4.73 Brown Long-eared bats were recorded by English Nature in the 1980's at Brympton d'Evercy and were thought to be breeding. Therefore, it is assumed that conditions are still extant and that there is a maternity colony of brown long-eared bats at that location.

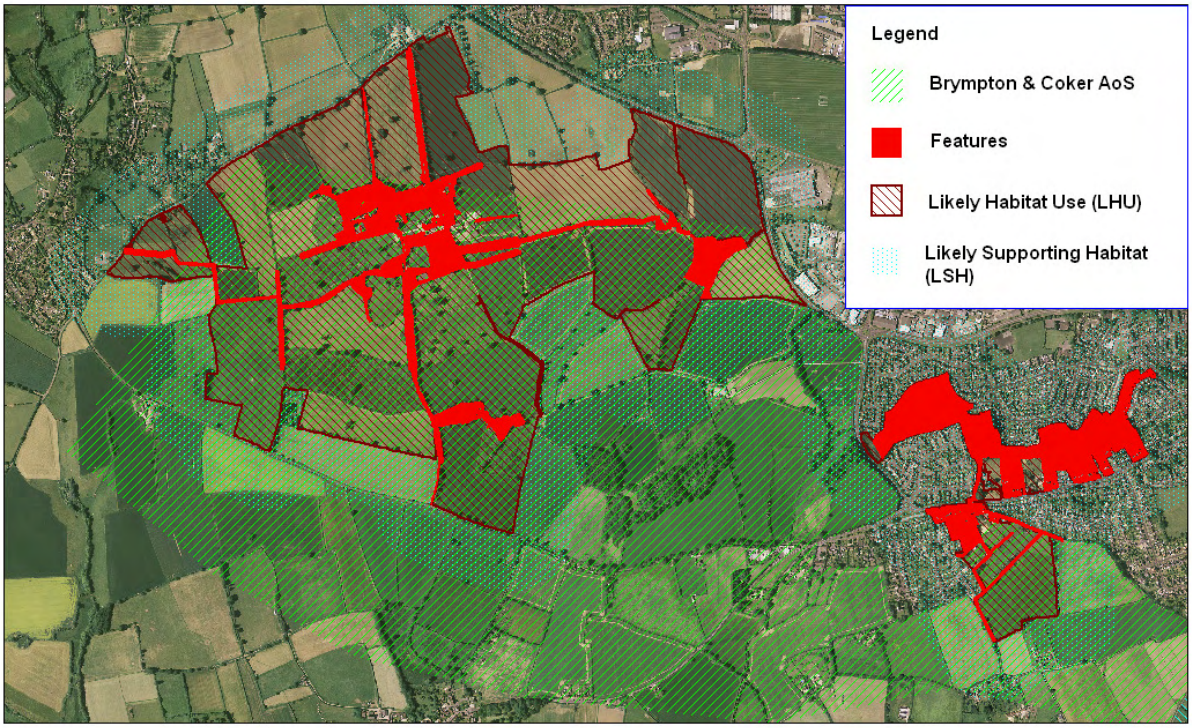
4.74 There is also a record for brown long-eared bats in West Coker Road from 1993 but no numbers are given nor the status of the roost in the record. Therefore it is assumed that this is also a maternity colony and is still extant lacking evidence to the contrary.

4.75 Brown long-eared bats are primarily a woodland species foraging in deciduous woods, woodland edges, scrub, and gardens with mature trees, orchards and parkland. The edges of non-native conifer stands are used for hunting. Ponds and water bodies are also important, as brown long-eared bats would require water to drink.

4.76 Brown long-eared bats are reliant on landscape features, such as hedgerows and tree lines, as fight lines between roost sites and foraging areas. Such features are shown in Map 9 and would be vital to ensuring the maintenance of the local population.

4.77 The home range of an individual is related to habitat structures and prey abundance and has a size between 1 and 40 hectares. Each long-eared bat has a core area has a size of 0.75 - 1.5 hectares, which is less than 1.5 kilometres from the roost.

**Map 9: Brown Long-eared Bats –Brympton & Coker AoS**




4.78 Map 9 shows the likely habitat use and the features likely to be used by brown long-eared bats in commuting and feeding. It would be necessary to maintain these features to maintain the viability of the roost site. The species is averse to artificial lighting.

4.79 See Appendix 2 for a more detailed description of brown long-eared bat ecology.

*Keyford & Barwick AoS*

4.80 The following EPS have been identified in the Keyford & Barwick AoS from SERC and DERC records and other sources where available:

- Otter *Lutra lutra*
- Lesser Horseshoe Bat *Rhinolophus hipposideros*
- Daubenton's Bat *Myotis daubentonii*
- Serotine Bat *Eptesicus serotinus*
- Noctule Bat *Nyctalus noctula*
- Common Pipistrelle Bat *Pipistrellus pipistrellus*
- Brown Long-eared Bat *Plecotus auritus*

Otter

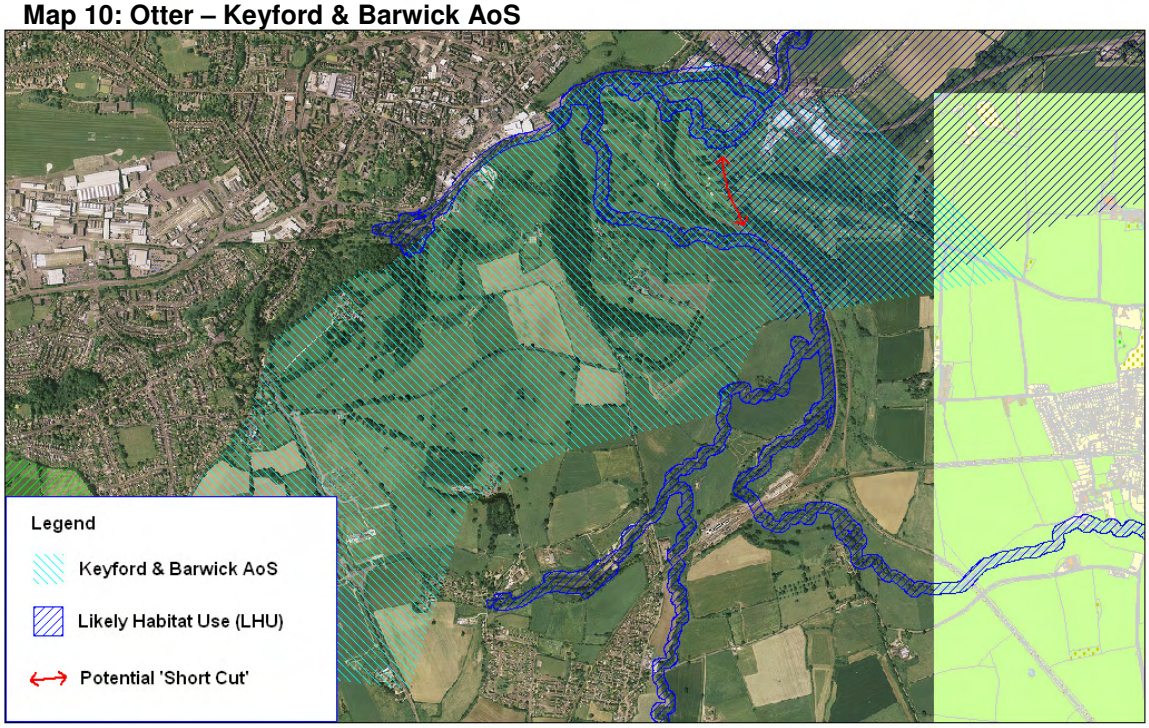
4.81 Otters have been recorded on the River Yeo to the south and east of Yeovil, including within the Country Park, since the early 1990s. There are records of scats under bridges at Sherborne Road

4.82 Otters are an amphibious species and are generally nocturnal. Optimal habitat for otters includes stream banks with dense herbaceous vegetation and fringes of trees (e.g. alder) with branches hanging low near the water, lakes, coastlands, rivers and marshes. Habitat cover is an essential element for otters.

4.83 Otter holts or dens are found in the roots of trees, heaps of sticks or rocks, drains, badger setts, rabbit burrows, etc., where the chance of physical disturbance is low. These are usually within 10 metres of the watercourse but can be up to 50 metres away. Man-made features such as culverts, pipes and buildings, such as found within Yeovil can also provide shelter for otters.

4.85 Natal holts seem to be located away from main watercourses and from water altogether, even being found up to 500 metres away. They are unlikely to be one located in the Keyford & Barwick AoS.

**Map 10: Otter – Keyford & Barwick AoS**




4.86 Adult otters tend to be solitary and territorial. In Somerset an otter territory is reported as being 15 to 20 kilometres long or approximately three riverside parishes (pers. comm. James Williams, Somerset Otter Group). They are known to 'cut corners' in meanders and across meadows at tributary junctions. Therefore, the River Yeo through the

Keyford & Barwick AoS is at most likely to be two adult otters, a male and a female. However, this is considered significant in terms of the numbers of otter in the population of Somerset.

4.87 Map 10 shows the likely habitat use (LHU) by otters in the Keyford & Barwick AoS. The LHU includes areas that may be utilised as holt sites or resting places outside the built area. A potential 'short cut' is also shown.

4.88 See Appendix 2 for a more detailed description of otter ecology.

Lesser Horseshoe Bat

4.89 A roost of 18 lesser horseshoe bats was present in a house on Henford Hill in 1992. The status of the roost is not recorded nor is the date. It is assumed that the roost is still extant given no evidence to the contrary and that given the numbers present it is a summer colony.

4.90 To the south of the AoS there is a hibernation roost at Yeovil Junction Station and a maternity colony at Clifton Maybank.

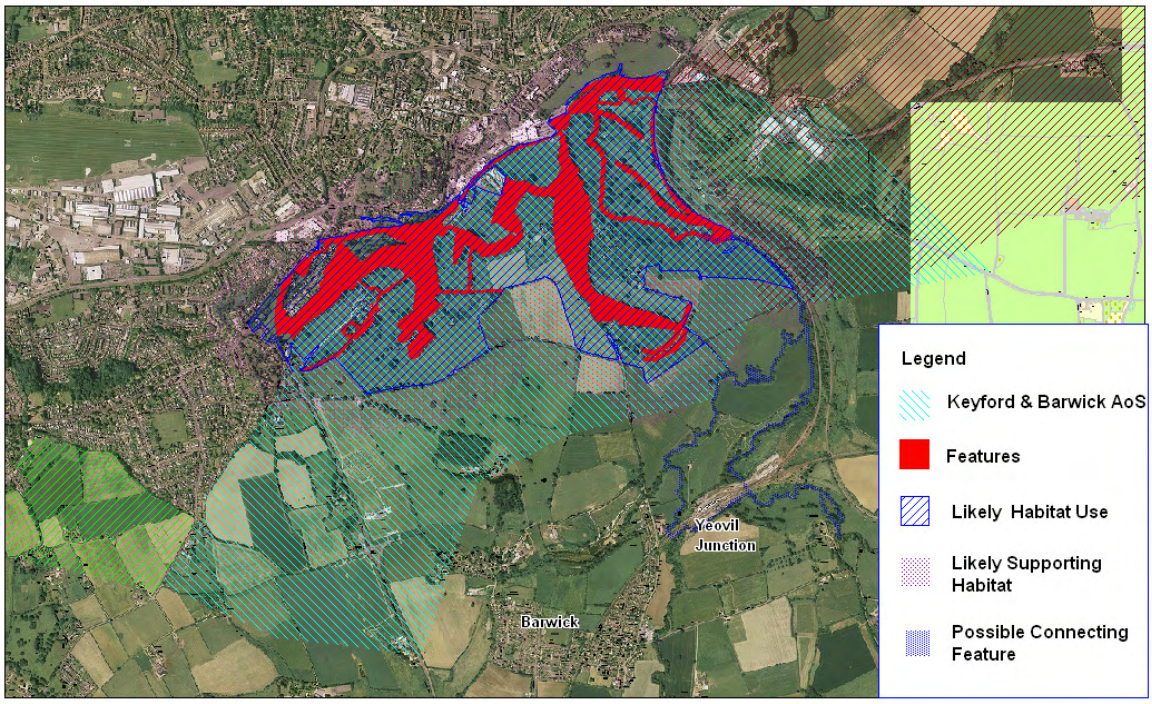
4.91 Lesser horseshoe bat roosts are situated close to woodland or parkland or are linked by linear landscape elements, such as hedgerows to foraging areas. Lesser horseshoe bats are primarily a woodland feeding bat using deciduous woodland or mixed coniferous woodland and hedgerows.

4.92 Lesser horseshoe bats avoid crossing open areas. Gaps of a little as 10 metres could prevent movement of lesser horseshoe bats along a flight line. Where they do they will cross open areas at the narrowest point flying very close to the ground (approx. 1 metre); and will cross roads where the tops of trees touch. Artificial lighting, such as from street lighting, will disrupt the flight activity and foraging ecology of lesser horseshoe bats.

4.93 Lesser horseshoe bats foraging range from a colony is usually within 2.5 kilometres, with furtherest distances of between 4 and 6 kilometres. The size of individual foraging areas range between 150 and 400 hectares, within which there are up to seven hunting grounds of between 3 and 50 hectares.

4.94 Map 11 shows the likely habitat use and the features likely to be used by lesser horseshoe bats in commuting and feeding. It would be necessary to maintain these features to maintain the viability of the roost site. Features used to connect the Henford Hill colony with hibernation roosts at Yeovil Junction and a maternity roost at Clifton Maybank are shown as in the map.

**Map 11: Lesser Horseshoe Bat – Keyford & Barwick AoS**




4.95 See Appendix 2 for a more detailed description of lesser horseshoe bat ecology.

<u>Daubenton's Bat</u>

4.96 Daubenton's bats are a riverine species feeding off invertebrates close to the water's surface. South Somerset District Council recorded that several Daubenton's bats were using Ninesprings Pond and Streams in 1998 as noted in the section on LWS. It is assumed that Daubenton's bats are continuing to use these water bodies for feeding lacking evidence to the contrary. No roost site is known but is potentially present in nearby woodland.

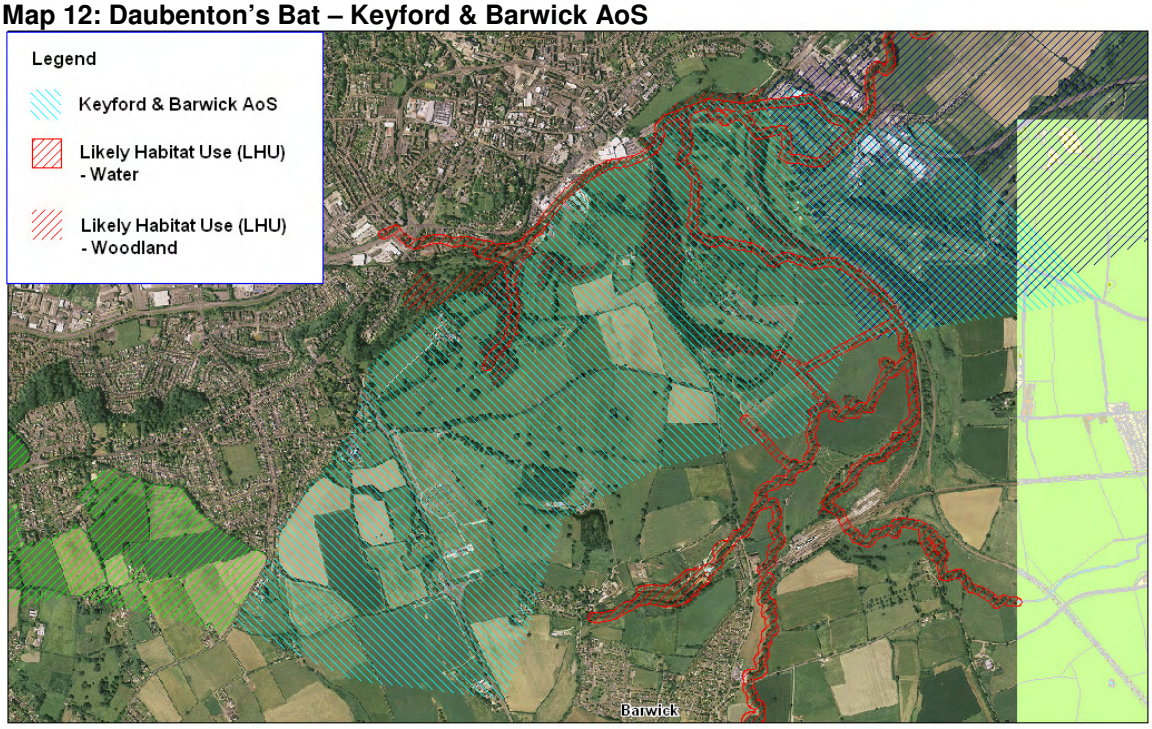
4.97 The roosts of Daubenton's bats are generally within between 2 to 300 metres of water. During the summer principal roost sites for Daubenton's bats include holes in trees.

4.98 Daubenton's bats forage almost exclusively over water within 3 kilometres of roost, but may travel up to 15 kilometres to forage. Ninety percent of breeding females have home ranges within a radius of 4 kilometres around the roost. Core areas within home ranges are dependent on the size of the water bodies. Each bat had 2 to 8 separate hunting grounds of between 0.1 hectares and 7.5 hectares each. Daubenton's bats defend these feeding patches, although many arrive in the same area together, they then forage singly or in pairs.

4.99 Sometimes, mainly in springtime and on windy nights, Daubenton's bats forage away from water, e.g. at a woodland clearing.

4.100 Daubenton's bats always use features as flyways and never cross open ground. A fringe of reeds will suffice as cover when commuting but wooded banks are preferred. The species is averse to artificial lighting.

**Map 12: Daubenton's Bat – Keyford & Barwick AoS**




4.101 Map 12 shows the likely habitat use used by Daubenton's bats in commuting and feeding. The likely areas of woodland used are also shown. It would be necessary to maintain these features to maintain the viability of the roost site.

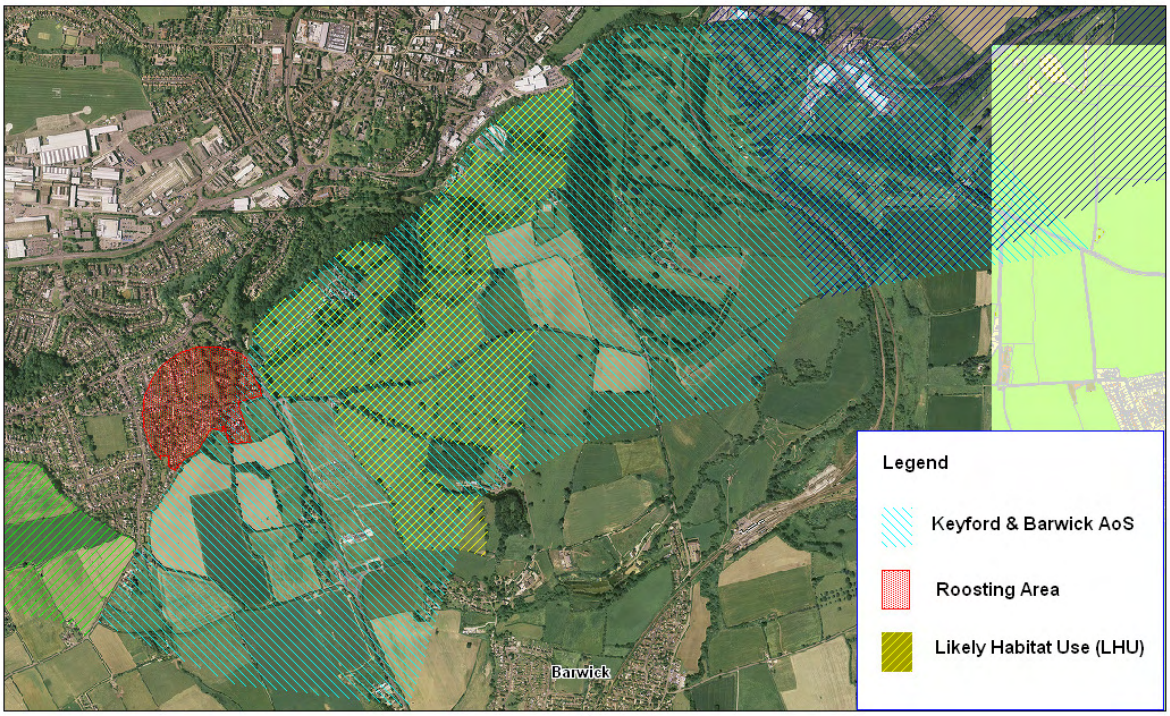
4.102 See Appendix 2 for a more detailed description of Daubenton's bat ecology.

<u>Serotine Bat</u>

4.103 A brief description of serotine bat ecology has been given in the Brympton & Coker AoS section above. A serotine hibernation roost was recorded in Turners Barn Lane in November 2003. However, it was considered that the species was potentially breeding at the same roost site. Lacking evidence to the contrary it is assumed that the roost, or other suitable roosts within the switching area, is currently used both for breeding and hibernation.

4.104 Serotines mainly forage over habitats such as hay meadows or grazed pasture and in many cases are open fields bordering woodland. Map 13 shows the likely foraging habitat use by serotine bats in the Keyford & Barwick AoS.

**Map 13: Serotine Bat – Keyford & Barwick AoS**




4.105 For a more detailed description of serotine bat ecology see Appendix 2.

Noctule Bat

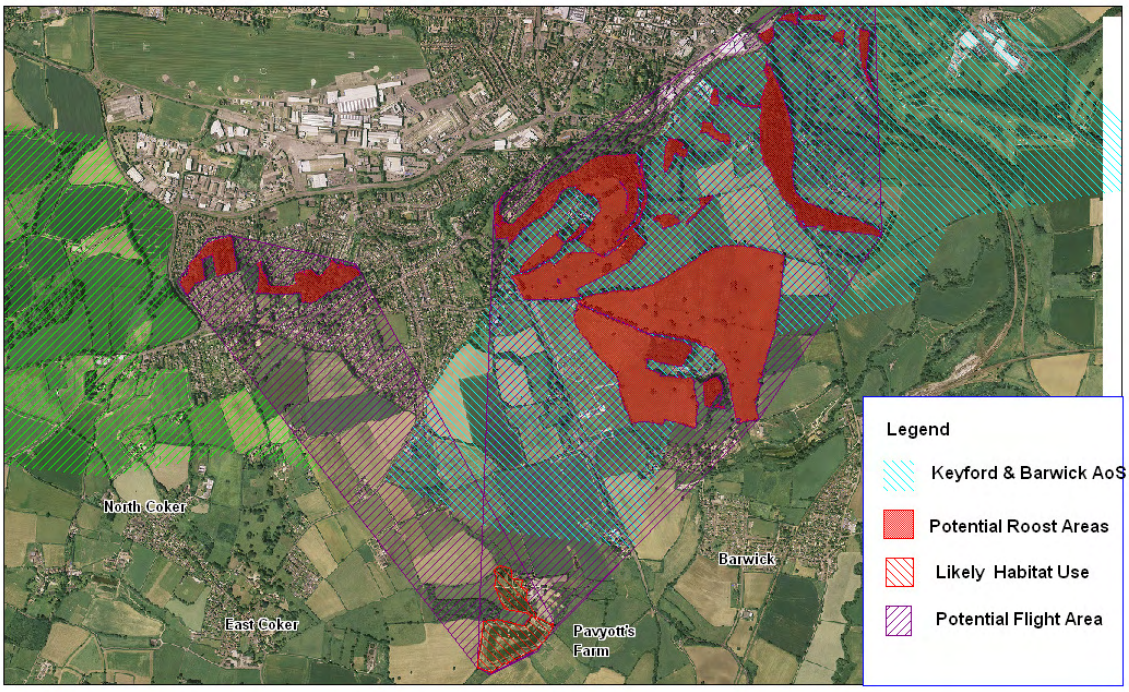
4.106 A description of noctule bats is provided in the Brympton & Coker AoS section above.

4.107 As afore mentioned there is a record of noctule bats foraging over the lakes at Pavyott's Farm, East Coker and further south over Sutton Bingham Reservoir.

4.108 Whilst this is not within the AoS it is possible that noctule bats would be overflying the Keyford & Barwick AoS. The roost sites, including maternity sites, for these foraging bats is not known. However, there is a record of woodpecker presence in Ninesprings Wood and other woodland in the AoS, and numerous veteran trees in the Barwick and Aldon Parks. Noctule bats are also likely to feed over cattle pasture and parkland within the AoS if present.

4.109 The potential areas used for roosting and areas possibly over flown by noctule bats are shown in Map 14.

**Map 14: Noctule Bat – Keyford & Barwick AoS**




Common Pipistrelle Bat

4.110 There have been three pipistrelle bat maternity roosts recorded within and adjacent to the Keyford & Barwick AoS. These are located in South Woods area and Newton. The South Woods' records are for 267 and 70 bats and date from 1991 and 1989 respectively. The Newton roost record is from 1988 with no abundance being recorded. Another maternity roost was located at Stoford to the south of the AoS in 1999. No numbers of bats were recorded. It assumed that these roost sites are still extant lacking evidence to the contrary.

4.111 The principal roost sites used by maternity colonies of pipistrelle bats are buildings, varying from modern buildings to churches. A large number of suitable roosts are necessary to maintain each social group as pipistrelle bats exhibit roost switching behaviour at maternity roosts.

4.112 The common pipistrelle hunts on the edges of woodland, in deciduous woodland, mixed deciduous/ coniferous woods, along hedgerows, in orchards, and also over open country, pastures and fields. They tend to avoid very open habitat such as grassland where linear features are comparatively rare.

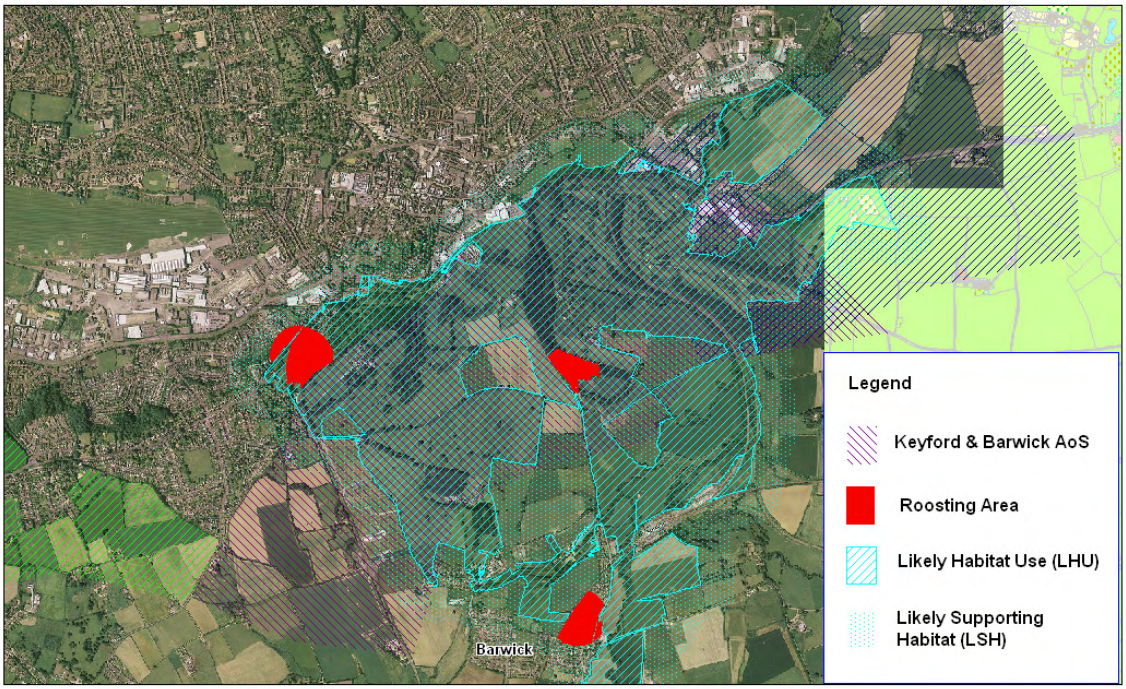
4.113 A study of pipistrelle bats around two colonies revealed that they moved between fixed foraging sites on regular flight routes. Pipistrelle bats are confined to linear elements and infrequently cross open areas but when they do so will cross open areas of 100 –150 metres wide. They will feed around streetlights but require darkened flight lines.

4.114 The foraging activity of common pipistrelle bats is in small areas within about 2 kilometres of the roost. Individual home range is dependant on

abundance of insects and may have a total size of more than 50 hectares.

4.115 Map 15 shows the likely habitat use in the Keyford & Barwick AoS by pipistrelle bats including areas where roost switching is likely to occur. Linear features need to be conserved if the population's viability is to be maintained.

**Map 15: Pipistrelle Bat – Keyford & Barwick AoS**

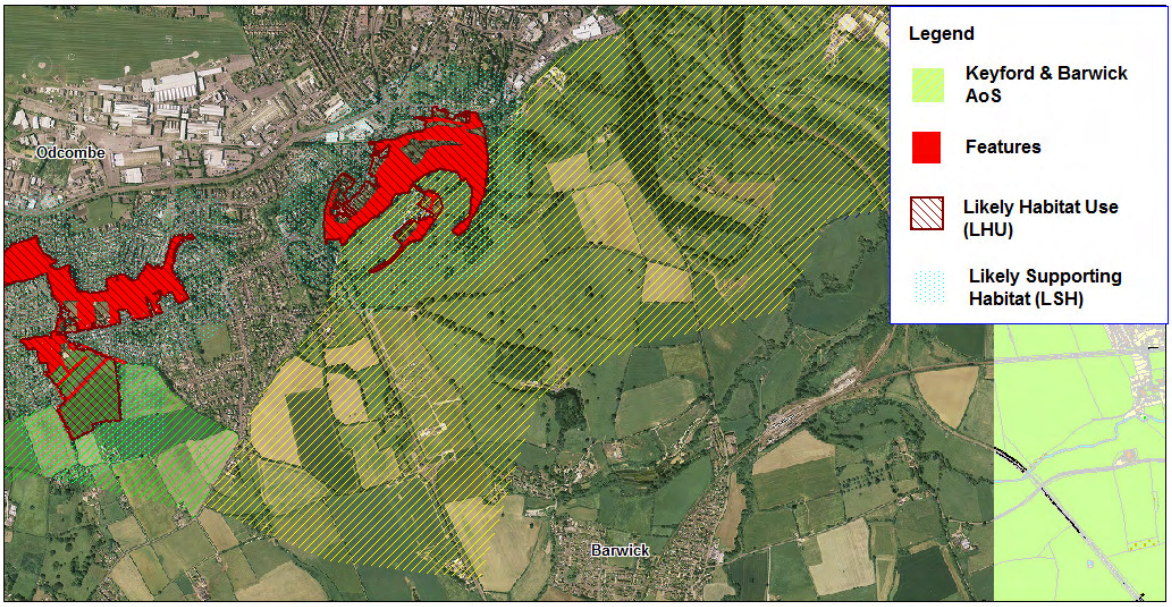



Brown Long-eared Bat

4.116 There is a record for brown long-eared bats in Southwood for September 1994. Neither the abundance nor the status of the roost is recorded. Therefore, it is assumed that the roost is still extant and that a number of brown long-eared bats are in occupation. Brown long-eared bats have also been reported hunting across the lower area of Wyndham on the edge of the AoS. In addition, two brown long-eared bats have been recorded in a bat box at Yeovil Junction to the south of the AoS.

4.117 Information on brown long-eared bats has been provided in the description accompanying the Brympton & Coker AoS. Map 16 shows brown long-eared bat usage of the landscape in the Keyford & Barwick AoS.

**Map 16: Brown Long-eared Bat – Keyford & Barwick AoS**




*East of Yeovil & Over Compton AoS*

4.118 The following EPS have been identified in the East of Yeovil & Over Compton AoS from SERC and DERC records and other sources where available:

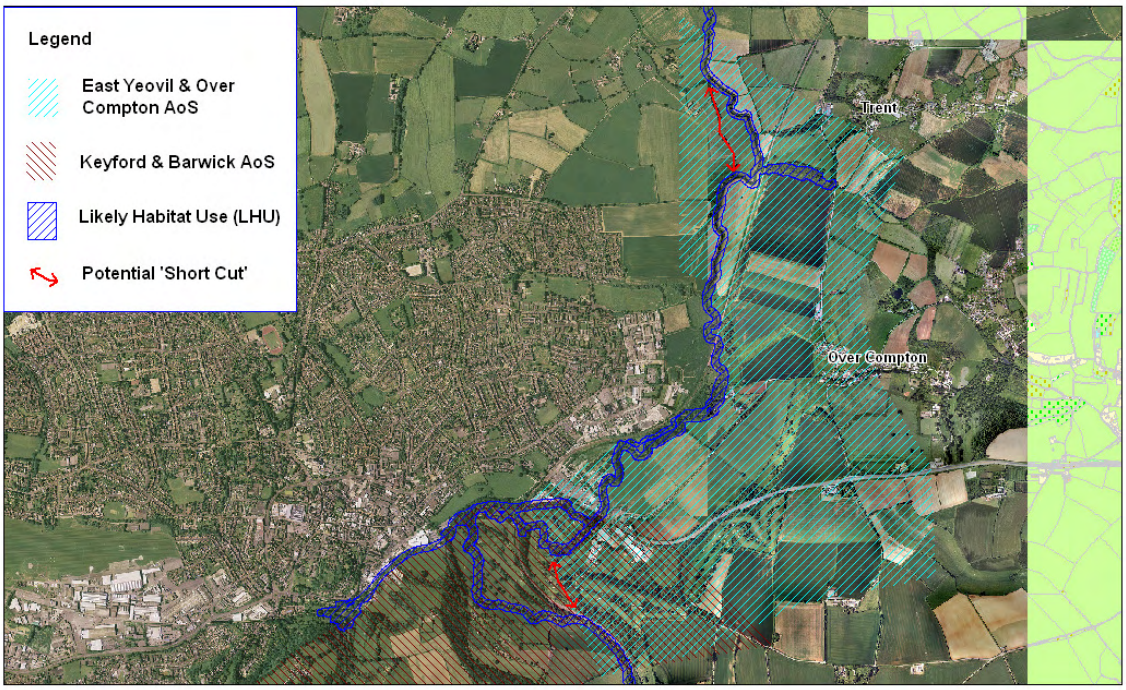
- Otter *Lutra lutra*
- Daubenton's Bat *Myotis daubentonii*
- Common Pipistrelle *Pipistrellus pipistrellus*

<u>Otter</u>

4.119 Otters have been recorded on the River Yeo to the east of Yeovil, including within the Country Park, since the early 1990s. There are records of scats under bridges at Sherborne Road.

4.120 Information on otters has been provided in the previous section.

**Map 17: Otter - East Yeovil & Over Compton AoS**




Daubenton's Bat

4.121 Although there are no records for Daubenton's bats within the AoS it is considered that watercourses and riverine woodland are within the known foraging range of the species and are therefore included.

4.122 Information on Daubenton's bats has been provided in the previous section.

**Map 18: Daubenton's Bat - East Yeovil & Over Compton AoS**

Common Pipistrelle

4.123 Information on common pipistrelle bats is given in the section on Keyford & Barwick AoS above. Although no roosts have been identified within the AoS habitat south of the A30 in the area of the golf course on the slopes of Tilly's Hill in the southern part of the AoS and towards Riverside on the River Yeo. See Map 15.

### *UK Protected and UK BAP Species*

*Introduction*

4.124 Within the study area, as well as EPS, the landscape supports a number of species protected at national level by the Wildlife and Countryside Act 1981 (as amended) [WCA]. These are species that are rare or threatened nationally.

4.125 In addition to those afforded legal protection, a number of species are considered of conservation importance to England's biodiversity and are listed on Section 41 of the Natural Environment and Rural Communities Act 2006 (NERC Act). These are species for which UK Biodiversity Action Plans have been formulated and for which progress against targets is monitored. Section 41 species are a material consideration in planning decisions. The list includes species afforded legal protection at both UK and European level.

4.126 Also included in this section are bird species listed on Annex I of the Birds Directive, which may also be afforded additional protection from disturbance under the WCA and are listed on Schedule 1.

4.127 Species, which have been mentioned in descriptions of LWS, are not included as it is assumed that LWS boundaries would encompass the species ecological requirements.

4.128 To ensure account is taken of the ecological requirements to maintain populations of these species the same mapping procedure is carried out as for EPS detailed above.

*Brympton & Coker AoS*

4.129 The following species have been identified in the Brympton & Coker AoS from SERC records and other sources where available:

- Water Vole *Arvicola amphibius*
- White Ermine Moth *Spilosoma lubricipeda*
- Buff Ermine Moth *Spilosoma luteum*

Water Vole

4.130 Water voles are fully protected under the Wildlife and Countryside Act 1981 (as amended) and are also a UK BAP priority species.

4.131 Water voles were recorded in 2001 in the stream to the north of the South Somerset District Council Offices in Brympton Way. Given the dynamic nature of water vole colonies there is potential that colonies were or are present in the ponds and watercourse west of the A3259, which run to Brympton House. It is assumed that water voles are still extant within this area.

4.132 Water voles are typically found on rivers, ditches, canals, ponds, lakes, marshland and land drains, as well as on blanket bogs, upland and peatland habitats, and occasionally on man-made reservoirs. Optimum habitat requirement is for greater than 60% marginal and emergent vegetation with less than 20% tree cover and a watercourse less than 1 metre wide and 1 metre deep, which has static or sluggish water flow rates, and is adjacent to fens, rough grassland, improved grassland or urban areas. Water voles are predominately vegetarian.

4.133 Each water vole uses a series of burrows that extend back to about 2 metres from banks above water. Earth banks are important for tunnelling and providing vegetative cover. Steep banks allow water voles to construct burrows at a number of levels above and below the waterline.

**Map 19: Water Vole – Brympton & Coker**

4.134 Home ranges are linear along the banks of a water body. Most females occupy a territory, which is exclusive. In Scotland the length of this territory ranged between 25 and 47 metres. Males do not defend territories, with a larger specimen having a larger home range and more females within it. In Oxford a male's home range was around 800 metres. Mean distance between colonies is 500 metres overland. Dispersal movements are frequent and extensive. Males travelled between 1.38 and 1.95 kilometres in Scotland.

4.135 Water voles are the fastest declining mammal species in the UK. This is partly due to predation by introduced American mink. However, the isolation of the water bodies between Brympton and Brympton Way make it unlikely that water vole in the AoS would be subject to American mink predation. Map 19 shows the likely habitat use within the AoS. The map also shows watercourses that may be used to disperse although they are unsuitable as habitat otherwise.

4.136 See Appendix 2 for a more detailed description of water vole ecology.

<u>Ermine Moths</u>

4.137 Two species of ermine moths were recorded to the north of West Coker in 1996. Both the white and buff ermine moths are on the Section 41 list of the NERC Act and are listed as a priority species in the UK BAP. However, it is considered that no further consideration is given as both these species are reliant on common plant species and are found in a wide variety of habitats including gardens and parks (Chinery, 2005).

*Keyford & Barwick AoS*

4.138 Many species have already been identified within the Country Park and/or LWS which are within or adjacent to the AoS. Within the Country Park and/or the LWS within or adjacent to the AoS the following species have been identified:

- Water Vole
- Song Thrush
- Tawny Owl
- Bullfinch
- Nightingale
- Lesser Whitethroat
- Green Woodpecker
- Kingfisher
- Grass Snake
- Slow-worm
- *Lygus pratensis*, a plant bug
- Corky-fruited Water-dropwort
- Waxcap fungi

4.139 It is considered that the ecological requirements of these species, apart from kingfishers, should be supported by habitats present within the LWS complex within the AoS. Therefore no further description or mapping is given.

4.140 However, the following species have been identified in the Keyford & Barwick AoS from SERC records and other sources where available, that are extant outside the LWS areas:

- Sandy Stilt Puffball *Battarrea phalloides*
- Kingfisher *Alcedo atthis*

Sandy Stilt Puffball

4.141 Sandy Stilt Puffball, a fungus, is a UK BAP priority species which was recorded in 1982 and 1992 adjoining Red House and assumed to still be present lacking evidence to the contrary. It is listed on Schedule 8 of the Wildlife and Countryside Act 1981, which makes it illegal to dig up, cut or destroy.

4.142 The sandy stilt puffball is found on sites with warm, free-draining sandy soil such as on hedge banks, road verges and about tree bases. A rare, warmth-loving species at the northern edge of its range with at least 16 post 1960 hectat records so far only from England. http://www.jncc.gov.uk/_speciespages/136.pdf

4.143 It can also be found at the edges of woods. The sandy stilt puffball seems to be associated with decaying wood, and can sometimes be located inside hollow trees facing towards the light. It has been found in association with ash, yew and pine. http://www.arkive.org/sandy-stiltball/battarrea-phalloides/

**Map 20: Sandy Stilt Puffball - Keyford & Barwick AoS**

4.144 It is threatened by habitat destruction; and disturbance at roadside sites due to digging; tipping, etc.
http://www.jncc.gov.uk/_speciespages/136.pdf

4.145 Map 20 shows the location of the likely habitat use by the species in the AoS

Kingfisher

4.146 Kingfishers are listed on Annex I of the EC Birds Directive 1979 and Schedule 1 of the Wildlife and Countryside Act 1981. Kingfishers, in the Keyford & Barwick AoS, have been recorded breeding at Ninesprings Pond and Streams LWS in 1997 and 1999, and an individual commuting in Ninesprings Wood in 1998. They were also recorded hunting along North Stream in the same area in June and July of 1998. A kingfisher was recorded in 1991 by the old railway line at Wyndham. Elsewhere in the AoS individual kingfishers have been observed at Newton Surmaville in 1994, along the River Yeo at the golf course in 1991 and further south at Bradford Abbas (outside the AoS) in 2003. It is listed as breeding at Ninesprings in the Yeovil and District Natural History Society records for the Country Park. They have also been recorded as nesting at Mudford and Sutton Bingham reservoir in 2004 (Somerset Ornithological Society, 2005).

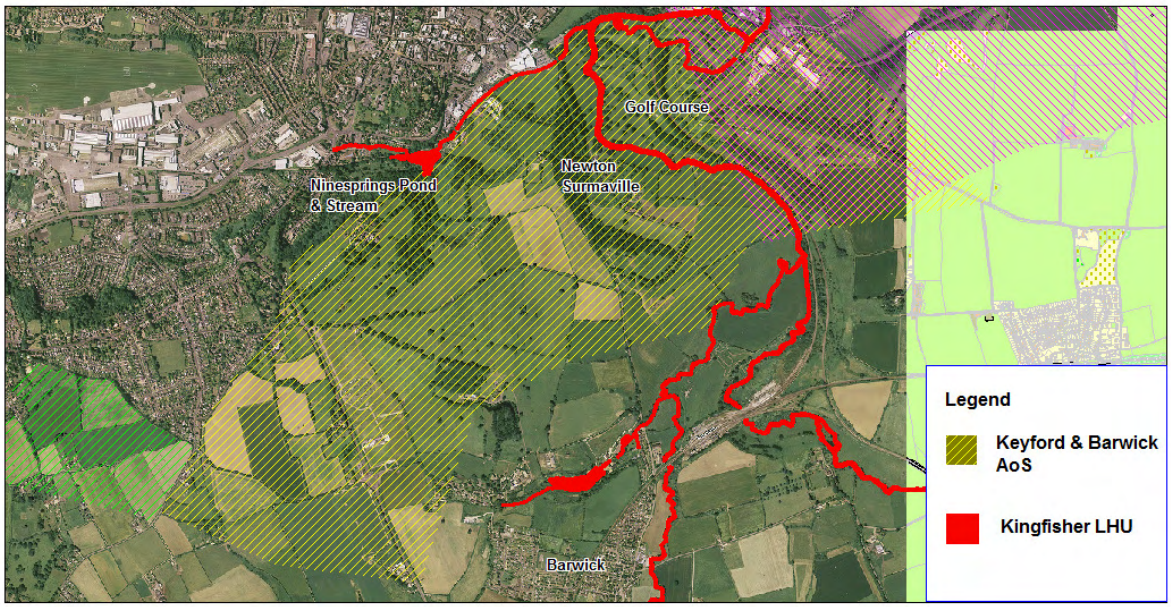
4.147 Kingfishers require relatively shallow and slow moving watercourses with vertical banks of fairly soft material in which to excavate nesting burrows linked with thriving populations of small fish on which to feed. They need overhanging tree branches and snags in the watercourse on which to perch during hunting. Nesting burrows are usually 60 - 90 centimetres in length and approximately 6 centimetres in diameter with a nest chamber at the end.

4.148 Kingfisher's breeding and feeding territories are separate and both are defended. There are no fixed rules about the size of territories, as it will vary according to the population and the availability of fish. Each bird would require at least 1 kilometre of river and territories may cover from 3 to 5 kilometres, which may include nearby lakes and side streams. Nest sites can be up to 300 metres away from a watercourse in the roots of a fallen tree or sandpit, usually in woodland.

4.149 Kingfishers are highly disturbed by the presence of walkers and dogs, which may account for the lack of records in the AoS since 2002 when the Country Park opened. '*Human disturbance of nesting birds is a serious problem, since the broods fail if something upsets the feeding routine*'.
http://www.rspb.org.uk/wildlife/birdguide/name/k/kingfisher/survival_and_threats.asp

4.150 Map 21 shows the likely habitat use by kingfishers in the Keyford & Barwick AoS.

**Map 21: Kingfisher – Keyford & Barwick AoS**




4.151 See Appendix 2 for a more detailed description of kingfisher ecology.

*East Yeovil & Over Compton AoS*

4.152 Many species have already been identified within the Country Park and/or LWS which are within or adjacent to the AoS. Within the Country Park and/or the LWS within or adjacent to the AoS the following species have been identified:

- Sedge Warbler
- Reed Warbler
- Kingfisher

4.153 It is considered that the ecological requirements of the warbler species should be supported by habitats present within the Riverside LWS within the AoS. Therefore no further description or mapping is given for these species.

4.154 However, the following species have been identified in the East Yeovil & Over Compton AoS from SERC records and other sources where available, that are extant outside the LWS areas:

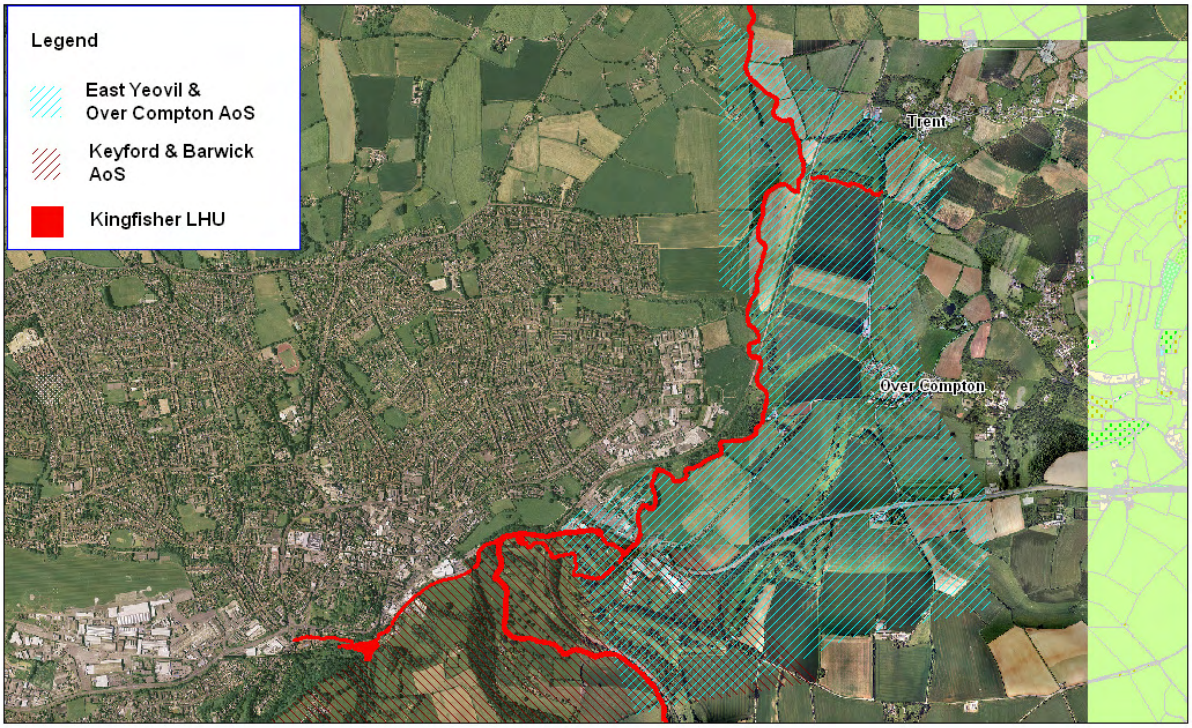
- Kingfisher *Alcedo atthis*
- Little Owl *Athena noctua*
- Bullhead *Cottus gobio*

Kingfisher

4.155 A description of kingfishers was given in the Keyford & Barwick AoS section above.

4.156 Kingfishers have been recorded on the River Yeo within the East Yeovil & Over Compton AoS at the Riverside LWS hunting in 2000 and between January and March 2003. Currently there are no recorded breeding sites. Map 22 shows likely habitat use by kingfishers in the AoS.

**Map 22: Kingfisher - East Yeovil & Over Compton AoS**




Little Owl

4.157 Little owls are listed on Annex 1 of the Birds Directive but are not afforded protection by UK legislation being an introduced species.

4.158 There is a record for little owl at Upper Mudford just to the west of the north end of the AoS. The record is for 1999 and has not been recorded since. The record may be for a vagrant. They have been recorded breeding at East Coker and elsewhere around Yeovil since. However, there were no records around Yeovil for the year 2004. (Somerset Ornithological Society, 2004/5)

4.159 Little owls were introduced successfully in the 19th century and have filled a niche in the UK being an owl species, feeding on worms and other invertebrates. (Holden & Cleeves, 2002; Hardy *et al*, 2009)

4.160 Little owls nest in holes in deciduous trees, particularly oak and fruit trees, but may use farm buildings, stonewalls and haystacks, about 3 metres above ground level (Hardy *et al*, 2009).

4.161 Little owls occur in a wide variety of habitats but most nests are found in lowland agricultural landscapes with woods, copses, hedgerows and old trees. They could occur in parkland and orchards in the Yeovil area. (Holden & Cleeves, 2002)

4.162 Home range for little owls is about 38 hectares in mixed farmland of which they use about 27 – 44%. Nests can occur as close as 240 metres apart. (Hardy *et al*, 2009)

4.163 Little owls do not migrate and young disperse in late summer but do not travel far (Holden & Cleeves, 2002).

4.164 Further surveys for the AoS may record the presence of little owls.

Bullhead

4.165 Bullheads are a small freshwater fish, also known as Miller's Thumb. They are listed on Annex II of the Habitats Directive, which provides for selection as a feature of a SAC, but otherwise are not afforded any special protection. Bullheads have been recorded in the River Yeo at Newtown in 1993. No record has been made since but it is possible that the species is still extant in the watercourse.

4.166 The species is unlikely to be effected by development unless changes in water quality and/or channel alteration occur. It is assumed neither that no reduction in water quality would result from the development nor that any alterations to the channel of the River Yeo would be made. Therefore, no further consideration is given in this report.

## UK Biodiversity Action Plan Priority Habitats

### *Introduction*

4.167 UK Biodiversity Action Plan (BAP) priority habitats are those that have been identified as priorities for conservation. Each of the BAPs proposes action for its priority habitat type, including for restoration and expansion. The habitats are also listed under Section 41 of the NERC Act 2006, being 'habitats of principal importance in England', and are therefore a material consideration in planning by local authorities.

4.168 This section identifies the presence of priority habitat types for each of the AoS. There may be some overlap with designated sites, such as LWS, but may also include undesignated areas which are nonetheless important in terms of nature conservation. Descriptions of each habitat type are given.

### *Brympton & Coker AoS*

4.169 The areas of UK BAP priority habitat are shown in Map 23. These include

- Lowland Mixed Deciduous Woodland; and
- Wet Woodland.

Lowland Mixed Deciduous Woodland

4.170 Lowland Mixed Deciduous Woodland includes woodland growing on the full range of soil conditions, from very acidic to base-rich, and takes in most semi-natural woodland in southern and eastern England, and in parts of lowland Wales and Scotland. In the AoS this woodland habitat occurs at Brympton d'Evercy, The Rookery and at Perry's Hill.

4.171 It occurs largely within enclosed landscapes, usually on sites with well-defined boundaries, at relatively low altitudes, although altitude is not a defining feature. They can be ancient woods. The woods tend to be small, less than 20 hectares. Often there is evidence of past coppicing, particularly on moderately acid to base-rich soils; on very acid sands the type may be represented by former wood-pastures of oak and birch.

**Map 23: UK BAP Priority Habitats – Brympton & Coker AoS**


4.172 There is great variety in the species composition of the canopy layer and the ground flora. *Quercus robur* is generally the commoner oak

(although *Quercus petraea* may be abundant locally) and may occur with virtually all combinations of other locally native tree species.

Wet Woodland

4.173 Within the AoS the wet woodland occurs at The Rookery adjacent to lowland mixed deciduous woodland.

4.173 Wet woodland occurs on poorly drained or seasonally wet soils, usually with alder, birch and willows as the predominant tree species, but sometimes including ash, oak, pine and beech on the drier riparian areas. It is found on floodplains, as successional habitat on fens, mires and bogs, along streams and hillside flushes, and in peaty hollows.

4.174 These woodlands occur on a range of soil types including nutrient-rich mineral and acid, nutrient-poor organic ones. The boundaries with dry land woodland may be sharp or gradual and may (but not always) change with time through succession, depending on the hydrological conditions and the treatment of the wood and its surrounding land. Therefore wet woods frequently occur in mosaic with other woodland key habitat types (e.g. with upland mixed ash or oakwoods) and with open key habitats such as fens.
http://www.ukbap.org.uk/UKPlans.aspx?ID=4

***Keyford & Barwick AoS***

4.175 The areas of UK BAP priority habitat within the Keyford & Barwick AoS are shown in Map 24. These include

- Lowland Mixed Deciduous Woodland;
- Lowland Dry Acid Grassland;
- Lowland Calcareous Grassland;
- Coastal and Floodplain Grazing Marsh;
- Lowland Wood Pasture and Parkland

Lowland Mixed Deciduous Woodland

4.176 This type of woodland habitat has been described in the previous section. It occurs within the AoS at Ninesprings, Newtown Copse and Wyndham Hill.

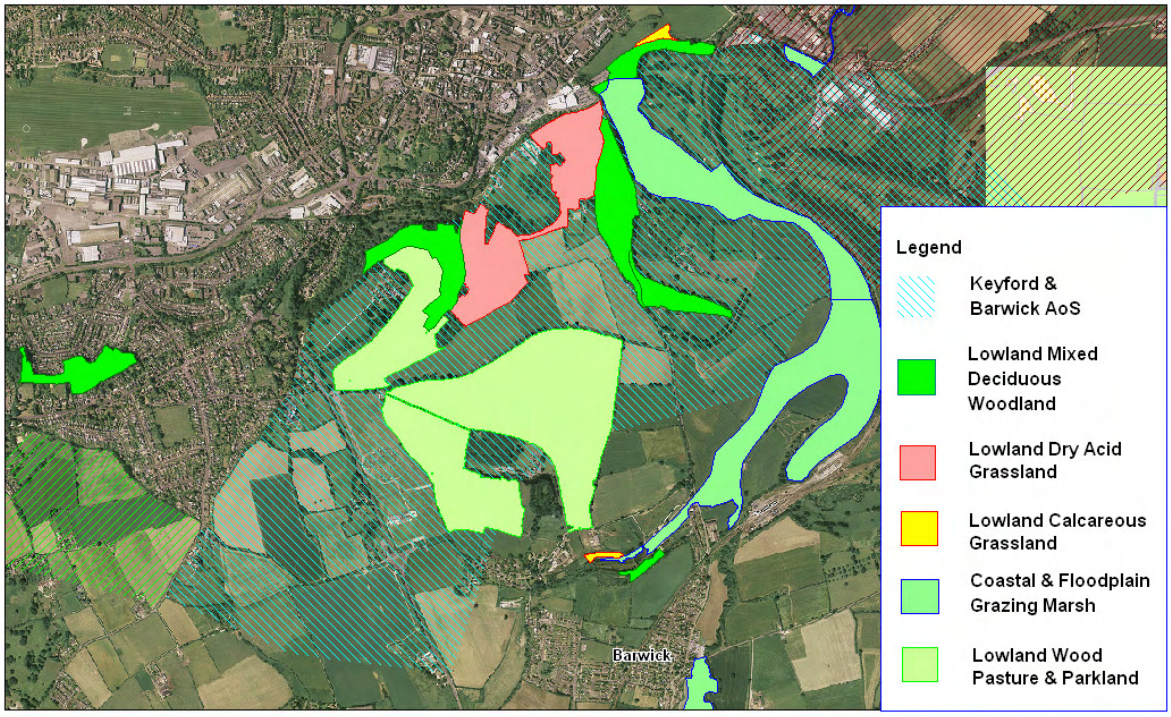
Lowland Dry Acid Grassland

4.177 Lowland dry acid grassland occurs at Summerhouse Hill within the AoS. The habitat typically occurs on nutrient-poor, generally free-draining soils with pH ranging from 4 to 5.5 overlying acid rocks or superficial deposits such as sands and gravels.

4.178 Acid grassland is characterised by a range of plant species with presence and abundance depending on community type and locality.

Acid grasslands can have a high cover of bryophytes and parched acid grassland can be rich in lichens. Acid grassland is very variable in terms of species richness and stands can range from relatively species-poor (less than 5 species per 4m²) to species-rich (in excess of 25 species per 4m²).

**Map 24: UK BAP Priority Habitats – Keyford & Barwick AoS**




4.179 Many of the invertebrates that occur in acid grassland are specialist species that do not occur in other types of grassland. The open parched acid grasslands on sandy soils in particular, can support a considerable number of ground-dwelling and burrowing invertebrates such as solitary bees and wasps. http://www.ukbap.org.uk/UKPlans.aspx?ID=14

Lowland Calcareous Grassland

4.180 There is small area of lowland calcareous grassland present in the AoS at Wyndham. Lowland calcareous grasslands are developed on shallow lime-rich soils generally overlying limestone rocks. These grasslands are now largely found on distinct topographic features such as escarpments or dry valley slopes and sometimes on ancient earthworks in landscapes strongly influenced by the underlying limestone geology.

4.181 Lowland calcareous grasslands are typically managed as components of pastoral or mixed farming systems, supporting sheep, cattle or sometimes horses; a few examples are cut for hay.

4.182 The definition of calcareous grasslands covers a range of plant communities in which lime-loving plants are characteristic. http://www.ukbap.org.uk/UKPlans.aspx?ID=12

Coastal and Floodplain Grazing Marsh

4.183 Coastal and Floodplain Grazing Marsh occurs both sides of the River Yeo through the AoS. Grazing marsh is defined as periodically inundated pasture, or meadow with ditches, which maintain the water levels, containing standing brackish or fresh water. The ditches are especially rich in plants and invertebrates. Almost all areas are grazed and some are cut for hay or silage. Sites may contain seasonal water-filled hollows and permanent ponds with emergent swamp communities, but not extensive areas of tall fen species like reeds; although they may abut with fen and reed swamp communities.

4.184 It is considered that the area of coastal and floodplain grazing marsh within the AoS is likely to be much degraded. However, one of the objects of the BAP is to rehabilitate and increase the area of grazing marsh.
http://www.ukbap.org.uk/UKPlans.aspx?ID=9

Lowland Wood Pasture and Parkland

4.185 Lowland Wood Pasture and Parkland occur at Barwick and Aldon Parks within the AoS. Lowland wood-pastures and parkland are the products of historic land management systems, and represent a vegetation structure rather than being a particular plant community. Typically this structure consists of large, open-grown or high forest trees (often pollards) at various densities, in a matrix of grazed grassland, heathland and/or woodland floras.
http://www.ukbap.org.uk/UKPlans.aspx?ID=5

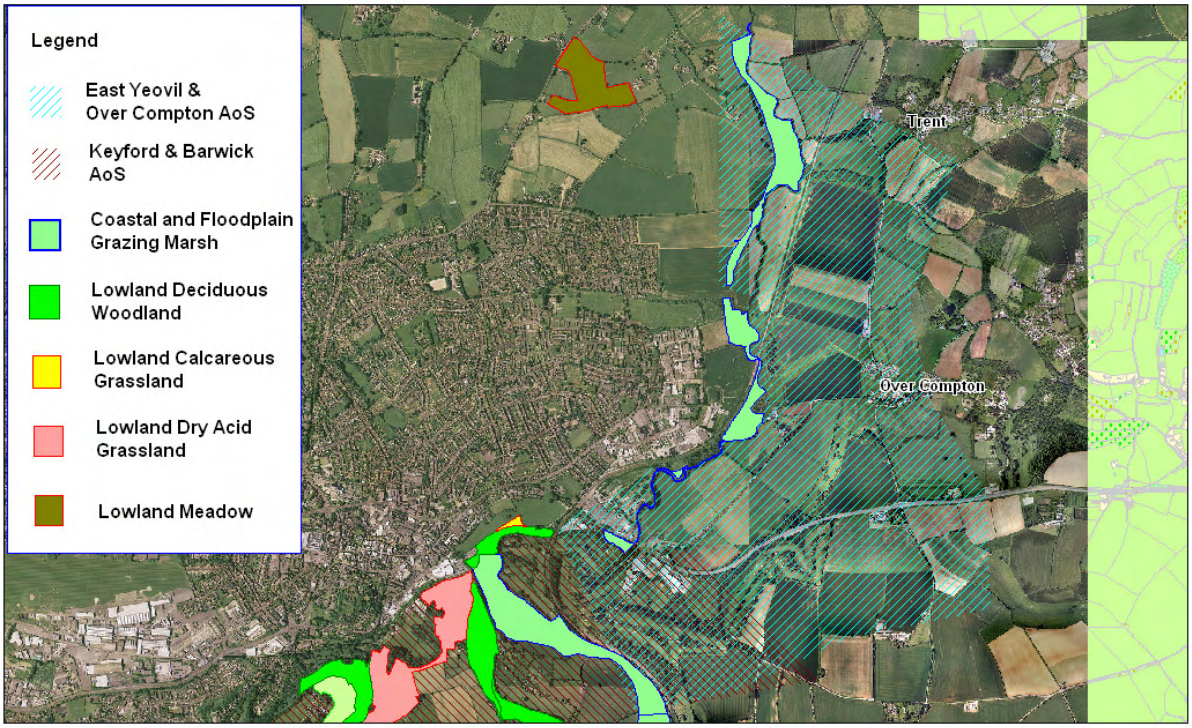
***East Yeovil & Over Compton AoS***

4.186 The areas of UK BAP priority habitat within the East Yeovil & Over Compton AoS are shown in Map 25. These include:

- Coastal and Floodplain Grazing Marsh

4.187 Coastal and Floodplain Grazing Marsh occur both sides of the River Yeo through the AoS and have been described in the previous section.

**Map 25: UK BAP Priority Habitats – East Yeovil & Over Compton AoS**



# 5. Appraisal

## Introduction

5.1 This chapter gives an appraisal of the nature conservation value of each of the Areas of Search (AoS) and will bring together and highlight features, which need to be conserved, enhanced and possibly extended, in order to maintain current populations of the species described above. Note that it is a legal requirement for populations of European Protected Species (EPS) and indeed a basic policy in the development of an Ecotown. Further work will be required in order to obtain the amount of habitat that is desirable.

5.2 There is also a consideration of the approximate size of the Area of Searches initially identified compared to the amount of land needed for the construction of the built environment of the Ecotown (192 hectares – see Table 1) and the area required for green space.

5.3 '*The extent of the land needed to accommodate the development of the eco-town will reflect the footprint of development, and the extent and distribution of its green infrastructure. The potential biodiversity impacts of increasing density and so reducing land take, and the alternative scenario of reducing density and so increasing land take, should be fully considered with respect to the impacts from the potential resulting footprint of the eco-town. These impacts will need to be evaluated on a case-by-case basis*.' (TCPA, 2009)

5.4 The Planning Policy Statement 1 supplement on Ecotowns states that 40% of the Ecotown's total area should be allocated to green space, of which at least half should be public and consist of a network of well managed, high quality green/open spaces which are linked to the wider countryside (DCLG, 2009). This indicates that around 20% can be allocated purely for non-accessible biodiversity interest.

## Brympton & Coker AoS

5.5 The Brympton & Coker AoS consists of agricultural land, which is a mixture of arable and improved permanent grassland with some pasture. There are small woodlands in the central area of the AoS, which are either LWS or UKBAP priority habitats. There is also woodland in the north of the AoS to the west of Brympton d'Evercy.

5.6 Around the Brympton d'Evercy House there is garden planting, including a pond on the southern side of the building, and remnants of the park in the hedgerows and fields further away from the house. There is a number of veteran trees present extending outwards to the south in the AoS. A good network of hedgerows and/or mature trees radiate in four directions from Brympton D'Evercy.

5.7 Elsewhere hedgerows appear to be small due to management. A stream runs near the northern border of the site between Brympton d'Evercy and the A3259 where it passes under the road and runs along the northern boundary of the South Somerset District Council offices. There is also a pond on the northern boundary of the AoS.

5.8 Key species likely to be found in the AoS includes lesser horseshoe, serotine and brown long-eared bats and water voles. There is a lesser horseshoe bat hibernation roost and a brown long-eared bat summer roost at Brympton d'Evercy. Serotine bats that roost in the south west of Yeovil are probably using pasture and fields to forage in the AoS particularly next to woodland blocks. Noctule bats are possibly over flying the area and could be hunting over woodland. Water voles are potentially present along the stream along the northern boundary given the dynamic nature of colonial occupation of watercourses.

5.9 In order, to maintain the populations of species using the AoS it will be necessary to retain habitat in sufficient quantity and quality and more, as enhancement and extension is also a consideration in planning Ecotowns (TCPA, 2009).

5.10 It is likely that brown long-eared bat habitat requirements would be key in the AoS. Lesser horseshoe bats are likely to be using the same features as that used by brown long-eared bats. As a guide, the brown long-eared bat colony would require, given a typical colony size of 20 individuals, an area of habitat of up to 220 hectares, using the maximum required as a precautionary approach. The LHU area, shown on Map 9, amounts to around 176 hectares of which 130 hectares are within the AoS. In addition, LSH would contribute to supporting the colony's feeding requirements.

5.11 Hedgerows and tree lines will need to be maintained unfragmented in order feeding areas are accessible (See features in Map 9). Water is important to brown long-eared bats is important as dehydration is through the flight membranes and ears is high (Dietz *et al*, 2009). Ponds should be retained with access to them. Development in fields next to woodland edges should be avoided, as these edges are often important feeding areas for bats.

5.12 The area of habitat available to brown long-eared (and lesser horseshoe) bats can be extended by creating hedgerows and/or woodland planting from Pound Lane, to the Rookery, Dry Copse through to Perry's Hill. This would then provide opportunity to link into the brown long-eared colony present on the north side of West Coker Road within Yeovil.

5.13 Another area of the AoS that is potentially used by brown long-eared bats is located to the south of Placket Lane and east of Nash Lane. This area can be accessed for bats roosting in the West Coker Road area and should be retained to ensure the colonies viability. This area

is also possibly important for serotine bats being located close to roost sites around Helena Road. Development needs to avoid isolating this area from the wider countryside to the south.

5.14 Artificial lighting such as streetlamps should not illuminate areas used by brown long-eared and lesser horseshoe bats. These are both light averse species and lighting could prevent access to feeding areas reducing availability. In addition, streetlights can attract insect prey away from feeding areas further decreasing the value of the habitat in supporting a viable population. (Outen, 2002; Stone, 2009) Streetlights will emit 1 Lux of light at a distance of 15 metres from the column with a mounting height of 10 metres and for 13.1 metres with a mounting height of 8 metres (Emery, 2008). Therefore it is estimated that light levels will not exceed 0.5 Lux at 30 metres distance from the column.

5.15 To maintain the serotine population foraging habitat in the Brympton & Coker AoS will need to be retained. These are indicated in Map 8. However, these feeding areas would need to be confirmed and identified through field survey. Any losses will need to be compensated for in the AoS through change of land use favouring serotine bats.

5.16 Noctule bats may over fly or forage within the AoS. Therefore, it is important that if wind turbines are likely to be incorporated within the Ecotown development surveys are carried out to assess movement of the species across the site. Where there is a risk to the species alternative forms of renewable energy will need to be employed.

5.17 Water voles have been recorded outside the AoS along the stream bordering the north side of the South Somerset District Council offices. If still extant, this colony appears to be isolated but there may be some exchange of individuals through the urban area to the colony reported along the streams in Ninesprings. To ensure the viability of this population the stream west of the housing development should be located at least 200 metres away to ensure that there is a minimised increase of risk to predation by domestic cats *Felis catus* (Kays & DeWan, 2004: Woods *et al*, 2003). Furthermore, the bank sides within 5 metres of the watercourse could be managed to favour water voles.

5.18 Box 1 summarises the requirements in order to maintain populations of important species in the AoS. Map 26 shows the areas that need to be retained and enhanced to maintain the viability of populations of important species using the AoS. The Map also shows those fields adjacent to woodland that could be used to expand the biodiversity potential of the AoS.

5.19 The total area of requirement to maintain biodiversity interests for this AoS is approximately 206 hectares. The AoS is approximately 435 hectares of which 192 hectares is required to accommodate 5000 houses and associated development. Therefore, it is concluded that the area could accommodate the proposed Ecotown development

including the 40% green infrastructure requirement stated in PPS1 by incorporating and improving features already present. However, this should be concentrated in the southern end of the AoS towards North and West Coker away from sensitive species and habitats.

**Box 1: Masterplan – Brympton & Coker AoS**

**Requirements**

To maintain the populations of species and extent and quality of important habitat the Masterplan for the Brympton & Coker AoS needs to:

- Retain the areas of habitat use (LHU) by brown long-eared bats (and lesser horseshoe bats) shown in Map 26. Avoid LSH if possible (see Maps 7 and 9)
- Maintain areas used by serotine bats (LHU). These areas should be confirmed by surveys but are possibly those indicated on Map 26. If lost to land use change this would need to be compensated for with appropriate habitat management within close foraging range of the Helena Road roost sites.
- Consider enhancement measures for water voles along the watercourse shown on Map 26.
- Avoid development in fields adjacent to woodland.
- Avoid built development and infrastructure between Placket Lane/Nash Lane and Longlands/Foxhole.
- Avoid built and infrastructure development between Pound Lane through to Perry's Hill. Consider hedgerow and woodland planting along this corridor and other habitat creation.
- Avoid use of wind turbines if there is a risk to noctule bats[2]. Surveys are required in order to ascertain use of the AoS by the species.

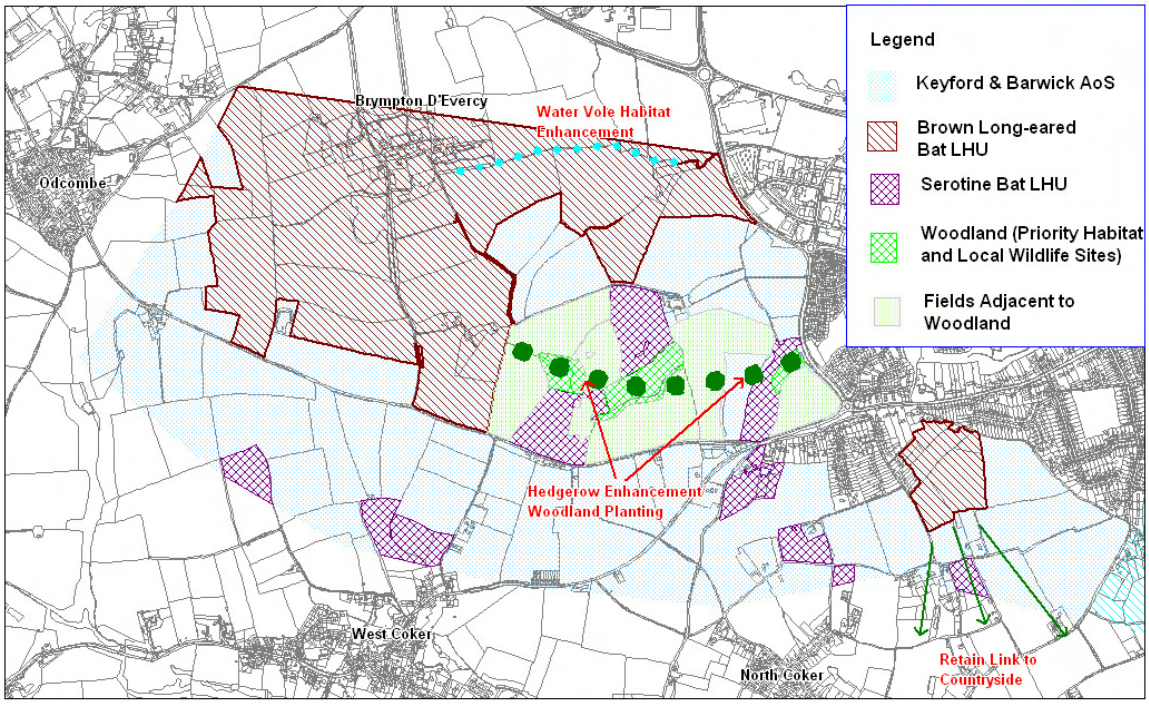
**Enhancements**

Potential biodiversity enhancements could include:

- Hedgerow management
- Creation of new hedgerows and woodland for bats
- Stream management for water voles
- Field management, e.g. grazing regimes, field margins

[2] See Appendix 4

**Map 26: Important Wildlife Areas to Maintain Species and Habitats – Brympton & Coker AoS**




5.20 The above is an initial appraisal only in order to guide early Masterplan development. Further measures may be required to ensure robustness of the Ecotown in delivering a net biodiversity gain and in maintaining populations.

5.21 The recommended method for calculating the value of habitat loss within the AoS for compensatory habitat creation is set out in Chapter 6.

## Keyford & Barwick AoS

5.22 The Keyford & Barwick AoS contains a wide range of habitats, much of which is UK BAP habitat and/or designated as Local Wildlife Sites (LWS). Parts of the AoS are also designated as a Country Park. The area also supports a rich variety of species including fungi, plants, trees, invertebrates, birds and mammals.

5.23 Running through the AoS from south to northeast is the River Yeo. This is an important wildlife corridor and supports species of European importance such as otters, Daubenton's bats and kingfisher. Some of the land area either side of the river has been identified as Coastal and Floodplain Grazing Marsh, a UK BAP priority habitat. However, it is considered that much of this area is degraded through agricultural improvement and the construction of a golf course but has the potential to be enhanced as the priority habitat. Along the northern boundary of

the AoS flows the Ninesprings stream, which joins the River Yeo at Wyndham.

5.24 There are several patches of woodland along the northern edge of the AoS, including two areas of the Lowland Deciduous Mixed Woodland UK BAP priority habitat that runs south like fingers into the AoS at Ninesprings and Newton Copse. Other patches of woodland occur east of the River Yeo, including strips bordering the railway line. These woodland patches support such species as slow-worms, tawny owls, bullfinch, common shrews, badgers and bats.

5.25 There are two large parkland areas, at Aldon and Barwick, both of which are Local Wildlife Sites and could be considered to be UK BAP priority habitat. These parks support many veteran trees. '*Veteran trees are a significant part of historic, cultural and ecological heritage treasured by many generations; in the past because of their economic and social value or as elements of picturesque or romantic landscapes and more recently as a result of our increased understanding of their considerable ecological importance*.' (Natural England, 1999) *Rigidoporus ulmarius* and *Hericium erinaceum*, basidiomycete fungi growing on trees and dead wood were recorded in Barwick Park. The parkland areas can be enhanced with tree planting and grassland management. Another aim would be to ensure the survival of ancient trees and their associated microhabitats, such as hollow trunks, dying and dead wood (Sutherland & Hill, 2004)

5.26 At Summerhouse Hill there is an area of Lowland Dry Acid Grasslands, a UK BAP Priority Habitat, which are cattle grazed. There are also some gorse scrub and trees on higher slopes and exposed patches of sandy soils. Acid grassland is characterised by a range of plant species with presence and abundance depending on community type and locality. Many of the invertebrates that occur in acid grassland are specialist species that do not occur in other types of grassland.

5.27 A number of species of waxcap fungus have been recorded on Summerhouse Hill. This also indicates that the fields are also important habitats for plants and invertebrates. A feature common to all sites with diverse waxcap populations is that they are grazed or mown regularly and that there has been no recent fertilizer application. Waxcaps are declining across Europe due to habitat degradation or loss. http://www.aber.ac.uk/waxcap/index.shtml

5.28 Elsewhere the AoS is made up of generally large fields of arable or improved grassland with small hedgerows due to management.

5.29 Key species likely to be found in the Barwick to Keyford AoS includes lesser horseshoe, Daubenton's, serotine, pipistrelle and brown long-eared bats and otters. There is a possible small maternity roost of lesser horseshoe bats on Henford Hill and a brown long-eared bat summer roost at Southwoods. Serotine bats that roost in the south

west of Yeovil are probably using pasture and fields to forage in the AoS particularly next to woodland blocks. Noctule bats are possible over flying the area and could be hunting over woodland.

5.30 In order, to maintain the populations of species using the AoS it will be necessary to retain habitat in sufficient quantity and quality and more, as enhancement and extension is also a consideration in planning Ecotowns (TCPA, 2009).

5.31 It is likely that lesser horseshoe bat habitat requirements would be key in the AoS. Brown long-eared bats are likely to be using the same features as that used by lesser horseshoe bats. As a guide, the lesser horseshoe bat colony size was recorded as consisting of around 20 individuals, which could use a landscape area of between 3000 and 8000 hectares. Within this area individual bats would require up to seven separate hunting areas totalling between 21 and 350 hectares of foraging habitat giving a requirement of between 420 and 7000 hectares. (Dietz *et al*, 2009) This figure does not allow for some overlap in foraging areas where particularly close to the roost lesser horseshoes bats would be found at a higher density. The LHU area, shown on Map 11, amounts to around 170 hectares of which 145 hectares are within the AoS. In addition, LSH would contribute to supporting the colony's feeding requirements. The figures indicate that lesser horseshoe bats would be using the whole LHU area. In addition it is likely that pipistrelle bats are present and competing for the same food resources (Arlettaz *et al*, 2000, Bontadina *et al*, 2008).

5.32 Hedgerows and tree lines will need to be maintained unfragmented in order feeding areas are accessible (See features in Map 11). Creating hedgerows and/or woodland planting either side of Newton Road can extend the area of habitat available to lesser horseshoe bats. This would then provide opportunity to link into the roosts sites at Yeovil Junction Station and Clifton Maybank.

5.33 Artificial lighting, such as streetlamps, should not illuminate areas used by lesser horseshoe bats as the species is very light averse. Introduced lighting could prevent access to feeding areas reducing availability. In addition, streetlights can attract insect prey away from feeding areas further decreasing the value of the habitat in supporting a viable population. (Outen, 2002; Stone, 2009) Street lighting would also favour pipistrelle bats, which are known to hawk for insects through the illuminated areas (Arlettaz *et al*, 2000, Bontadina *et al*, 2008). As afore mentioned, it is considered that illumination from streetlights should not exceed 0.5 Lux at 30 metres distance from the column.

5.34 To maintain the serotine population roosting in the Turner Barns Lane area foraging habitat in the Keyford & Barwick AoS will need to be retained. These are indicated in Map 11. These feeding areas have

initially been identified as lying within LWS or priority habitat areas but would need to be confirmed by further survey.

5.35 Noctule bats are possibly over flying or foraging within the AoS. This species is at high risk of mortality from wind turbine development and losses of 1 or 2 bats can have long term effects on the maintenance of the local population (See Appendix 4). Therefore, it is crucial that if wind turbines are likely to be incorporated within the Ecotown development surveys are carried out to assess movement of the species across the site. There is a likelihood that noctule bats are roosting in the Country Park area and commuting towards ponds near Pavyotts Farm (where they have been recorded) and Barwick to feed. Identification of possible roost site in woodland and parkland within the AoS also needs to be carried out. Where there is a risk to noctule bats alternative forms of renewable energy will need to be employed.

5.36 Map 15 shows the locations of three common pipistrelle bat maternity roosts recorded within and adjacent to the Keyford & Barwick AoS. These are located in South Woods area, where there are roosts of around 270 and 70 bats, at Newton and at Stoford to the south of the AoS. No numbers of bats were recorded for the latter two roost sites but colonies of around 50 to 100 are typical for maternity roosts (Deitz *et al*, 2009).

5.37 It appears that pipistrelle bats emerge and head for feeding grounds in groups (Simon *et al*, 2004). The average area of a hunting ground around a maternity roost for common pipistrelle bats is around 92 hectares (Dietz *et al*, 2009). Individual home range is dependant on abundance of insects and may have a total size of more than 50 hectares. (Boye & Dietz, 2005) However, only small areas within the home range are used and can be hunted for hours (Dietz *et al*, 2009). The colonies at South Woods and Newton are likely to be foraging in areas used by lesser horseshoe bats but close around the roosting areas. Even so foraging further a field may occur being not so restricted by gaps in flight lines as lesser horseshoe bats. (See Map 15)

5.38 Streetlights also attract pipistrelle bats where they feed on the insects attracted by the light (Bat Conservation Trust/Institute of Lighting Engineers. n/d). However, they still require darkened commuting routes.

5.39 The River Yeo supports otters, Daubenton's bats and kingfishers (See Maps 10, 12 and 21 respectively). All these species require tree cover along the banks of watercourses. Optimal habitat for otters includes riverbanks with dense herbaceous vegetation and fringes of trees with branches hanging low over the water. Daubenton's bats always use flyways and never cross open ground. Ideally watercourses should have overgrown bank side vegetation with trees on both sides.

Kingfishers need overhanging tree branches and snags in the watercourse on which to perch during hunting.

5.40 Daubenton's bats can forage through urban areas provided light levels are low enough and there is sufficient bank side cover. Otter resting places need to be free from disturbance. Nesting kingfishers are susceptible to disturbance. They have not been recorded nesting at Ninesprings since the opening of the County Park. The development of an Ecotown could increase and widen disturbance effects on these species due to increased recreational pressure resulting from the development of 5000 new homes. Therefore, a Masterplan that includes the river should restrict access and maintain a buffer to the watercourse to enable maintenance of populations. There should be no increases in lighting affecting the river.

5.41 There are opportunities to improve the bank side vegetation along the River Yeo and enhance the habitat for otters, bats and kingfishers. In addition, areas of floodplain grazing marsh can be restored and/or created. There may also be opportunities to create wetland habitats.

5.42 Sandy Stilt Puffball has been identified being present on land (road verge?) adjoining Red House to the west of the A37. This species would be vulnerable to road improvements from the roundabout along the road (Pavyotts Lane?) from Keyford Roundabout. Its fruiting body appears randomly in the same location and may not be seen in some years. Therefore, surveys may not always find it. To conserve it presence it would be essential that any development should not disturb its current range within the AoS.

5.43 Box 2 summarises the requirements in order to maintain populations of important species in the AoS. Map 27 shows the areas that need to be retained and enhanced to maintain the viability of populations of important species using the AoS.

5.44 The total area of requirement to maintain biodiversity interests for this AoS is approximately 214 hectares. However, there are areas within the requirement for biodiversity interest that if developed are likely to cause barrier effects, habitat fragmentation and/or isolation. Therefore, the area of these patches needs to be added to the biodiversity requirement. This gives a revised total of approximately 255 hectares. These extra land areas can be used to enhance and extend the biodiversity interests in the AoS.

5.45 The area available for development is effectively split into two areas. One towards the east is approximately 80 hectares. The other along the A37 at Keyford and towards East Coker is approximately 110 hectares in area. Two hundred and four hectares is required to accommodate 5000 houses and associated development. Therefore, it is concluded that the 40% green infrastructure requirement is unlikely to be present. Therefore, an additional area of land for housing

development needs to be acquired either from the adjacent East Yeovil & Over Compton AoS (112 hectares) or the Brympton & Coker AoS (82 hectares). The western extension is preferred in terms of biodiversity as the eastern extension includes habitat likely to be used by common pipistrelle bats, which if developed would put additional pressure on resources jointly used by lesser horseshoe and pipistrelle bats.

**Box 2: Masterplan Guidance – Keyford & Barwick AoS**

**Requirements**

To maintain the populations of species and extent and quality of important habitat the Masterplan for the Keyford & Barwick AoS needs to:

- Extend AoS westward towards North Coker and/or southward along the A37 by approximately 82 hectares.
- Retain the areas of habitat use (LHU) by lesser horseshoe bats (and brown long-eared bats) shown in Map 27. Maintain flyways southwards towards Yeovil Junction Station. Avoid LSH if possible (see Maps 11 and 16)
- Avoid UK BAP Priority habitat areas and Local Wildlife Sites.
- Avoid development near watercourses used by riverine species, including otter, Daubenton's bats and kingfishers. A buffer of 200 metres should be maintained to avoid increased risk of predation by domestic cats
- Control access to sections of riverside to allow undisturbed areas where resting places for otters and artificial nesting banks for kingfishers may be developed.
- Maintain areas used by serotine bats (LHU). These areas should be confirmed by surveys but are possibly those indicated on Map 27. If lost to land use change this would need to be compensated for with appropriate habitat management within close foraging range around Keyford.
- Avoid any development of roads around the Sandy Stilt Puffball LHU.
- Avoid use of wind turbines if there is a risk to noctule bats[3]. Surveys are required in order to ascertain use of the AoS by the species.

[3] See Appendix 4

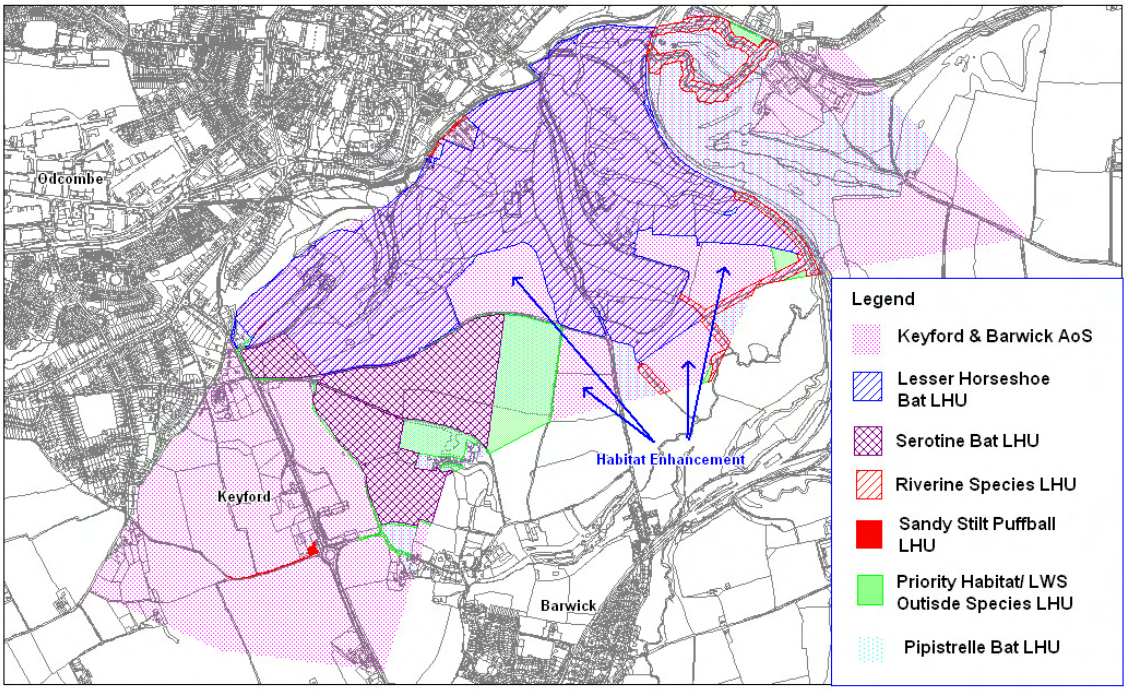
**Box 2: Masterplan Guidance – Keyford & Barwick AoS**

**Enhancements**

Potential biodiversity enhancements could include:

- Wood pasture and parkland enhancement through grassland management, e.g. grazing regimes, and new planting
- Woodland and hedgerow planting for bats
- Riverbank management for bats, otters and kingfishers, including installation of artificial nest sites and holts.
- Restoration of flood plain grazing marsh.
- Creation of wetland habitats along river corridor including ponds and wet woodland.
- Hedgerow management
- Field management, e.g. grazing regimes, field margins

**Map 27: Important Wildlife Areas to Maintain Species and Habitats – Keyford & Barwick AoS**




5.46 This is an initial appraisal only in order to guide early Masterplan development. Further measures may be required to ensure robustness of the Ecotown in delivering a net biodiversity gain and in maintaining populations.

5.47 The recommended method for calculating the value of habitat loss within the AoS for compensatory habitat creation is set out in Chapter 6.

**East Yeovil & Over Compton AoS**

5.48 The East Yeovil & Over Compton AoS consists for the most part of generally large fields of arable and/or improved permanent grassland with some grazing north of Over Compton. Some pasture occurs in the west of Nether Compton. Hedgerows are generally small. There is a golf course on the slopes of Tilly's Hill south the A30 in the southern part of the AoS.

5.49 A railway line east of the River Yeo strongly divides the AoS north south in the western area of the site and the A30 runs east west across the southern part of the AoS. Alongside the A30 there are two SSSIs that are designated for their geological features.

5.50 There is a strong wooded belt along the stream flowing west from Nether Compton into the River Yeo dividing the AoS near its northern end. Adjacent to the stream/ wooded belt within the AoS is a small woodland, Park's Plantation, near the River Yeo and another small woodland north of this leading away from the river towards Trent. There would be opportunity to enhance this wildlife corridor.

5.51 The River Yeo flows to the north on the western side of the AoS and generally has vegetated banks. Riverside Walk lies along side the river and railway in of the AoS. Riverside LWS is of semi-improved grassland, rough grassland and meadow, some of which is of high botanical interest in the southern section off the AoS. The site also supports a diverse mix of habitats including native broadleaved woodland and sandy riverbanks. There is reed bed, which supports reed warbler and sedge warbler territories. The River Yeo is designated a LWS north of Park's Plantation.

5.52 Coastal and Floodplain Grazing Marsh, a UK BAP priority habitat occurs both sides of the River Yeo through the AoS. Grazing marsh is defined as periodically inundated pasture, or meadow with ditches, which maintain the water levels, containing standing brackish or fresh water. However, it is considered that the area of floodplain grazing marsh within the AoS is likely to be much degraded through agricultural improvement.

5.53 Key species in the AoS are found along the River Yeo are otters, Daubenton's bats and kingfishers (See Map 22). All these species require tree cover along the banks of watercourses. Optimal habitat for otters includes riverbanks with dense herbaceous vegetation and fringes of trees with branches hanging low over the water. Daubenton's

bats always use flyways and never cross open ground. Ideally watercourses should have overgrown bank side vegetation with trees on both sides. Kingfishers need overhanging tree branches and snags in the watercourse on which to perch during hunting.

5.54 Daubenton's bats can forage through urban areas provided light levels are low enough and there is sufficient bank side cover. Otter resting places need to be free from disturbance. Nesting kingfishers are susceptible to disturbance. The development of an Ecotown could increase and widen disturbance effects on these species due to increased recreational pressure resulting from the development of 5000 new homes. Therefore, a Masterplan that includes the river should restrict access and maintain a buffer to the watercourse to enable maintenance of populations. There should be no increases in lighting affecting the river.

5.55 There are opportunities to improve the bank side vegetation along the River Yeo and enhance the habitat for otters, bats and kingfishers. In addition, areas of floodplain grazing marsh can be restored and/or created. There may also be opportunities to create wetland habitats, including wet woodland, and broadleaved woodland.

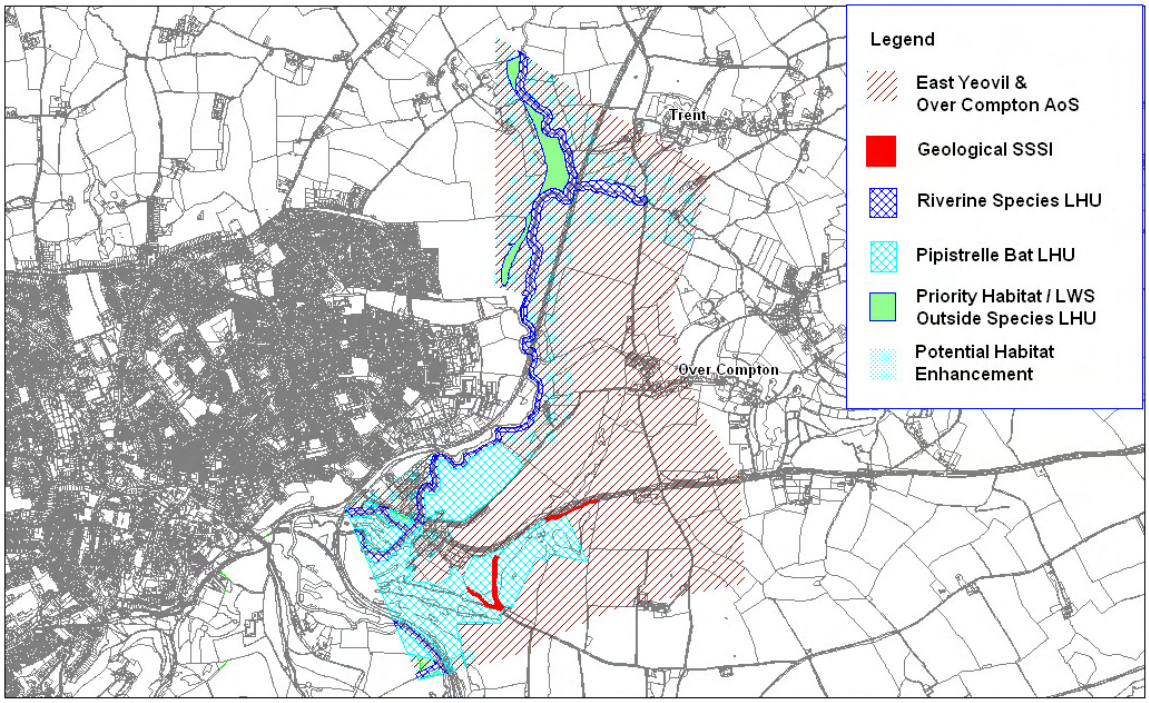
5.56 At the southern end of the AoS pipistrelle bats may be using habitat around the golf course south of the A30 at Tilly's Hill and along the River Yeo towards Riverside. If developed the reduced foraging value would put additional pressure on resources jointly used by lesser horseshoe and pipistrelle bats in the Keyford & Barwick AoS to the west.

5.57 Box 3 summarises the requirements in order to maintain populations of important species in the AoS. Map 28 shows the areas that need to be retained and enhanced to maintain the viability of populations of important species using the AoS.

5.58 The total area of requirement to maintain biodiversity interests for this East Yeovil & Over Compton AoS is approximately 113 hectares. The AoS is approximately 539 hectares of which 192 hectares is required to accommodate 5000 houses and associated development. There is also potential to enhance habitat along the watercourses in the AoS and this would occupy approximately 132 hectares, giving a biodiversity area of around 212 hectares. Therefore, it is concluded that the area could easily accommodate the proposed Ecotown development including the 40% green infrastructure requirement stated in PPS1 by incorporating and improving features already present.

5.59 This is an initial appraisal only in order to guide early Masterplan development. Further measures may be required to ensure robustness of the Ecotown in delivering a net biodiversity gain and in maintaining populations.

**Map 28: Important Wildlife Areas to Maintain Species and Habitats - East Yeovil & Over Compton AoS**




**Box 3: Masterplan Guidance – East Yeovil & Over Compton AoS**

**Requirements**

To maintain the populations of species and extent and quality of important habitat the Masterplan for the East Yeovil & Over Compton AoS needs to:

- Avoid development near watercourses used by riverine species, including otter, Daubenton's bats and kingfishers.
- Retain the areas of habitat use (LHU) by pipistrelle bats shown in Map 28.
- Avoid UK BAP Priority habitat areas and Local Wildlife Sites.
- Control access to sections of riverside to allow undisturbed areas where resting places for otters and artificial nesting banks for kingfishers may be developed.

**Enhancements**

Potential biodiversity enhancements could include:

- Riverbank management for bats, otters and kingfishers, including installation of artificial nest sites and holts.
- Restoration of flood plain grazing marsh.
- Creation of wetland habitats along river corridor including ponds and wet woodland.
- Hedgerow management
- Field management, e.g. grazing regimes, field margins

5.60 The method for calculating the value of habitat loss within the AoS for compensatory habitat creation is set out in Chapter 6.

**Generic Masterplan Requirements**

5.61 This section outlines further principles that are not specific to an Area of Search but should be applied to whichever AoS is selected for the Yeovil Ecotown development. These measures are required to ensure the maintenance of the species' populations and should be a key consideration in designing the Masterplan.

***Road Networks***

5.62 Distributor roads should be avoided, as these are likely to sever areas that have been identified for conservation and/or enhancement of biodiversity within the Ecotown from the wider countryside. Cutting off such biodiversity areas would prevent recruitment and emigration of individuals within populations of species that find roads a barrier to movement, or then suffer mortality as a result of attempts to cross the road.

5.63 Limitations on genetic exchange and response to climate change may have on effect on the population of the species maintained. This isolation can result in a 'sink' where a population is growing but there is not sufficient to support this increase and there is no route out of the area to enable migration (Hanski, 1999). If a distributor road is necessary, either wholly or in part, a series of underpasses and or green bridges should be designed at points that are identified as corridors of movement.

5.64 Preferably a 'green finger' approach should be taken to designing the Masterplan of the preferred AoS in order to avoid habitat isolation. This approach has successfully been used in the Viikki district of Helsinki, Finland. This brings corridors of ecological planting into housing areas from the surrounding countryside. (TCPA, 2004; TCPA, 2009)

***Street and Other Artificial Lighting***

5.65 Street lighting can disturb the diurnal rhythm of species. Many of the species, including otters and bats, identified as occurring within the Yeovil Ecotown study area are sensitive to artificial lighting. Indeed, the introduction of street lighting can have significant effects on their behaviour, cause loss of access to feeding areas and resting areas, and hence affect the viability of populations. (Outen, 2002)

5.66 Bats respond to high light levels as they fly to foraging areas. Slower flying bats such as Myotis species, such as Daubenton's, long-eared and horseshoe bats avoid bright lights. (Outen, 2002) For example, Mathews & Jones (2008) found that the presence of artificial lighting

disrupted the flight activity and foraging ecology of lesser horseshoe bats. They found that the species made no passes in their trial where metal halide light was used. Metal halide (mostly bluish white) is brighter and contains more ultraviolet light than SON (mostly yellow) lighting. Even when SON was used only one pass was recorded. A study by Schofield (2006) (in Mathews & Jones, 2008) reports that a light level over 1 lux disrupts the flight behaviour of lesser horseshoe bats.

5.66 A PhD study (Stone, 2009) carried out at the University of Bristol has shown that lesser horseshoe bats are disrupted from flying along hedgerows by artificial light levels above 0.5 Lux. It was also found that continued disruption increased the effect, i.e. lesser horseshoe bats do not become habituated to the presence of artificial lighting and would therefore permanently disrupt their behaviour.

5.67 Continuous lighting along a road creates barriers, which bats will not cross (Outen, 2002). Low-level bollard lighting alone is enough to prevent lesser horseshoe bats crossing a road in North Wales (Billington, 2005b). Thus streetlights will form a barrier to bats sensitive to artificial lighting moving in the landscape and where introduced can isolate or prevent access to feeding areas.

5.68 Street lamps also have an effect on prey availability (Outen, 2002; pers. comm. Emma Stone, University of Bristol). Whereas they do not sustain insect populations *per se* but attract insects from the surrounding natural environment. Therefore, as a consequence of attracting the insects deplete prey availability for light sensitive bats in surrounding zones. In addition, as pipistrelle bats feed around street lamps on the same insects that lesser horseshoe bats would otherwise feed. (Crucitti & Cavalletti, 2002)

5.69 Moths are reported to be attracted to street lights from 60 to 200 metres away depending on the moth species and may be responsible for dramatic declines in numbers over the past fifty years. Other species of insects are also affected by artificial lighting including Coleoptra (beetles), Hemiptera (bugs), Trichoptera (caddis flies), and Diptera (two winged flies). (Outen, 2002)

5.70 Therefore, the Masterplan should specify that street lighting should be set at 5 metres high and be directional away from sensitive wildlife habitat. LED or low-pressure sodium lamps should be used. (The lamps should not be of the white mercury vapour or high pressure sodium types) In addition, hoods or shields should be fitted to prevent light shining in any direction apart from the highway.

# 6. Next Steps - Evaluation and Assessment

## Introduction

6.1 Biodiversity must be a key theme in Masterplanning an Ecotown (TCPA, 2009). The Masterplan should identify the existing key habitat areas are to be protected, enhanced and expanded as part of the plan.

6.2 This chapter sets out the recommended methodology to be used in assessing the preferred AoS so that there are no the impacts from the Ecotown development as required by policy (ET 16.1 states that '*Eco-towns should demonstrate a net gain in local biodiversity*') and by legislation for populations of European protected species. The methodology takes into account direct habitat loss from construction and indirect loss from the effects of street lighting, disturbance and fragmentation preventing access. The method of assessment includes the development of Habitat Suitability Indices (HSI) for each of species affected by the Ecotown development. Much of this work has been carried out in Somerset for the Hestercombe House SAC Appropriate Assessment and for the Mendip District area.

6.3 The chapter also sets out recommendations for ecological surveys that need to be carried out in order to contribute towards ensuring that all the important ecological features are identified, including those that may be present and as yet have not been recorded, and to inform the assessment process.

6.4 The results of the Habitat Evaluation Procedure, further informed by field survey of the preferred AoS, and mitigation measures, arising from the ecological impact assessment of the site area, will be a critical part of designing the Masterplan for the Ecotown development in order to show that there would be a net gain to biodiversity as a result of the development.

## Assessment Procedure

### *Introduction*

6.5 The assessment procedure requires three phases of development. Initially the study area will need to be mapped in Somerset Environmental Record Centre's Integrated Habitat System, and Habitat Suitability Indices developed for the key species. These will then enable the utilisation of a Habitat Evaluation Procedure in meeting the goals for biodiversity in Ecotown development for Yeovil.

### *Integrated Habitat System GIS Mapping*

6.6 Somerset Environmental Records Centre (SERC) developed the Integrated Habitat System (IHS) in 1999 and is now one of the standard methods for mapping habitat in the UK.

6.7 The IHS represents an integration of existing habitat classifications in use in the UK with particular emphasis on UK Biodiversity Action Plan Broad Habitat Types; UK Biodiversity Action Plan Priority Habitat Types; the National Vegetation Classification; Annex 1 of the Habitats Directive; and Phase 1 systems.

6.8 The Integrated Habitat System classification comprises over 400 habitat categories, the majority drawn from existing classifications, together with descriptions, authorities and correspondences arranged in a logical hierarchy that allow application for different purposes. The classification can be customised for a geographical area or special project use without losing data integrity. http://www.somerc.com/cdrom.php

6.9 In order to carry out the assessment the habitats in the Yeovil study area need to be known, both in order to assess what would be affected or lost in supporting the wildlife species and in order to plan where offset habitat creation can be located.

6.10 The IHS mapping will be derived from aerial photograph interpretation of each of the AoS to the limits of the study area (See Map 1). Each of the map polygons is allocated IHS classifications based on interpretation of habitat in that polygon.

### *Habitat Suitability Indices*

6.11 Use of an HSI in the assessment makes it possible to quantify the areas required for compensatory habitat creation needed to maintain populations. This is carried out through a process known as Habitat Evaluation Procedure.

6.12 Basic assumptions are made in developing a HSI is that habitat influences animal distribution; and HSI models predict habitat suitability not occurrence or abundance (Dijak & Rittenhouse, 2009).

6.13 A decimal system of 0.1 to 1.0 is to be used to index the suitability of habitats for each of the identified species. The most suitable habitat is indexed 1.0. This habitat would provide that species needs in total or provide an integral part of its lifecycle without which it would not be able to maintain its existence. On the other hand if a habitat provides low abundance of food, no shelter and therefore is of poor quality a score of 0.1 can be applied. Habitats not providing any support to the species at all would have a value of 0.

6.14 In constructing the HSI the index scores are to be applied to each habitat and matrix codes in the Integrated Habitat System (IHS) based on analysis of the ecological requirements, from existing literature and professional judgement, of each species mapped. For this study a value is applied only to those IHS habitat and matrix codes present in the Yeovil Ecotown IHS mapping tables. Other habitat codes in the IHS system are ignored.

6.15 IHS matrix, formation, management and codes further describe the type of habitat and therefore can modify the scores applied to the Habitat Code. Scores applied to these codes act as multipliers to the main Habitat Code.

6.16 No allowance is made for seasonal variations, i.e. due to the availability of prey species at different times of year, has been made in developing the HSI. It is considered a habitat valued at 1 at a particular period but not at other times will remain at a value of 1 being necessary to support that species at that time of year when other prey may not be so readily available.

6.17 The HSI mapping produced will show the suitability of habitats across the geographic extent of a study area, in this case the Yeovil Ecotown AoS. In order to meaningfully use the HSI further assessment, such as Habitat Evaluation Procedures (described in following section), further mapping layers will be overlain on to the HSI layer. These mapping layers indicate the extent of landscape use by a species. The likely habitat use from species presence is shown in two mapped zones, Likely Habitat Use (LHU) and Likely Supporting Habitat (LSH), which have been explained in Chapter 3 and further described in Appendix 1.

***Habitat Evaluation Procedure***

6.18 In assessing the impacts of land use change Habitat Evaluation Procedures (HEP) are to be used in order that a quantative impact can be defined. This valuation may be used for the purposes of determining the amount of offset habitat required to maintain a population. (U. S. Fish and Wildlife Service, 1980)

6.19 The U. S. Geological Survey states that HEP is '…*an important tool for land use managers, as they can quantify the effects of alternative management plans over time, and provide for mitigation and compensation that can allow fair use of the land and maintain healthy habitats for affected species*'.[4]

6.20 HEP analysis is structured around the calculation of Habitat Units (HU). The HU is defined as the product of the HSI (quality) and the total area of affected habitat (quantity). The area of habitat for a species would

[4] http://www.fort.usgs.gov/Products/Software/HEP/

include all areas that can be expected to provide support for that species. (U. S. Fish and Wildlife Service, 1980)

6.21 Where a habitat is valued in the HSI at 1.0, 1 hectare will provide 1 hectare of required habitat (Ritcey *et al*, 1998). This counts as 1 HU. Therefore, 10 hectares of a habitat valued at 0.1 would be required to make up 1 HU. There is an assumption that habitat values are related on a linear relationship and that a change from 0.8 to 0.9 is the same as a change from 0.1 to 0.2 (Treweek, 1999).

6.22 Within the HSI mapping table (in MapInfo/ ArcGIS) a separate but linked column is assigned for each species giving a HU value for each parcel of land through multiplying the HSI score by the area in hectares. HUs can be summed up for the area of an LHU giving a value for a species' population. In addition some species, such as bats, which feed on mobile prey, also have a LSH that should also be taken into the assessment.

6.23 The effect on a population from land use change can then be estimated by calculating the revised value of the parcel affected as a percentage of the total LHU (and LSH) by a particular population.

6.24 A significant loss requiring compensatory habitat creation can be calculated by looking at the recorded population of a species from SERC or other data to which the affected LHU (and LSH) and the amount of habitat required to support the population home range of a species colony lost to development.

6.25 To maintain a viable population a minimum area of habitat is required. This should be taken into account when assessing effects on a local population of a species. These areas will be 'generous' given that information about habitat quality may be absent and that land use is dynamic.

6.26 The concept of Minimum Dynamic Area, or MDA (developed by Pickett & Thomson 1978), is defined as '…*the smallest area with a natural disturbance regime, which maintains internal re-colonisation sources and hence minimises extinction*', i.e. the smallest area required for a species or habitat to sustain itself independently without intervention. Each species has its own peculiar requirements so MDAs vary between species. This study makes use of the best data to hand, on the understanding that figures will be reviewed, revised and updated as better information becomes available. (South West Wildlife Trusts, 2005) However, the MDA for most species in the UK is unknown but some area requirements can be estimated either from the literature, or by use of formula used in the South Carolina GAP Analysis (Allen *et al*, 2002).

6.27 This formula to determine MDA (termed 'Minimum Critical Area' in the case of the South Carolina Gap analysis) is as follows:

$$MDA = \frac{[(\text{home range area})\ N_e]}{2}$$

Here 2 accounts for intersexual overlap of socially interactive species, i.e. most mammals. Home range area is in hectares. $N_e$ is either 50 or 500. Fifty is an estimated minimum population size to avoid extinction due to demographic stochasticity, whereas a population of 500 is estimated to avoid loss of genetic heterozygosity resulting from inbreeding and genetic drift. (Allen et al, 2002) The resultant figure would be in hectares but is also equivalent to the HU value for the MDA.

6.28 The HU value for a particular population can be compared to the MDA to aid assessment of viability.

6.29 This HU value can then be used to offset or compensate land lost to land use change to maintain a population. However, the IHS mapping does not include an assessment of habitat quality. In addition, as the data is not comprehensive, 'foreign' values can be applied in developing a HSI, survey information is limited and non validation would require a 'habitat multiplier' or 'compensation ratio' be applied to the resultant HUs lost to development in order to provide robust compensation, i.e. maintain 'favourable conservation status'.

6.30 *'There is wide acknowledgement that ratios should be generally well above 1:1. Thus, compensation ratios of 1:1 or below should only be considered when it is demonstrated that with such an extent, the measures will be 100% effective in reinstating structure and functionality within a short period of time (e.g. without compromising the preservation of the habitats or the populations of key species likely to be affected by the plan or project).'* European Communities, 2007. Due to uncertainty, such as the limited nature of the surveys and errors of omission, it cannot be demonstrated with surety that measures would 100% effective in a short time period. Habitat required as offset habitat creation could need at least ten or more years to mature (not a short time period), e.g. for woodland, and to be functional in terms of prey production, structure and use by the affected species.

6.31 In order to ensure off site offset measures are adequate a habitat multiplier of 2 for 1 is applied to the resultant HUs lost to development. The Environment Bank recommend a two for one ratio where habitats are easily re-creatable contiguous to the development or on similar physical terrain as a minimum (Briggs *et al*, 2008).

**Ecological Survey Scope**

6.32 As part of developing the Ecotown Biodiversity Strategy the developer would have to produce an ecological impact assessment. Surveys will

be required to inform that assessment, further inform the Habitat Evaluation Procedure through confirming and further detailing the IHS survey and provide further information on species presence.

6.33 The following surveys are recommended:

Habitats

6.34 This should use SERC's IHS coding. In addition, sizes and conditions of hedgerows should be recorded. Floristic surveys, including for bryophytes[5], lichens and fungi, should be undertaken where appropriate.

6.35 Transects for fungi should be carried out in the Keyford & Barwick AoS, especially to provide further information on sandy stilt puffball around red House and Waxcap fungus elsewhere. These may need to take place over consecutive years, as the fruiting body may not show. Survey should correspond with the period of maximum fruiting. (Hill *et al*, 2005)

6.36 Hedgerows should also be surveyed as for the Hedgerow Regulations as set out in the Hedgerow Survey Handbook (Bickmore, 2002) and an assessment made of suitability for bats (see Limpens & Kapteyn, 1991)

Otter

6.37 Keyford & Barwick AoS and East Yeovil & Over Compton AoS only. Otters should be surveyed for along the River Yeo and its tributaries identifying potential and actual lying up places or holts. Areas where artificial holts could be installed should also be considered.

Common (Hazel) Dormouse

6.38 The Common or Hazel Dormouse is afforded protection under the Habitats Regulations and is a UK BAP priority species. Although no records exist for any of the AoS it is recommended that surveys be carried out to determine presence. There are records for common dormouse across South Somerset District Council's administrative area from the west of Yeovil to Chard, including just to the west of the Brympton & Coker AoS and again north of this AoS at Lufton.

Bats

6.39 This should use the Bat Conservation Trust's (BCT) survey guidelines (Bat Conservation Trust, 2007) and be carried out throughout the AoS and with a suitable buffer around it, i.e. towards known bat roosts.

6.40 The AoS should be searched for likely bat roosts, including trees and buildings, through a walkover survey. Use of these roosts by bats should then be determined through either inspection or emergence surveys. Tree roost surveys should also follow guidance given by Colebrook & Edmonds (2010).

[5] See Callaghan, 2008.

6.41 Activity surveys should be 2/3 walked transect surveys a month between March and September. Driven transects can also be considered as part of the survey effort considering the large size of the AoS. BCT (2007) recommend 8 surveyors for areas of up to 200 hectares. In addition, automated surveys should be undertaken over the same period and located at strategic points.

6.42 If wind turbines are proposed then further survey effort will be required, especially directed at those species at high risk such as noctule bats. Catherine & Spray (2009) recommend 20 sample points per hectare for a walked manual activity transect at high risk sites. These surveys are to be monthly (dusk or dawn alternating with bimonthly back-to-back dusk and dawn visits). Automated surveys should number 5 Anabat recorders per kilometre, carried out over a three day period and take place once in spring, summer and autumn. In addition, low level Anabat detectors should be placed on the site area near habitat features at the same periods as the higher level recorders according to the presence of such features

Water Vole

6.43 Brympton & Coker AoS only. Surveys should be carried out following guidelines in the Water Vole Conservation Handbook, 2004. These surveys should be carried out on the stream north of the South Somerset District Council offices in Brympton Way as well as on the stream between the A3259 and Brympton D'Evercy.

Badger

6.44 Badgers (*Meles meles*), afforded protection under the Protection of Badgers Act 1992, have been recorded in all of the AoS. Records are at a 1-kilometre resolution and are from between1992 and 1995. Therefore, as the data is out of date and at low-resolution surveys for badger setts and signs will be required. This could take place at any time of year except autumn should be avoided. However, the optimal time is between February and April. Bait marking to establish territories should be carried out in the preferred AoS in order to determine the effects from built development on social groups and resources available. (Hill *et al*, 2006)

Kingfisher

6.45 Keyford & Barwick AoS and East Yeovil & Over Compton AoS only. Kingfisher nesting sites should be surveyed for along the River Yeo and its tributaries identifying potential and actual lying burrows. Areas where artificial nesting sites could be installed should also be considered. Surveys should be undertaken outside the breeding season.

Little Owl

6.46 Particular attention should be made to potential roost sites for little owls in the areas surveyed (see Hardy *et al*, 2009).

Breeding Birds

6.47 Breeding bird surveys should be carried out based on British Trust for Ornithology methodology. http://www.bto.org/birdtrends2004/bbs.htm. A minimum of two visits should be made and breeding birds surveyed along set transects.

Reptiles

6.48 Surveys for reptiles should be established after an assessment of suitability has been undertaken following habitat surveys. Reptile surveys should follow guidelines set out by Gent & Gibson (2003) and be conducted in the active period. April, May and September are key months when temperatures are between 10ºC and 17ºC. Artificial refugia set at 10 metre intervals on a grid are recommended (Hill *et al*, 2006).

6.49 Grass snakes (*Natrix natrix*), afforded protection under the Wildlife and Countryside Act 1981 and a UK BAP species, have been recorded in both the Brympton & Coker AoS and the Keyford & Barwick AoS and to the west of the East Yeovil & Over Compton AoS. Map 29 shows areas where grass snakes are most likely to occur based on SERC records. Home range and dispersal distances are shown (Somerset County Council, 2009)

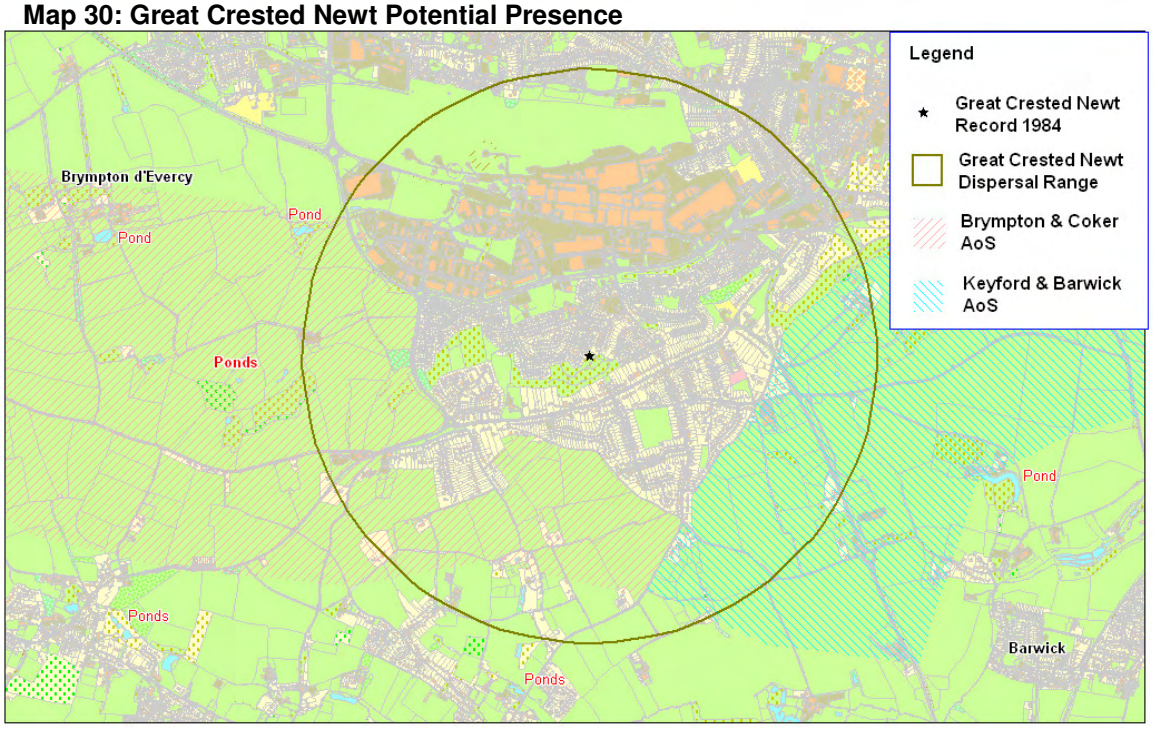
**Map 29: Grass Snake Potential Presence**


Amphibians

6.50 Surveys for amphibians should only be carried out where appropriate habitat exists. Great crested newts (*Triturus cristatus*), afforded protection under the Habitats Regulations, were recorded by Natural England in 1984 at Yew Tree Wood. However, it is unlikely that the species is still extant due to woodland shading out of ponds. Nonetheless the presence of the species should not be discounted in

the study area (see Map 30). An assessment of the suitability of ponds should be made using the Habitat Suitability Index developed for great crested newts by Oldham et al, 2000 and surveys carried out following English Nature (2001) methodology.

**Map 30: Great Crested Newt Potential Presence**




Invertebrates

6.51 Sample transects should be carried out for invertebrates including surveys for butterflies following an assessment of site quality. English Nature (2005) has produced guidelines on when to carry out surveys for invertebrates. Guidelines for sites of up to 50 hectares are for 3 to 7 days of fieldwork per site.

# Bibliography


Aars, J., Lambin, X., Denny, R. & Griffin, A. C. 2001. Water vole in the Scottish uplands: distribution patterns of disturbed and pristine populations ahead and behind American mink invasion front: in *Animal Conservation (2001) 4, 187-194*.

Acts of Parliament. 1981. *Wildlife and Countryside Act 1981* (as amended). London: Her Majesty's Stationary Office.

Acts of Parliament. 2000. *Countryside and Rights of Way Act 2000* (as amended). London: Her Majesty's Stationary Office.

Acts of Parliament. 2006. *Natural Environment and Rural Communities Act 2006.* London: Her Majesty's Stationary Office.

Ahlén, I. 2003. *Wind turbines and bats - a pilot study*. Report to the Swedish National Energy Administration, 11 December 2003

Akmali, V., Sharifi, M. & Farassat, A. n/d. Habitat selection by the Common Pipistrelle, *Pipistrellus pipistrellus* s. l. (Chiroptera: Vespertilionidae), in the Dinevar region of western Iran: in *Zoology in the Middle East*. Kermanshah: Department of Biology, Faculty of Science, Razi University

Allen, C. R., Simpson, K. & Johnson, A. R. 2002. Improving Vertebrate Modelling in Gap Analysis: Incorporating Minimum Viable Populations and Functional Connectivity in Patchy Environments: in *Gap Analysis Bulletin, No.11, 2002, USGS*

Arlettaz, R., Godat, S. & Meyer, H. 2000. Competition for food by expanding pipistrelle bat populations (*Pipistrellus pipistrellus*) might contribute to the decline of lesser horseshoe bats (*Rhinolophus hipposideros*): in *Biological Conservation 93 (2000) 55-60*.

Avery, M.I. 1985. Winter activity of pipistrelle bats: in *Journal of Animal Ecology Vol. 54, No.3 (October, 1985)*

Baerwald, E. F., D'Amours, G. H., Klug, B. J. & Barclay, R. M. R. 2008. Barotrauma is a significant cause of bat fatalities at wind turbines: in *Current Biology, 18, 16, R695-R696, 26 August 2008*

Barataud, M., Faggio, G., Pinasseau, E. & Roué, S. G. 2000. *Protection et restauration des habitatas de chasse du Petit rhinolophe (*Rhinolophus hipposideros*) Année 2000*. Paris: Ministère de l'Environnement – Direction de la Nature et des Paysages.

Bartonička, T. 2002. Habitat use by four bat species in Jablonec n. N. revealed by bat detector: in *Przyroda Sudetów Zachodnich Suplement 2, 2002: 79-87*

Bartonička, T. & Řehák, Z. 2004. Flight activity and habitat use of *Pipistrellus pygmaeus* in a floodplain forest: in *Mammalia, 2004, 68, (4), 365-375*

Bartonička, T. & Zukal, J. 2003. Flight activity and habitat use of four bat species in a small town revealed by bat detectors: in *Folia Zoologica. - 52(2): 155-166 (2003)*

Bat Conservation Trust. 2002. *Agricultural practice and bats: A review of current research literature and management recommendations*. London: Defra.

Bat Conservation Trust. 2005. *A Review and Synthesis of Published Information and Practical Experience on Bat Conservation within a Fragmented Landscape*. Cardiff: The Three Welsh National Parks, Pembrokeshire County Council, Countryside Council for Wales

Bat Conservation Trust. 2007. *Bat Surveys – Good Practice Guidelines.* London: Bat Conservation Trust.

Bat Conservation Trust/Institute of Lighting Engineers. n/d. *Bats and Lighting in the UK.*

Benda, P. & Ivanova, T. 2003. Long-eared Bats, Genus *Plecotus* (Mammalia:Chiroptera), in Bulgaria: a revision of systematic and distributional status: in *Časopis Národního muzea, Řada přírodovědná (J. Nat. Mus., Nat. Hist. Ser.) Vol. 172 (1–4): 157–172, 2003*

Betts, S. 2006. Are British bats at risk from windfarms?: in *British Wildlife, June 2006, 339-345*

Bickmore, C. J. 2002. *Hedgerow Survey Handbook: a standard procedure for local surveys in the UK*. London: Defra.

Billington, G & Norman, G. 1997. *The Conservation of Bats in Bridges Project: A report on the survey and conservation of bat roosts in bridges in Cumbria*.

Billington, G. 2005. *Radio tracking study of lesser horseshoe bats at Hestercombe House Site of Special Scientific Interest, July 2005*. Peterborough: English Nature.

Billington, G. 2005b. *Bats and roads*. Presentation to Somerset Highways, October, 2005.

Bio Regional Development Group and the Commission for Architecture and the Built Environment (CABE). 2008. *What makes an eco-town? A report from BioRegional and CABE inspired by the eco-towns challenge panel*.
http://www.bioregional.com/files/publications/WhatMakesAnEcotown.pdf

Boag, D. 1982. *The Kingfisher*. Poole: Blandford Press

Bontadina, F., Schmied, S.F., Beck, A. & Arlettaz, R. 2008. Changes in prey abundance unlikely to explain the demography of a critically endangered Central European bat: in *Journal of Applied Ecology, 2008, 45, 641–648*

Bontadina, F., Schofield, H. & Naef-Daenzer, B. 2002. Radio-tracking reveals that lesser horseshoe bats (Rhinolophus hipposideros) forage in woodland: in *J. Zool. Lond. (2002) 258, 281-290*.

Boonman, M. 2000. Roost selection by noctule (*Nyctalus noctula*) and Daubenton's bats (*Myotis daubentonii*): in *Journal of Zoology 251 (2000), 385-389*

Boye, Dr. P. & Dietz, M. 2005. *English Nature Research Reports Number 661: Development of good practice guidelines for woodland management for bats*. Peterborough: English Nature.

Brandt, G., Blows, L., Linton, D., Paling, N. & Prescott, C. 2007. Habitat associations of British bat species on lowland farmland within the Upper Thames catchment area; in *Centre for Wildlife Assessment and Conservation E-Journal (2007) 1: 10-19*

Briggs, B., Hill, D. & Gillespie, R. 2008. *Habitat banking – how it could work in the U.K*. http://www.environmentbank.com/docs/Habitat-banking.pdf

Brinkmann, R., Bach, L., Biedermann, M., Dietz, M., Dense, C., Fiedler, W., Fuhrmann, M., Kiefer, A., Limpens, H., Niermann, I., Schorcht, W., Rahmel, U., Reiter, G., Simon, M., Steck, C. & Zahn, A. 2003. *Crossing Points for Bats – limiting damage in habitat fragmentation by transport projects.* Position Paper of the Wildlife Crossing Points Working Party. www.buero-brinkmann.de

Brinkmann, R., Schauer-Weisshahn, H. & Bontadina, F. 2006. *Survey of possible operational impacts on bats by wind facilities in Southern Germany*. Freiburg: Administrative District of Freiburg – Department 56 Conservation and Landscape Management.

Callaghan, D. A. 2008. Neglected Biodiversity: Mosses, Liverworts and Ecological Impact Assessment: in *In Practice, 62, December 2008, 28-31*.

Cathrine, C. & Spray, S. 2009. Bats and Onshore Wind Farms: Site-by-Site Assessment and Post- Construction Monitoring Protocols: in *In Practice 64, June 2009, 14-17.*

Chanin, P. 1988. *The Natural History of Otters.* London: Christopher Helm

Chanin, P. 1993. *Otters*. London: Whittet Books

Chanin, P. 2003. *Ecology of the European Otter* Lutra lutra. Peterborough: English Nature

Cinery, M. 2005. *Complete British Insects*. London: HarperCollins Publishers Ltd.

Clements, A. N. 1955. *The Sources of Energy for Flight in Mosquitoes*. Cambridge: University of Cambridge. http://jeb.biologists.org/cgi/reprint/32/3/547.pdf

Colebrook, J. & Edmonds, B. 2010. A Review of Two Years Following BCT Tree Survey Guidelines: in *In Practice, 67, March 2010, 25-27*

Council for European Communities. 1992. *Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and wild flora and fauna*. Brussels: European Union.

Cresswell Associates. 2004. *Bats in the Landscape Project*. The National Trust, Sherborne Park Estate.

Cryan, P. M. 2008. Mating Behaviour as a Possible Cause of Bat fatalities at Wind Turbines: in *Journal of Wildlife Management 72(3) 845-849, 2008*

Dale, K. & Naylor, R. 2006. *Review of Ecological Impacts of Boating and Associated Activities on Loch Lomond and its Shore*. Aboyne: Northern Ecological Services.

Davidson-Watts, I. & Jones, G. 2006. Differences in foraging behaviour between Pipistrellus pipistrellus (Schreber, 1774) and Pipistrellus pygmaeus (Leach, 1825): in *Journal of Zoology 268 (2006) 55-62*.

Daymond, Dr. J. 2002. *Bats and new farm environment*. Central Science Laboratory.

Department of Communtities and Local Government. 2009. *Planning Policy Statement: eco-towns. A supplement to Planning Policy Statement 1*. London: Department of Communtities and Local Government.

Dietz, C., von Helversen, O. & Nill, D. 2009. *Bats of Britain, Europe and Northwest Africa*. London: A. & C. Black Publishers Ltd.

Dijak, W. D. & Rittenhouse, C. D. 2009. Development and Application of Habitat Suitability Models to Large Landscapes: in Millspaugh, J. J. & Thompson, F. R. 2009. *Models for Planning Wildlife Conservation in Large Landscapes*. London: Academic Press.

Dulieu, R., Merckx, T., Paling, N. & Holloway, G. 2007. Using mark-release-recapture to investigate habitat use in a range of common macro-moth species: in *Centre for Wildlife Assessment & conservation E-Journal (2007) 1: 1-9*

Emery, M. 2008. *Effects of Street Lighting on Bats*. Urbis Lighting Ltd.

Encarnação, J. A., Kierdorf, U., Holweg, D., Jasnoch, U. & Wolters, V. 2005. Sex-related differences in roost-site selection by Daubenton's bats *Myotis daubentonii* during the nursery period: in *Mammal Rev. 2005, Volume 35, No3&4, 285-294*

English Nature. 2001. *Great crested newt mitigation guidelines*. Peterborough: Natural England

English Nature. 2005. *Organising surveys to determine site quality for invertebrates: A framework guide for ecologists*. Peterborough: Natural England.

Entwhistle, A. C., Harris, S., Hutson, A. M., Racey, P. A., Walsh, A., Gibson, S. D., Hepburn, I. & Johnston, J. 2001. *Habitat Management for Bats*. Peterborough: Joint Nature Conservation Committee.

Entwhistle, A. C., Racey, P. A. & Speakman, J. R. 1997. Roost selection by the brown long-eared bat *Plecotus auritus*: in *Journal of Applied Ecology, 34, 399-408*

Eurobats. 2005. Report of the Intersessional Working group on Wind turbines and Bat Populations: *10th Meeting of the Advisory Committee, Bratislava, Slovak Republic, 25-27 April 2005*

European Commission, 2007. *Guidance document on the strict protection of animal species of community interest under the Habitats Directive 92/43/EEC*. (http://circa.europa.eu/Public/irc/env/species_protection/library?l=/commission_guidance/final-completepdf/_EN_1.0_&a=d).

European Communities. 2007. *Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC: Clarification of the concepts of: alternative solutions*, *imperative reasons of overriding public interest*, *compensatory measures*, o*verall coherence, opinion of the commission.* Brussels: Office for Official Publications of the European Communities.

Flavin, D. A., Biggane, S. S., Shiel, C. B., Smiddy, P. & Fairley, J. S. 2001. Analysis of the diet of Daubenton's bat *Myotis daubentonii* in Ireland: in *Acta Theriologica, 46, 1, January 2001, 43-52(10)*

Flegg, J. 2001. *Birds of the British Isles*. Enderby: Silverdale Books

Freeman, B. E. 1964. A Population Study of Tipula Species (Diptera, Tipulidae): in *Journal of Animal Ecology, Vol. 33, No. 1 (Feb., 1964), 129-140*

Garshelis, D. L. 2000. Delusions in Habitat Evaluation: Measuring Use, Selection, and Importance: in Boitam, L. & Fuller, T. K. (eds.) 2000. *Research Techniques in Animal Ecology: Controversies and Consequences*. New York: Columbia University Press.

Gent, T. & Gibson, S. 2003. *Herpetofauna Workers' Manual*. Peterborough: Joint Nature Conservation Committee.

Gontier, M. 2004. Integrating landscape ecology in environmental impact assessment using GIS and ecological modelling: in *Proceedings of the Frontis Workshop From Landscape Research to Landscape Planning: Aspects of Integration, Education and Application Wageningen, The Netherlands 1-6 June 2004*

Gullan, P. J. & Cranston, P. 1994. *The Insects: An Outline in Entomology*. Cheltenham: Stanley Thornes (Publishers) Ltd

Hanski, I. 1999. *Metapopulation Ecology*. Oxford: Oxford University Press.

Hardy, J., Crick, H., Wernham, C., Riley, H., Etheridge, B. & Thompson, D. 2009. *Raptors: A Field Guide for Surveys and Monitoring*. Edinburgh: The Stationary Office.

Hayman, P. & Burton, P. 1976. *The Birdlife of Britain*. London: Michael Beazley Publishers Limited.

Hays, G. C., Speakman, J. R. & Webb, P. I. 1992. Why Do Brown Long-eared Bats (*Plecotus auritus*) Fly in Winter?: in *Physiological Zoology, 65, 554-567*

Her Majesty's Stationary Office. 2010. *Statutory Instrument 2010 No. 490 The Conservation of Habitats and Species Regulations 2010*. London: HMSO.

Hill, D., Fasham, M., Tucker, G., Shewry, M. & Shaw, P. (eds) 2005. *Handbook of Biodiversity Methods: Survey, Evaluation and Monitoring*. Cambridge: Cambridge University Press.

Holden & Cleeves. 2002. *RSPB Handbook of British Birds*. London: Christopher Helm

Holzhaider, J., Kriner, E., Rudolph, B-U. & Zahn, A. 2002. Radio-tracking a Lesser horseshoe bat (*Rhinolophus hipposideros*) in Bavaria: an experiment to locate roosts and foraging sites: in *Myotis, 49, 47-54.*

Hötker, H., Thomsen, K-M. & Jeromin, H. 2006. Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats. Norderstedt: Books on Demand GmbH

Huiting, H. F., Moraal, L.G., Griepink, F.C. & Ester, A. 2006. Biology, control and luring of the cockchafer, Melolontha melolontha: Literature report on biology, life cycle and pest incidence, current control possibilities and pheromones. Wageningen: Alterra - Applied Plant Research (Praktijkonderzoek Plant & Omgeving BV)

Jensen, B. 1997. *Suomen ja Poljolan Nisakkaat*. Porvoo, Werner Soderstrom Osakeyhtio.

Jobin, W. 1999. *Ecological Design and Health Impact of Large Dams, Canals and Irrigation Systems*. London: E & FN Spon.

Joint Nature Conservation Committee. 2007. *The deliberate disturbance of marine European Protected Species: Interim guidance for English and Welsh territorial waters and the UK offshore marine area*. Peterborough: Joint Nature Conservation Committee.

Jones, G., Cooper-Bohannon, R., Barlow, Dr. K. & Parsons, Dr. K. 2009. *Determining the potential ecological impact of wind turbines on bat populations in Britain: Scoping and Method Development Report*. Bristol: University of Bristol/ London: Bat Conservation Trust

Jones, G. & Racey, P. A. 2008. Common and soprano pipistrelle: in Harris, S. & Yalden, D. W. (eds.) 2008. *Mammals of the British Isles: Handbook 4th Edition*. Southampton: The Mammal Society.

Kapfer, G., Rigot, T., Holsbeek, L. & Aron, S. 2008. Roost and hunting site fidelity of female and juvenile Daubenton's bat *Myotis daubentonii* (Kuhl, 1817) (Chiroptera: Vespertilionidae): in *Mammalian Biology - Zeitschrift fur Saugetierkunde, 73, 4, 15 July 2008, 267-275*

Kaňuch, P. 2005. Roosting and population ecology of three synoptic tree-dwelling bat species (*Myotis nattereri, M. daunbentonii and Nyctalus noctula*): in *Biologia, Bratislava, 60/5: 579-587, 2005*

Kaňuch, P., Janeckova, K. & Kristin, A. 2005. Winter diet of noctule bat *Nyctalus noctula: in Folia Zool, - 54 (1-2): 53-60 (2005)*

Kays, R. W. & DeWan, A. A. 2004. Ecological impact of inside/outside house cats around a suburban nature preserve: in *Animal Conservation (2004), 7:3:273-283*

Knight, T. 2007. The use of landscape features and habitats by the Lesser Horseshoe bat. Ph.D thesis. University of Bristol. (presentation at *Horseshoe Bat Conference, Shipham, 2007*)

Knight Ecology. 2008. *Hestercombe House, Taunton, Somerset: Lesser Horseshoe Bat Diet Analysis*. Clutton: Knight Ecology

Liles, G. 2003. *Otter Breeding Sites. Conservation and Management.* Peterborough: English Nature

Limpens, H. J. G. A. & Kapteyn, K. 1991. Bats, their behaviour, and linear landscape elements: in *Myotis 29: 63-71*.

Macdonald, D. W., Mace, G. & Rushton, S. 1998. *Proposals for future monitoring of British mammals*. London: Department of the Environment, Transport and the Regions.

Mackie, I. J. & Racey, P. A. 2007. Habitat use varies with reproductive state in noctule bats (*Nyctalus noctula*): Implications for conservation: in *Biological Conservation 140 (2007) 70 –77*

Matthews, J., Mitchell-Jones, T. & Raynor, R. 2009. *Natural England Technical Information Note TIN059 Bats and single large wind turbines: Joint Agencies interim guidance*. Peterborough: Natural England.

McCafferty, D. J. (n/d): *Ecology and Conservation of Otters* (Lutra lutra) *in Loch Lomond and the Trossachs National Park.* Glasgow: Department of Continuing Education, University of Glasgow

Mitchell-Jones, T. & Carlin, C. 2009. *Natural England Technical Information Note TIN051 Bats and onshore wind turbines: Interim guidance.* Peterborough: Natural England.

Motte, G. & Libois, R. 2002. Conservation of the lesser horseshoe bat (Rhinolophus hipposideros Bechstein, 1800) (Mammalia: Chiroptera) in Belgium. A case study in feeding requirements: in *Belg. J. Zool., 132 (1): 47-52.*

Morrison, M. L., Marcot, B. G. & Mannan, R. W. 2006. *Wildlife-Habitat Relationships: Concepts and Applications (3rd edition)*. Washington D. C.: Island Press.

Natural England. 1999. *IN13 - Veteran Trees: A guide to good management*. http://naturalengland.etraderstores.com/NaturalEnglandShop/IN13

Nicholls, B. & Racey P. A. 2006. Habitat selection as a mechanism of resource portioning in two cryptic bat species *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus*: in *Ecography 29: 697-708, 2006*

Office of the Deputy Prime Minister. 2005. *Planning Policy Statement 9: Biodiversity and Geological Conservation*. London: ODPM.

Office of the Deputy Prime Minister. 2005. *Government Circular 06/2005: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System.* London: ODPM.

Office of the Deputy Prime Minister. 2006. *Planning Policy Statement 9: Biodiversity and Geological Conservation: A Good Practice Guide*. London: ODPM.

Oldham, R.S., Keeble, J., Swan, M. J. S. & Jeffcote, M. 2000. Evaluating the suitability of habitat for the great crested newt (*Triturus cristatus*): in *Herpetological Journal 10 (4), 143-155*

Opdam, P., Steingröver, E., Vos, C. & Prins, D. 2002. *Effective protection of the Annex IV species of the EU-Habitats Directive: The landscape approach*. Wageningen (The Netherlands): Alterra.

Ottino, P. & Giller, P. 2004. Distribution, Density, Diet and Habitat Use of the Otter in Relation to Land Use in the Araglin Valley, Southern Ireland: in *Biology and Environment: Proceedings of the Royal Irish Academy, Vol 104B, No1, 1-17 (2004)*

Outen, A. R. 2002. The ecological effects of road lighting: in Sherwood, B., Cutler D. & Burton J. (eds.) 2002. *Wildlife and Roads: The Ecological Impact*. London: Imperial College Press.

Reiter, G. 2004. The importance of woodland for Rhinolophus hipposideros (Chiroptera, Rhinolophidae) in Austria: in *Mammalia, 2004, 68(4), 403-410*.

Reynolds, A.M., Reynolds, D. R., Smith, A. D., Svensson, G. P. & Löfstadt, C. 2007. Appetitive flight patterns of male *Agrotis segetum* over landscape scales: in *Journal of Theoretical Biology, 245, 1, March 2007, 141-149*

Richardson, P. W., Waters, D. & Waters, R. 2008. Daubenton's bat *Myotis daubentonii*: in Harris, S. & Yalden, D. W. (eds.) 2008. *Mammals of the British Isles: Handbook, 4th Edition*. Southampton: The Mammal Society.

Ritcey, R., Low, D., Harestad, A., Wayne Campbell, R. & Harcombe, A. P. 1988. *Wildlife Habitat Handbooks for the Southern Interior Ecoprovince: Volume 5 Species-Habitat Relationship Models for Mammals.* Victoria, British Columbia: Ministry of Forests Research/ Ministry of Environment.

Robertson, J. 2002. Lesser Horseshoe Bats in a Welsh Valley: in *British Wildlife. 2002. 412-418*

Robinson, M. F. & Stebbings, R. E. 1997. Home range and habitat use by the serotine bat, *Eptesicus serotinus*, in England: in *J. Zool., 243, 1, 117-136, Sep. 1997*.

Rodrigues, L., Bach, L., Dubourg-Savage, M. J., Goodwin, J. & Harbusch, C. 2008. *Guidelines for consideration of bats in wind farm projects, EUROBATS Publication Series No. 3 (English Version).* Bonn: UNEP/EUROBATS.

Roslin, T & Koivunen, A. 2001. Distribution and abundance of dung beetles in fragmented landscapes: in *Oecologia (2001) 127:69–77*

Ruczynski, I. & Bogdanowicz, W. 2008. Summer Roost Selection by Tree-dwelling Bats Nyctalus noctua and N. leisleri: Multiscale Analysis. in *J. Mammal. 89, 4, 942-951. August 2008*

Schober, W. & Grimmberger, E. (trans. Stebbings, Dr. R.) 1989. *A Guide to Bats of Britain and Europe*. London, Hamlyn.

Schofield, H. W. 2008. *The Lesser Horseshoe Bat Conservation Handbook.* Ledbury: The Vincent Wildlife Trust.

Schofield, H., Messenger, J., Birks, J. & Jermyn, D. 2003. *Foraging and Roosting Behaviour of Lesser Horseshoe Bats at Ciliau, Radnor*. Ledbury: The Vincent Wildlife Trust

Scott, J.M. and Schipper, J. 2006. Gap analysis: a spatial tool for conservation planning: in M.J. Groom, G.K. Meffe, C. Ronald Carroll and Contributors. *Principles of Conservation Biology (3rd ed.)*. Sunderland, MA: Sinauer.

Shirley, M. D. F., Armitage, V. L., Barden T. L., Gough, M., Lurz, P. W. W., Oatway, D. A., South, A. B. & Rushton, S. P. 2000. Assessing the impact of a music festival on the emergence behaviour of a breeding colony of Daubenton's bats (*Myotis daubentonii*): in *J. Zool., Lond. (2001) 254, 367-373*

Simon, M., Hüttenbügel, S. & Smit-Viergutz, J. 2004. *Ecology and Conservation of Bats in Villages and Towns*. Bonn: Bundesamt für Naturschutz.

Somerset County Council. 2009. *Somerset Econet*. Taunton: Somerset County Council.

Somerset Ornithological Society, 2004/5. *Somerset Birds 2003/4*.

South Somerset District Council. 2008. *Yeovil Country Park Management Plan. 2008 – 2012*. Yeovil: South Somerset District Council

South West Wildlife Trusts. 2005. *Rebuilding Biodiversity in the South West Technical Manual: A regional approach to landscape-scale planning for habitat restoration*. Bristol: The South West Wildlife Trusts

Stone, E. 2009. The impact of street lighting on lesser horseshoe bats: Unpublished PhD, University of Bristol. *Presented at the South West Bat Conservation Trust Conference, 25 April, 2009*.

Stracham, R. & Moorhouse, T. 2006. *Water Vole Conservation Handbook: Second Edition*. Oxford: Wildlife Conservation Research Unit.

Sutherland, W. J. & Hill, D. A. 2004. *Managing Habitats for Conservation*. Cambridge: Cambridge University Press.

Swift, S. M. 1998. *Long-eared Bats.* London: Poyser Natural History.

Telfer,S., Piertney, S. B., Dallas, J. F., Stewart, W. A., Marshall, F., Gow, J. L & Lambin, X. 2001. Parentage assignment detects frequent and large-scale dispersal in water voles: in *Molecular Ecology, 12, 7, July 2003, 1939-1949*

Town and Country Planning Association. 2004. *Biodiversity By Design*. London: Town and Country Planning Association.

Town and Country Planning Association/ Department of Communities and Local Government/ Natural England. 2009. *Biodiversity positive: eco-towns biodiversity worksheet*. http://www.tcpa.org.uk/data/files/etws_biodiversity.pdf

Treweek, J. 1999. *Ecological Impact Assessment*. Oxford: Blackwell Science Ltd.

Tuzun, I. & Albayrak, I. 2004. The Effect of Disturbance to Habitat Quality on Otter (*Lutra lutra*) Activity in the River Kizilirmak (Turkey): in *Turkish Journal of Zoology 29 (2005) 327-335*

U. S. Fish and Wildlife Service. 1980. *Habitat Evaluation Procedures ESM102*. Washington, D. C.: Department of the Interior

Vaughan, N., Jones, G. & Harris, S. 1997. Habitat use by bats (Chirpotera) assessed by means of a broad-band acoustic method: in *Journal of Applied Ecology 1997, 34, 716-730*

Verboom, B. & Huitema, H. 1997. The importance of linear landscape elements for the pipistrelle *Pipistrellus pipistrellus* and the serotine bat *Eptesicus serotinus*: in *Landscape Ecology vol 12, no 2, 117-125 (1997)*

Wall, C. & Perry, J. N. 1987. Range of action of moth sex-attractant sources: in *Entomologia Experimentalis et Applicata 44, 5– 14*.

Warren, R. D., Waters, D. A., Altringham, J. D. & Bullock, D. J. 2000. The distribution of Daubenton's bats (*Myotis daubentonii*) and pipistrelle bats (*Pipistrellus pipistrellus*) (Vespertilionidae) in relation to small-scale variation in riverine habitat: in *Biological Conservation, Vol. 92, No. 1, 85-91*

Wingfield Gibbons, D., Reid, J. B. & Chapman, R. A. 1993. *The New Atlas of Breeding Birds in Britain and Ireland: 1988-1991*. London: T & A D Poyser

Woodroffe, G. L., Lambin, X. & Strachan, R. 2008. Water Vole: in Harris, S. & Yalden, D. W. (eds.) 2008. *Mammals of the British Isles: Handbook, 4th Edition*. Southampton: The Mammal Society.

Woods, M., Mcdonald, R. A. & Harris, S. 2003. *Domestic Cat Predation on Wildlife.* http://www.mammal.org.uk/index.php?option=com_content&view=article&id=256&Itemid=289

http://www.bats.org.uk/publications_download.php/212/pipistrelles.pdf
http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/commonpipi.htm#Foraging

http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/daubentons.htm#Habitat

# Appendix 1: Species Mapping Methodology

**Introduction**

The HSI mapping described in the Chapter 6 would show the suitability of habitats across the geographic extent of a study area. In order to meaningfully use the HSI further assessment, such as Habitat Evaluation Procedures or GAP analysis (described in following chapters), further GIS mapping layers need to be overlain on to the HSI layer showing species presence. These mapping layers are based on records held by Somerset Environmental Records Centre (SERC) and show the likely occurrence of species across the Yeovil Ecotown AoS, and are known as Species Occurrence Mapping.

These mapping layers indicate the extent of landscape use by a species. The likely habitat use from species presence is shown in two mapped zones, which are explained in the following sections. These are layers for:

- Likely Habitat Use (LHU); and
- Likely Supporting Habitat (LSH).

An Estimated Home Range (EHR) for a species is used as guidance in determining the extent of habitat use extrapolated from a record(s). In the case of some species it is more appropriate to map the Estimated Dispersal Range (EDR).

In addition, resting places, such as known roosting areas for bats, are mapped as Likely Resting Area (LRA)

A further layer is mapped for some species. This is an Inferred Extent (IE)

Descriptions of mapping layers are given below. A detail of how species' EHR, LHU, LSH, EDR, LRA and IE, as appropriate, are mapped is given in Appendix 3.

The requirements for these mapping layers for each species are initially a recorded identified sighting. These records are kept by SERC data, and derived from specialist species groups in Somerset, either independent or associated with the Somerset Wildlife Trust, the Mammal Society, the Environment Agency and similar organisations as well as reports by private individuals. The LHU and EHR mapping layers are based on those that have been developed as part of the Somerset Econet project (Somerset County Council, 2009).

As afore stated, the EHR, LRA and LHU mapping layers are principally based on point records for a species that are held by SERC on their database. In the initial stages of mapping these records are checked to ascertain that they are located correctly. The accuracy of the map reference is considered as there is a tendency for records using a six figure (e.g. ST595 314) classification to

displace to the north east and may be 200 to 300 metres away from the sighting in some cases (Butcher & Coles, 1999). Old records are filtered out, for example those over ten years old but this may vary according to species. Many recordings are dependent on the number and frequency of surveys undertaken by various conservation bodies and ecologists so a generous period is used.

Consideration is also given to data that is of flight only records for bats and birds, whether it is a wintering or breeding record and to the size of the population in determining what is mapped.

The date of the record is considered. Records over a certain age are not included in the mapping. The time period is dependent on the species and the recording effort. Older records can be mapped but distinguished from mapping derived from more recent data. Layers from old records are produced in the same way but mapped separately and distinguished by the suffix 'H', e.g. LHU(H).

In selection for mapping the number of records can also be taken into account. For birds, which can be subject to vagrancy, a minimum of five records may be required, dependent on the species, whereas, terrestrial and other more sedentary flying species only one record is required.

**Likely Resting Area**

The Likely Resting Area (LRA) is a mapped area around a record, which a species is known to occupy for roosting, hibernation or breeding. For single nesting site, such as for birds, the defended area around the nest is mapped. This may included several such places in a buffered distance from the record, e.g. bats will have a number of roost sites within a defined area between which they switch over a period of time. For some species, such as common dormouse, which nest in an area of woodland, no LRA is shown.

The LRA is also distinguished in the mapping to show the type of resting place, e.g. whether it is used as a maternity, hibernation or other type of roost site for bats. Single roosts are buffered.

The location of the record is checked in MapInfo Professional and corrected to the actual location stated in its attached data. In MapInfo, the LRA is created by selecting the target records and in the Buffer Objects dialogue box inserting the value and units from the species data sheet, setting smoothness at 20 segments per circle and the width distance to Cartesian, and selecting one buffer of all objects

Records, which give no indication of population size, are considered for significance and type of LRA. Descriptions of how LRA are derived are given in Appendix 2.

This LRA layer can then overlaid upon the HSI map or used as a stand-alone map to show likely known distribution.

**Estimated Home Range**

The Estimated Home Range (EHR) shows where the species may occur based on researched home or foraging range distances from a roost, nest or resting place. Although at its centre is a record, a species has the potential to be present, if habitat conditions are suitable to support it, anywhere within it.

To map the EHR a buffer for each record of a species' home range is produced, after correcting the record's location as necessary and buffering to produce an LRA. Home ranges and territorial areas were researched for each species from the literature, scientific journals, consultation with specialists and the Internet. The distances used to produce the EHR buffer is given in the species descriptions in Appendix 2. Separate buffers are formed for each record, in order that overlaps can be identified.

The EHR, as formed in MapInfo Professional, is created by selecting the target records and in the Buffer Objects dialogue box inserting the value and units from the species data sheet, setting smoothness at 20 segments per circle, the width distance to Cartesian and selecting one buffer of all objects (although sometimes a buffer of each objective is more appropriate in mapping the LHU).

The EHR is used to determine the maximum extent of the Likely Habitat Use of a species in most cases, although for some species the EHR will define the whole LHU as well.

The size of a recorded population may also be considered in determining the radius of the EHR and assumes that smaller numbers are able to exploit habitat closer to their resting place. This is based on detail in the data accompanying the SERC record. Where no detail is given it is assumed to be a significant population.

**Estimated Dispersal Range**

Instead of EHR some species are mapped with an Estimated Dispersal Range (EDR) The EDR shows where the species may occur based on researched dispersal distances from a recorded LHU. Although at its centre is a record, a species has the potential to be present, if habitat conditions are suitable to support it, anywhere within it. EDR were researched for each species from the literature, scientific journals, consultation with specialists and the Internet.

The EDR is mapped in the same way as EHR. The EDR is used to determine the maximum extent of Inferred Extent.

**Likely Habitat Use**

The Likely Habitat Use (LHU) shows where a species is likely to occur or where there is a near certain presence at least at some point in the year within the EHR. However, a species occurrence within the LHU may be monthly, seasonal or even annually depending on factors such as the availability of food. Some species are known to leave suitable habitat empty and return after spells of several years away (Hanski, 1999)

The LHU is mapped by analysis of suitable habitat contiguous with the record, or where a species is capable of traversing areas not used by it, within the EHR. A LHU often represents a local population, but a LHU may sometimes encompass a portion of a population (*e.g.*, for species characterized by frequent long-distance dispersal) or a group of nearby populations (metapopulation). LHUs are typically separated from each other by barriers to movement or dispersal, or by specific distances defined for each species across either unsuitable habitat or suitable but apparently unoccupied habitat. Because they are defined on the basis of biological information, LHUs may cross administrative boundaries[6].

Note that OS Mastermap does not distinguish linear features, such as hedgerows, separately, which are required by many species for commuting through the landscape to reach foraging areas, hence the necessity for carrying out this procedure. Habitats are analysed by means of aerial photography and other sources within the home range (EHR). The selection of these areas of habitat is based on research into the requirements of each species in the literature, scientific journals, consultation with specialists and the Internet. Where radio-tracking or other data is available this is also used.

The LHU zones of some species, where it is not easy to distinguish habitat or where the species tends to be a generalist, are based on the foraging range for that species and are merely mapped as for the EHR.

LHU are usually formed out from the record by digitising polygons of suitable connected habitat, i.e. habitat that is not fragmented to an extent that a species will not move between two patches, using OS Mastermap (occasionally buffers are used as appropriate). This method of mapping is used because development sites usually come forward in such parcels. If a species is potentially present only along one edge, in a hedgerow for example, the whole field is mapped as development may impact on the boundary either directly or indirectly, such as from the effects of artificial lighting. Although not used the field may also support prey species that directly support the population. Separate LHUs are formed for each record, in order that overlaps can be identified.

[6] www.**natureserve**.org/

Any 'holes' or 'appendages' in the mapping are 'tidied up' for the finished mapping. In using the Habitat Evaluation Procedure, the HSI scores of these will allow proper assessment of these small commissions.

This LHU layer can then overlaid upon the HSI map or used as a stand alone map to show likely known distribution.

### Separation Distance

Separation Distance is not a mapping layer but a guide to digitising a LHU layer. A LHU continues until there is a break in contiguous habitat use. For example some species will not cross gaps in their day to day movements, such as some species of bat are reliant on flight lines formed of habitat features and where a gap occurs, of say 10 or 20 metres, will not continue on its course. Another example is the habitat use of dormice which are arboreal and do not come to ground to cross breaks in hedgerows. This is called Separation Distance[7]. These distances are given under mapping procedures for Species Occurrence in Appendix 2.

### Likely Supporting Habitat

Habitats within the LHU are considered to be accessible to the species mapped. However, in the case of certain species of bats habitats that occur within a certain distances of ‘accessible habitat’ are identified, as prey is also mobile and loss would affect availability to bats. These habitat polygons are selected through use of a buffer from the flight line and are termed in this study as ‘Likely Supporting Habitat’ (LSH).

The LSH layer is not included in the stand alone Species Occurrence Mapping.

Although there may be some temporal and geographical variation it is assumed that the prey supply from habitats is constant. Some species of insect actively forage, which includes searching for suitable patches of habitat. Other movements can be associated with searching for mates. These movements can be directional (non random) or non-directional (random) movements. They result from stimuli such as air currents; solar, lunar or astral (including polarised) light; taste and odour; gravitational; moisture; sound; water currents; or temperature. (Gullan & Cranston, 1994) Loss of prey supporting habitat due to land use change can also act as a ‘sink’ (Hanski, 1999) or reduce the amount of prey dispersing into bat foraging areas.

This LSH layer can then overlaid upon the HSI map.

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7 http://www.natureserve.org/prodServices/pdf/EO_Specs_Separation_Distance_and_Mapping_Guidelines_for_Animals.pdf

**Inferred Extent**

Inferred Extent (IE) is related to Likely Habitat Use (LHU) and is used for some of the species mapped. An IE polygon is a representation of additional habitat surrounding the known occupied habitat (LHU). Conceptually, the inferred extent for an occurrence consists of one or more polygons that represent the area likely encompassed by the occurrence, as inferred from mapped source features (known occupied habitat) and knowledge of the biology of the species.[8] Therefore, the IE includes contiguous habitat or that which can be traversed by the species mapped outside of the limits of the LHU determined by the EHR. For example the LHU of the great crested newt would consist of the pond where recorded plus 250 metres of supporting terrestrial habitat around the site. However, the species is capable of dispersing to neighbouring ponds up to 1300 metres away. The neighbouring pond may not have a record but is otherwise potentially suitable. This pond and the 1300 metres of terrestrial habitat are included as an IE mapped layer.

8 http://www.natureserve.org/prodServices/pdf/EO_Specs_Separation_Distance_and_Mapping_Guidelines_for_Animals.pdf

# Appendix 2: Species Ecological Requirements

**Otter**

*Resting Place*

Otter in Somerset are generally nocturnal and use undisturbed holts and couches in which to rest up. Couches occur in thick vegetative cover. Otter holts are usually tunnels in riverbanks among roots and boulders. Holt sites, used for lying up and breeding areas are located in areas away from human disturbance and can occur up to 50 metres away over dry land (Chanin 1993). Holts are known to occur in urban areas but are likely to be closer to a watercourse than in a rural setting.

Natal holts seem to be located away from main watercourses and from water altogether even being found 500 metres away. Most sites are within 3.5 metres of water although have been recorded 40 metres from a lake edge and 100 metres in a young conifer plantation. Breeding sites are generally located on but not restricted tributary streams (width 0.7 to 4 metres). (Chanin, 2003)

Breeding sites are generally located on but not restricted tributary streams (width 0.7 to 4 metres). Main habitat types for otter breeding sites are: reed beds; ponds and lakes; deciduous woodland (ranging from 20 metre strip to several hectares; young conifer plantations; and extensive areas of scrub. Structures or buildings immediately adjacent to a watercourse may be used occasionally. Mature sycamore and ash trees are important as potential holt sites and holt density is higher in areas dominated by peat. (Liles, 2003)

Otter breeding sites require security from disturbance; one of more potential natal den sites; play areas for cubs; no risk of flooding; and access to good food supply. (Liles, 2003)

In undisturbed areas otters are not fussy where they sleep; in Shetland this is often in open. Couches were often in thick vegetation such as sallow scrub or rhododendrons.

*Food*

In most places the diet of otters is dominated by fish, and the only two other groups of prey that normally form a substantial proportion of the diet (>33%) are crayfish and amphibia (mostly frogs). Otters prefer slowing swimming fish species and, therefore, tend to prey disproportionately on cyprinids and other coarse fish compared to salmonids, and on eels in preference to all other fish. However, there is little unequivocal evidence to support this. (Chanin, 2003) salmonids and eels were the main prey in a study in Ireland and mammals were also occasionally taken (Ottino & Giller, 2004).

*Habitat*

Inland otter populations utilise a range of running and standing freshwaters. Optimal habitat for otters includes stream banks with dense herbaceous vegetation and fringes of trees (e.g. alder) with branches hanging low near the water, lakes, coastlands, rivers and marshes. Otters may be found near fresh water with suitable cover such as rivers, lakes, canals, marshes and occasionally even ditches. Also found in marine areas where shore is rocky and steep rather than shelving or sandy. (Macdonald *et al*, 1998)

Habitat cover is an essential element for otters and its minimum requirements are not yet known (Tuzun & Albayrak, 2004). Lowest numbers of otter signs were recorded where watercourses flowed through conifer plantations.

Another factor that limits otters is river depth. No otter signs were found in the headwater stretches of small tributaries, where water levels are low. In addition otter signs were positively identified with pools. Significant and positive relationships were found between number of otter signs and river depth, river width, lying up availability and the presence of otter holts. (Ottino & Giller, 2004)

These must have an abundant supply of food (normally associated with high water quality), together with suitable habitat, such as vegetated riverbanks, islands, reedbeds and woodland, which are used for foraging, breeding and resting.

*Habitat Use*

Otters are a riverine species hunting in aquatic habitats throughout their territory. They usually follow watercourses, either swimming or running along the bankside, but may commute overland to reach ponds, lakes and other water bodies, or to access other river catchments. (Grogan *et al*, 2001)

Anecdotal evidence suggests that otters are not seriously affected by disturbance from anglers, walkers and dogs. Otters do not appear to avoid houses, industry, roads and campsites The response of otters to the sounds of anglers or walkers with dogs is to move to a position where they can see the source of disturbance, dive and swim underwater, then resurface and rest on the bank before resuming their previous activity a short while later. Although individual otters do not appear to be influenced by short periods of disturbance there is a lack of information on how sustained levels of disturbance influences female otters with young. (McCafferty, n/d)

*Home Range*

A dog otters require about 20 kilometres of lowland river by about 20 metres wide as territory whilst a bitch requires about 11 kilometres (Wayre, 1979). Estimates for area of water occupied of vary between 2 hectares and 50 hectares per otter. This is equivalent to one individual every 3–50 km of stream (median value of one otter per 15 km of stream). (Chanin, 2003)

An otter territory is approximately 15 to 20 kilometres long in Somerset or approximately three riverside parishes (pers. comm. James Williams, Somerset Otter Group).

*Mapping*

The following stages are carried out in mapping:

**Habitat Suitability Index**

1. Evaluate and score IHS codes for otter to produce a HSI for the species

2. Apply HSI scores to IHS map table

3. Produce thematic map from otter HSI column in the IHS map table

**Species Occurrence Mapping**

The following stages are carried out in order to develop a Species Occurrence map:

1. Any identified holt sites are digitised and buffer by 250 metres[9] (LRA)

2. Buffer positive records by 15 kilometres to extent of the records (EHR). (Chanin, 2003) This will adequately cover overlapping ranges and records at edge of range. A view of the records shows that most watercourses in the County are included.

3. Watercourses, and reedbed adjacent to watercourses, are mapped and buffered by 20 metres within the EHR (LHU). (Wayre, 1979).

4. Buffer watercourses by 100 metres and add areas of scrub and woodland within the buffer, extracted and copied from the OS Mastermap layer, which may serve as lying up places, i.e. couches and holt sites (IE). (Chanin 1993)

*Likely Supporting Habitat*

Not applicable.

[9] http://www.snh.org.uk/publications/on-line/wildlife/otters/effects.asp#footnote

**Lesser Horseshoe Bat**

*Resting Place*

Lesser horseshoe bat maternity roosts were originally located in caves but are now commonly found in old country houses with large attic or loft spaces, which are easily accessible. These sites can also be found in farm buildings and derelict/disused cottages and houses or even barns. Lesser horseshoe bat roosts are situated close to woodland or parkland or are linked by linear landscape elements, such as hedgerows to foraging areas.
(Bat Conservation Trust, 2003; Kelleher, 2004; Schofield, 2003)

*Food*

The diet of the lesser horseshoe bat consists mostly of Diptera of the crepuscular sub-order Nematocera. Families of Nematocera Diptera recorded in the diet include Tipulidae (crane-flies), Ceratopogonidae (biting midges), Chironomidae (non-biting midges), Culicidae (mosquitoes), and Anisopodidae (window midges). Lepidoptera (moths), Trichoptera (caddis-flies) and Neuroptera (lacewings) are also eaten. (Vaughan, 1997; Boye & Dietz, 2005) Due to their small body size they cannot cope with large prey, such as cockchafers. By comparison they eat smaller moth species than the greater horseshoe bat *Rhinolophus ferrumequinum* (Boye & Dietz, 2005)

*Habitat*

'*The primary foraging habitat for lesser horseshoe bats is broadleaf woodland where they often hunt high in the canopy. However, they will also forage along hedgerows, tree-lines and well-wooded riverbanks*.' (Schofield, 2008)

Lesser horseshoe bats are primarily a woodland feeding bat using deciduous woodland or mixed coniferous woodland and hedgerows. It has been found that habitats that were most important contained a high proportion of woodland, parkland and grazed pasture woodland, combined with linear features, such as overgrown hedgerows. Woodland with watercourses has more importance. Broadleaved woodland predominated over other types of woodland and was shown to be a key habitat for the species. In the core foraging areas used by bats woodland accounted for 58.7 ± 5.2% of the habitats present. (Barataud *et al*, 2000; Bontadina *et al*, 2002)

Knight (2007) showed that broadleaved woodland was used most by lesser horseshoe bats where tree cover was 75% – 90% of the core feeding area. In addition, pasture was used where there was 25% tree cover.

Occasionally bat activity is concentrated in fields containing cattle where bats forage directly over cattle. However, the same lesser horseshoe bats forage little, if at all, over the same pasture immediately after the cattle are removed (Cresswell Associates, 2004).

*Habitat Use*

Lesser horseshoe bats are susceptible to loss of linear features, such as mature hedgerows, which act as commuting routes between roost sites and foraging areas and indeed to other roost sites. Lesser horseshoe bats avoid crossing open areas; they will cross open areas at the narrowest point; they will cross roads where the tops of trees touch but in the open do so by flying very close to the ground (approx. 1 metre). Gaps of a little as 10 metres could prevent movement along a flight line. (Schofield *et al*, 2002; Brinkmann *et al*, 2003). At Ciliau SSSI lesser horseshoe bats only crossed the River Wye when fully dark (Schofield et al, 2002). Lesser horseshoe bats have been observed crossing roads where the tops of trees have touched (Brinkmann *et al*, 2003). Hedgerows below 2 metres high and certainly below 1 metre high would be avoided (Limpens & Kapteyn, 1991).

A study of lesser horseshoe bats crossing a 5 metre gap showed that they would only start flying across when light levels dropped to 21.0 Lux flying at 1 metre above ground level. After 4.0 Lux they start flying slightly higher and at 1 Lux would fly at 4 metres above ground level. This has implications for the structure of vegetation in the landscape as well as that close to roosts. (Schofield, 2008)

Lesser horseshoe bats are averse to streetlights. Low-level bollard lighting alone is enough to prevent lesser horseshoe bats crossing a road in North Wales (Billington, 2005). Mathews & Jones (2008) found that the presence of artificial lighting disrupted the flight activity and foraging ecology of lesser horseshoe bats. A PhD study (Stone, 2009) carried out at the University of Bristol has shown that lesser horseshoe bats are disrupted from flying along hedgerows by artificial light levels above 0.5 Lux. It was also found that continued disruption increased the effect, i.e. lesser horseshoe bats do not become habituated to the presence of artificial lighting and would therefore permanently disrupt their behaviour.

Additional pressure on prey availability to lesser horseshoe bats may arise from the presence of pipistrelle bats (*Pipistrellus* spp.), which hunt the same range of prey and will also hawk around streetlights. Therefore, urban development is likely to favour pipistrelle bat populations over that of lesser horseshoe bats. (Arlettaz *et al*, 2000; Bontadina *et al*, 2008)

*Home Range*

At Hestercombe House individual lesser horseshoe bats were recorded in late July/early August travelling distances of 5 and 6 kilometres to feeding areas (Billington, 2005). Bontadina *et al* (2002) considered that a large colony size increases the foraging range of individuals, and conversely that the average foraging distance in smaller colonies might be even smaller. In the Bontadina *et al* study (2002) a colony of 300 bats had a maximum foraging range of 4.2 kilometres whereas at Hestercombe there is a maximum foraging range of 6 kilometres for a colony of c.150 bats. Individual home ranges of females from maternity colonies are between 12 and 53 hectares in area (Boye & Dietz, 2005)

The lesser horseshoe bats also feed throughout the winter, depending on temperature (Williams 2001: in Bat Conservation Trust/BMT Cordah, 2005). In England radio-tracking of bats revealed that they foraged on average to a maximum distance of 1.2 kilometers from the hibernation site. One bat traveled to an absolute maximum distance of 2.1 kilometers. The winter foraging range appears to be approximately half the area covered in the summer months. (Bat Conservation Trust/BMT Cordah, 2005)

*Mapping*

The basic requirement for a population of lesser horseshoe bats is a maternity roost site. Without such a roost site habitat cannot be exploited even though it suitable. Note OS Mastermap does not produced distinct hedgerow polygons. Therefore, current accessibility of habitat is not possible using the IHS part of the assessment. Therefore, further interpretation is needed for evaluation or assessment purposes.

**Habitat Suitability Index**

The following stages are carried out in order to develop a HSI map:

1. Evaluate and score IHS codes for lesser horseshoe bats to produce a HSI for the species

2. Apply HSI scores to IHS map table

3. Produce thematic map from lesser horseshoe bat HSI column in the IHS map table

**Species Occurrence Mapping**

The following stages are carried out in order to develop a Species Occurrence map:

1. Add roost sites to HSI map, distinguishing maternity, hibernation and other roosts and buffer by 200 metres (LRA). In-flight records are not mapped but can be used for GAP analysis.

2. Buffer known maternity roost sites by 4 kilometres (EHR)

3. Buffer other roost sites by 2 kilometres (EHR) [2.1 kilometres - Bat Conservation Trust/BMT Cordah, 2005]

4. Produce mapping from likely habitat use through consideration of flight lines from the roost sites through aerial photographic interpretation. This will in effect distinguish habitat that is currently available to the species. (LHU)

5. To produce the LSH buffer the LHU by 200 metres to include prey producing habitat. Mastermap polygons included in the buffer but not

adjacent to flight lines are modified by multiplying the HSI score by 0.5 (LSH).

*Likely Supporting Habitat*

The LSH for lesser horseshoes bats is calculated as follows. The principle prey species for lesser horseshoe bats, using data collected at Hestercombe house, are from the Diptera and Lepidoptera families (Knight Ecology, 2008). Male Lepidoptera are known to be attracted to female pheromones from about 200 metres (*Cydia nigricana*) (Wall & Perry, 1987) and up to 500 metres for *Agrotis segetum* (Reynolds *et al*, 2007). Tipula, another main element of lesser horseshoe bat diet, have populations separated by distances of 250 metres according to Freeman (1964), who states that little interchange takes place within that distance. Mosquitos (8% of the diet) are capable of travelling 2.5 kilometres or more from water in search of prey but most remain within a 1.6 kilometres of the breeding site (Clements, 1955; Jobin, 1999).

The buffered distance is 200 metres, which is based on the flight distance of insect prey.

**Daubenton's Bat**

*Resting Place*

The roosts of Daubenton's bats are generally within between 2 to 300 metres of water although mature trees up to 2 kilometres away can be used. Within woodland, more than 40% of roost sites are located within 30 metres of the wood edge. (Boye & Dietz, 2005)

During the summer the majority of Daubenton's bat roost sites are in humid, more or less underground sites near water. These sites may be crevices in tunnels or underneath bridges over water or in caves, mines or cellars. They are occasionally found in buildings, mostly old stone buildings such as waterworks and castles with moats. Other principal roost sites for Daubenton's bats are holes in trees. Preferred tree roosts are woodpecker holes, which have been enlarged by rotting. These occur in beech (*Fagus sylvestris*), oak (*Quercus robur*), hornbeam (*Carpinus betulus*) or ash (*Fraxinus excelsior*) trees with a trunk diameter of at least 30 centimetres. They will also use fissures in stems, wood crevices, hollow branches and bat or bird boxes. Summer roost sites may be changed frequently. (Boye & Dietz, 2005)

Daubenton's bats were found to occupy a limited number of trees located in a specific and small roosting area. This roost aggregation was not linked to the distribution of hollow trees. The study indicated that they are highly faithful to their roosting area. (Kapfer *et al*, 2008)

Another study showed that Daubenton's bats regularly change nursery roosts, with up to 40 tree holes being employed during the year, which are distributed up to 2.6 kilometres from each other within an area of 5.3 $km^2$ (Dietz *et al*, 2009).

Male roosts are frequently found in the cracks in bridges, tree holes or around tunnels. Male bats can roost in 'bachelor' groups of up to 200 individuals (Dietz *et al*, 2009)

Night roosts in trees and tunnels are used regularly, especially during periods of rainfall and low temperatures (Richardson *et al*, 2008).

*Food*

The diet of Daubenton's bats mainly consists of aquatic Diptera. Aquatic pupae are taken from the water surface and male Chironomidae can be caught as they swarm above the water surface waiting for females to emerge (http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/daubentons.htm #Habitat).

In Ireland the diet of Daubenton's bat was investigated by analysis of faeces collected in summer at 7 roosts, all close to rivers in pastoral land, in three widely-separated districts. Forty-seven categories of arthropod prey were

identified; several were insect taxa found in and around water. Most categories were recovered at most roosts, but mainly in small amounts. The main categories were the same throughout, accounting for 82% of the diet by percentage frequency in droppings for pooled data: Chironomidae/ Ceratopogonidae (midges) 24%, other nematoceran Diptera (e.g. gnats) 21%, other Diptera 10%, and Trichoptera (caddis flies) 26%. A quarter of the prey had evidently been obtained from the water's surface (eg aquatic insects, their larvae and pupae). Although consumption of several food items varied significantly by month at one or more roosts, little of such variation was consistent between roosts. (Flavin *et al*, 2001)

The preferred size of prey is approximately 7.2mm. Non biting midges consist of the majority of food eaten by Daubenton's bats but other sources include other Diptera (mosquitoes, craneflies), aphids, mayflies, lacewings and Hymenoptera, moths and caddis flies are seasonally captured. (Dietz *et al*, 2009)

*Habitat*

Daubenton's bats are a riverine species feeding off invertebrates close to the water's surface. They also hunt in woodland, parks and orchards (Dietz *et al*, 2009). Sometimes, mainly in springtime, they also forage away from water, e.g. at a woodland clearing. On windy nights where prey abundance over water is reduced they forage in woodland instead. In Finland females hunt in mixed forests early in the year and move into open habitats above water in summer and autumn (Vaughan *et al*, 1997).

*Habitat Use*

They always use flyways and never cross open ground. Hedgerows, overgrown bankside vegetation and linear watercourses are used to move between roosts and feeding areas. (Richardson *et al*, 2008) In Holland, Helmer (1983) found that Daubenton's bats used regular flyways of lanes, wood edges, hedgerows and watercourses. A fringe of reeds will suffice as cover when commuting.

*Home Range*

Daubenton's bats forage almost exclusively over water within 3 kilometres of roost, but may travel up to 15 kilometres to forage. Ninety percent of breeding females have home ranges within a radius of 4 kilometres around the roost. Core areas within home ranges are dependent on the size of the water bodies (Boye& Dietz, 2005). A study in Germany (Encarnaçäo *et al*, 2005) radio tracked Daubenton's bats to foraging between 620 metres and 7587 metres from the roost (mean 3633 metres).

Another study found that female Daubenton's bats range up to 6 to 10 kilometres from the roost. Each bat had 2 to 8 separate hunting grounds of between 0.1ha and 7.5 ha each. (Dietz *et al*, 2009) Aggressive behaviour is demonstrated by Daubenton's bats defending these feeding patches,

although many arrive in the same area together, they then forage singly or in pairs (Richardson *et al*, 2008).

On a study of foraging fidelity of female and juvenile Daubeton's bats all 11 ponds in the study area were exploited. However, monitored individuals were limited to two ponds to which they showed high fidelity. These two ponds were not the closest to the roosting area. Overall, these results show that for the duration of the experiment, female and juvenile Daubenton's bats are highly faithful to specific hunting grounds. (Kapfer *et al*, 2008)

The minimum pond area used by Daubenton's bats is 0.5ha (Jensen, 1997). A study by Boonman *et al* in 1998 found that Daubenton's bats avoided foraging over ponds covered with duckweed. This behaviour was unrelated to prey abundance and experimental evidence suggests that bats are less able to catch prey where there is duckweed cover. (http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/daubentons.htm #Habitat)

Daubenton's bats may emerge to feed in winter (Richardson *et al*, 2008).

*Mapping*

The basic requirement for a population of Daubenton's bat is a maternity roost site. Without such a roost site habitat cannot be exploited even though it suitable. Note OS Mastermap does not produced distinct hedgerow polygons. Therefore, current accessibility of habitat is not possible using the IHS part of the assessment. Therefore, further interpretation is needed for evaluation or assessment purposes.

**Habitat Suitability Index**

The following stages are carried out in order to develop a HSI map:

1. Evaluate and score IHS codes for Daubenton's bats to produce a HSI for the species
2. Apply HSI scores to IHS map table
3. Produce thematic map from Daubenton's HSI column in the IHS map table

**Species Occurrence Mapping**

The following stages are carried out in order to develop a Species Occurrence map:

1. Add roost sites to HSI map, distinguishing maternity, hibernation and other roosts and buffer by 200 metres if a roost site located in a building or structure. Woodland roost sites should be digitised to the extent of the habitat and included other linked woodland within 2.6 kilometres [Dietz et al, 2009] (LRA)

2. Buffer known roost sites by 4 kilometres or by 6 kilometres for 'in flight' records where no roost is recorded (EHR). [Boye & Dietz, 2005] As the species is active in the winter period buffer hibernation roost sites by 2 kilometres (EHR)

3. Buffer watercourse either side of roost site by 300 metres and exclude habitat outside the buffer (Boye & Dietz, 2005)

4. Produce mapping of likely habitat use through consideration of flight lines from water habitat to woodland within the 300metres buffer through aerial photographic interpretation. Similarly produce mapping from likely habitat use through consideration of flight lines from the hibernation roost sites within the EHR. This will in effect distinguish habitat that is currently available to the species. (LHU)

*Likely Supporting Habitat*

Daubenton's bats feed at the source of most prey species they consume, i.e. over water and seasonally within woodland. Therefore, it is not considered appropriate that a LSH is applied to this species.

**Noctule Bat**

*Resting Place*

Noctule bats prefer to roost near woodland edges. It seems that they are very selective about their tree hole roosts, preferring large uncluttered woodpecker holes, indicating dependence on woodpeckers, high up in trees in less dense areas of woodland close to the woodland edge. (Boonman, 2000) Oak trees are preferred and hornbeam and alder avoided (Ruczynski & Bogdanowicz, 2008). In another study in park woodland noctule bats were found to prefer the tallest and largest trees in the park, in this case ash and white poplar (Kaňuch, 2005). Noctule bats shift roost sites every two or three days within an area of 200 hectares (Dietz *et al*, 2009).

*Habitat*

Noctule bats regularly visit areas with high insect density but often there are no well defined hunting grounds, and they seem to roam freely (Dietz *et al*, 2009) They are found over water early evening, in urban areas around streetlights and along woodland edges. It forages above meadows, lakes, refuse tips and above treetops. Noctule bat activity is high near lakes and over improved cattle pasture and low in woodlands. Villages do not support high levels of activity. Mackie & Racey, (2007) found that noctule bats at Horner Woods preferred foraging above woodland, then pasture, followed by other habitats, arable and finally moorland.

*Habitat Use*

The noctule bat flies to its foraging areas from its roost site fast and in straight lines at 10 to 50 metres above ground level, up to 100s of metres high (Dietz at al, 2009). This behaviour makes it vulnerable to collision with wind turbines if placed along commuting flight paths or in feeding areas

Noctule bats are known to actively hunt in the winter (Kanuch *et al*, 2005).

*Home Range*

The foraging range of the noctule bat can be as much as 26 kilometres from its roost site. A study of noctule bats roosting at Horner Wood in Somerset found that bats foraged a maximum of 6.3 kilometres away from the roost although one bat flew in a straight line for 23.5 kilometres (mean distance travelled was 4.23 kilometres). There is no overlap between neighbouring colonies and home range may be defined by proximity (Mackie & Racey, 2007)

*Longevity*

Noctule bats are also relatively short lived, compared to other species of bat, with an average lifespan of 2.2 years after reaching the first year. The

required birth rate to maintain a population is 1.5 to 1.6 births per year. The observed birth rate for the species in central Europe is 1.4 to 1.5 births per year. (Dietz *et al*, 2009) Therefore, it is considered that even small increases in mortality rates can have significant effects on noctule bat populations.

*Mapping*

**Habitat Suitability Index**
The following stages are carried out in mapping for this study:

1. Evaluate and score IHS codes for noctule bats to produce HSI
2. Apply HSI scores to IHS map table
3. Produce thematic map from noctule HSI column in the IHS map table

**Species Occurrence Mapping**
The following stages are carried out in order to develop a Species Occurrence map:

1. Add roost sites to HSI map, distinguishing maternity, hibernation and other roosts. Buffer maternity roosts sites by 800 metres to allow for roost switching behaviour (Dietz *et al*, 2009)
2. In addition, potential roost sites are identified are woodlands with greater spotted or green woodpecker records if within 2.5 kilometres of a flight record (Boonman, 2000; Dietz *et al*, 2009). The woodland is digitised.
3. Buffer maternity roost sites by foraging range of 6.3 kilometres (EHR and LHU are considered to be synonymous) [Mackie & Racey, 2007]
4. Buffer other roosts by 2.5 kilometres (EHR) (EHR and LHU are considered to be synonymous) [Dietz *et al*, 2009]
5. In-flight records outside of EHR/ LHU are also buffered by 2.5 kilometres (LHU) [Dietz *et al*, 2009]

*Likely Supporting Habitat*

LSH is not mapped for noctule bats, as the species is not restricted to the use of fly lights in accessing feeding habitat.

**Pipistrelle Bats**

There are two species of pipistrelle bat recorded as being present and breeding in Somerset. These are the common pipistrelle (*Pipistrellus pipistrellus*) and the soprano pipistrelle (*Pipistrellus pygmaeus*).

*Resting Place*

Pipistrelle bats congregate in summer in maternity colonies of between 20 to 1000 individuals. The principal roost sites used by maternity colonies of pipistrelle bats of both species are buildings, varying from modern buildings to churches. Due to the mobility of colonies a large number of suitable roosts are necessary to maintain each social group. Males roost singly or in small groups in trees or buildings. Maternity roosts more common where there are nearby tall trees or have linear features leading to woodland or a river within 500 metres of the roost. Soprano pipistrelle roosts are likely to have water or habitat associated with water within 2 kilometres of the roost. (Bat Conservation Trust/BMT Cordah, 2005).

Pipistrelle roosts mainly occur in settlements and are even present in city centres. Summer roosts are predominately crevices in buildings, especially between tiles and the underlying roofing or behind boards on the gable. (Boye & Dietz, 2005)

Pipistrelle bats exhibit roost switching behaviour at maternity roosts during pregnancy, whilst lactating and post lactating. In Germany the distances between the roost sites varied between 144.8 and 158 metres apart. Due to the mobility of colonies a large number of suitable roosts are necessary to maintain each social group (Simon *et al*, 2004).

*Food*

Both the common pipistrelle and the soprano pipistrelle prey mainly on Diptera: Nematocera (crane flies, mosquitoes), and both had a similar dietary range. The common pipistrelle mainly feeds on insects in the families Psychodidae, Anisopodidae and Muscidae whilst the soprano pipistrelle mainly feeds on the families Chironomidae and Ceratopogonidae. (http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/commonpipi.htm )

*Habitat*

The soprano pipistrelle feeds almost exclusively over habitats associated with water where as the common pipistrelle has a much wider range of habitats including lakes, rivers, woodland and cattle pasture (Davidson-Watts. & Jones. 2006; Bat Conservation Trust/BMT Cordah, 2005). Woodland edge and large hedgerows are also used by soprano pipstrelles (Brandt *et al*, 2007)

Radio tracking carried out in north east Scotland showed that there was resource partitioning between the two pipistrelle species with common

pipistrelle bats using woodland edges and isolated tree lines for foraging and soprano pipistrelle bats foraging predominantly in riparian woodland and over water (Nicholls & Racey, 2006).

Pipistrelles of both species prefer smooth water with trees both sides. They avoid rapid water with no trees, and rapid water with trees on one side. There is a 55% reduction in activity downstream of effluent. Riparian habitats in upland areas are potentially important. (Warren *et al*, 1999)

The common pipistrelle hunts on the edges of woodland, in deciduous woodland, mixed deciduous/ coniferous woods, along hedgerows, in orchards, and also over open country, pastures and fields (Simon *et al*, 2004). In Scotland activity was only limited by the distribution of linear landscape elements (Jones & Racey, 2008). They tend to avoid very open habitat such as moorland and grassland where linear features are comparatively rare. (http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/commonpipi.htm )

In the Dinevar region of Kermanshah Province, western Iran common pipistrelle bats foraged predominantly in a different range of aquatic habitat although other terrestrial habitats are also used regularly. From 699 *P. pipistrellus* s. l. passes, 25% were made above riparian vegetation, 24% in marshland, 23% above water meadows, 14% in fields, and 13% in conifer plantations. (Akmali *et al*, n/d)

Soprano pipistrelle bats prefer foraging in wetland habitats and have a larger proportion of wetland within 2 kilometres of its maternity roosts than common pipistrelles (Boye & Dietz, 2005). In Moravia it was found that there was no seasonal variation in habitat use except over large bodies of water when peak activity was recorded in the springtime. Soprano pipistrelle bats foraged elsewhere in forests, over forest paths, at edges and over meadows. Flight activity over meadows was low throughout the study season. They preferred semi-close habitats and did not forage over open (meadows, clearings) or in close habitats (dense forest stands). (Bartonička & Řehák, 2004)

Streetlights also attract pipistrelle bats where they feed on the insects attracted by the light (Bat Conservation Trust/Institute of Lighting Engineers. n/d). However, they still require darkened commuting routes.

*Habitat Use*

Pipistrelle bats have been found to avoid mechanically cut hedgerows (Brandt *et al*, 2007). Hedgerows below 2 metres high and certainly below 1 metre high would be avoided (Limpens & Kapteyn, 1991). A study of pipistrelle bats around two colonies revealed that they moved between fixed foraging sites on regular flight routes. Pipistrelle bats are confined to linear elements, and infrequently cross open areas but will cross open areas of 100 –150 metres wide (up to 200 metres observed). (Verboom & Huitema, 1997) At Lahn in Germany most pipistrelle bats (66%) from a maternity roost were recorded

flying straight across open land from the urban area to foraging sites over a distance of 375 metres (Simon *et al*, 2004).

There is no significant difference in home range between the two species. The foraging activity of common pipistrelle bats is in small areas within about 2 kilometres of the roost. Individual home range is dependant on abundance of insects and may have a total size of more than 50 hectares. (Boye & Dietz, 2005)

Pipistrelle bats leave hibernation roosts to feed in all winter months on warm and calm nights (Avery, 1985)

*Home Range*

Common pipistrelle bats travel short distances (up to 1.5 kilometres on average) to foraging sites but uses a greater number of sites for foraging than sopranos, which travel greater distances (up to 1.75 kilometres) to fewer sites (Bat Conservation Trust/BMT Cordah, 2005).

In Scotland had a maximum distance between roost and foraging sites of 2.5 kilometres and 5.1 kilometres (average between 1.0 kilometres and 1.8 kilometres) in the breeding season and 2.5 kilometres and 3.7 kilometres (average 1.0 kilometres and 1.8 kilometres) in the lactation period. In Hesse pipistrelle bats were measured as foraging at less than 2 kilometres and found the shortest distances were between 50 metres and 300 metres. (Simon *et al*, 2004)

*Mapping*

The basic requirement for a population of pipistrelle bats is a maternity roost site. Without such a roost site habitat cannot be exploited even though it suitable. Note OS Mastermap does not produced distinct hedgerow polygons. Therefore, current accessibility of habitat is not possible using the IHS part of the assessment. Therefore, further interpretation is needed for evaluation or assessment purposes.

**Habitat Suitability Index**

The following stages are carried out in order to develop a HSI map:

1. Evaluate and score IHS codes for pipistrelle bats to produce HSI
2. Apply HSI scores to IHS map table
3. Produce thematic map from pipistrelle HSI column in the IHS map table
4. Add roost sites to HSI map, distinguishing maternity, hibernation and other roosts

**Species Occurrence Mapping**
The following stages are carried out in order to develop a Species Occurrence map:

1. Add roost sites to HSI map, distinguishing maternity, hibernation and other roosts. Buffer known maternity roost sites by 306 kilometres to allow for roost switching behaviour (LRA)

2. Buffer LRA by foraging range of 2 kilometres (EHR) [Simon et al, 2004; Boye & Dietz, 2005] In-flight records are not mapped but can be used for GAP analysis.

3. Buffer hibernation and other roosts by 1 kilometre (it is assumed that winter foraging range is half that of summer ranges as was estimated for lesser horseshoe bats (EHR) [Bat Conservation Trust/BMT Cordah, 2005])

4. Produce mapping from likely habitat use through consideration of flight lines from the roost sites through aerial photographic interpretation. This will in effect distinguish habitat that is currently available to the species. However, note that pipistrelle bats have been recorded crossing open spaces of 200 metres in the Netherlands (Verboom & Huitema, 1997). (LHU)

5. Buffer the LHU by 200 metres to include prey producing habitat. Mastermap polygons included in the buffer but not adjacent to flight lines are modified by multiplying the HSI score by 0.5 (LSH).

*Likely Supporting Habitat*

The LSH for pipistrelle bats is calculated as follows. The diet of common and soprano pipistrelle bats mainly consists of Diptera, particularly Chironomidae. Diurnal Diptera are also eaten. Midges, caddis flies, mosquitoes, mayflies, lacewings, and small moths are the main food of pipistrelle bats
http://www.bats.org.uk/publications_download.php/212/pipistrelles.pdf
Aquatic insects are an important part of the common pipistrelle bat's diet and so they often forage near fresh water habitats.
http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/commonpipi.htm#Foraging

The diet of pipistrelle bats is broadly similar to that of lesser horseshoe bats (Arlettaz *et al*, 2000; Bontadina *et al*, 2008) and therefore the buffered distance is likewise 200 metres.

**Serotine Bat**

*Resting Place*

Serotine bats are well adapted to man-made roosting sites, so much so that it is now only rarely found in natural sites. In summer they roost in buildings that have high gables and cavity walls, they are thought to typically remain in the same building to hibernate during winter. Some hibernating serotine bats have been found in caves, but this is rare

A serotine bat colony uses at least 10 different roosts and exhibits roost switching behaviour. In Germany the distances between these roosts was between 110 metres and 260 metres. (Simon *et al*, 2004)

*Habitat*

Serotine bats occur mainly in lowland areas, where there are human settlements. In 37 passes 19 were recorded on river or lake shores, 12 in grassland (of which 7 were improved cattle pasture), 4 in arable land, 1 in a village and 1 in ancient semi-natural woodland (Vaughan *et al*, 1997). Serotine bats feed over grassland especially cattle pasture; over rivers and lakes; and around white streetlights. Robinson & Stebbings (1993) investigated the diet of the serotine and found that in 96.1% of the faeces they examined Coleoptera were present and in 14.7% Lepidoptera were present. The beetle species found were from habitats such as hay meadows or grazed pasture indicating that this population of serotine bats foraged mainly over these habitat types. In most cases serotine bat foraging areas are open fields with some woods on the edge.

*Habitat Use*

Serotine bats fly at about tree-top height (to about 10 m) often close to vegetation, and will sometimes flop, wings outstretched, onto the foliage to catch large insects. The serotine will even catch prey from the ground. Serotine bats feed over grassland especially cattle pasture; over rivers and lakes; and around white streetlights. In most cases foraging areas are open fields with some woods on the edge. In agricultural landscapes they prefer pasture with tree rows for protection from winds. (Boye & Dietz, 2005; Entwhistle *et al*, 2001; http://www.bio.bris.ac.uk/research/bats/britishbats/batpages/serotine.htm#Roost)

Sertoine bats usually commute along linear structures such as lines of trees, hedges, waterways and roads; and over pastures (Dietz et la, 2009). Activity in open areas is negatively related to the distance to a landscape element. There is a positive relationship between the density of serotine bats and the density of linear landscape features (Verboom & Huitema, 1997).

*Home Range*

Robinson & Stebbings (1997) found that serotine '… *nursery roosts with less than 20 bats were found to have home ranges of at least 24 to 77 km$^2$ and core areas of activity from 13 to 33 km$^2$. The size of the range may have increased further if more individuals had been tracked, as three of the four colonies studied had not reached their asymptotes. The total home-range area covered by four serotine colonies was 127.36 km$^2$. Excluding non-breeding bats, a density of one bat per 120 ha was estimated. However, actual density was likely to be higher if there were additional non-breeding females and immatures that were not in nursery roosts. Colonial home ranges and core areas overlapped, with individuals from different colonies feeding at the same sites. Individual home ranges (n= 32) varied from 0.16 to 47.58 km$^2$, but these were not used exclusively by one individual. Around the colonial core area and breeding roosts, home ranges were used by all individuals from a single colony. It is only further from the core area that ranges appeared to be used by individuals. The distance from roost to feeding areas varied by up to 7.4 km, but the bat usually commuted along lines of trees and hedges and over pastures. This resulted in greater distances being travelled than if they had flown by a direct route. On average, individuals commuted distances of 8 km each night between feeding areas, with a maximum distance of over 41 km. They visited between 0 and 10 feeding sites each night (mean = 2.89).*'

Another study found that although individuals forged up to 14 kilometres away from maternity roosts most foraging occurred within 5 kilometres (Bat Conservation Trust/BMT Cordah, 2005). In maternity colonies the foraging areas are at an average of 1.25 kilometres from the roost, and up to a maximum of 5.7 kilometres in Hesse, 4.5 kilometres in Saarland, up to a maximum of 11.5 kilometres. In towns (Berlin) serotine rarely foraged further than 1 kilometre from the roost. Each individual visits 2 to 8 different foraging areas per night. (Simon et al, 2004; Boye & Dietz, 2005)

*Mapping*

The basic requirement for a population of serotine bats is a maternity roost site. Without such a roost site habitat cannot be exploited even though it suitable.

**Habitat Suitability Index**

The following stages are carried out in order to develop a HSI map:

1. Evaluate and score IHS codes for serotine bats to produce HSI
2. Apply HSI scores to IHS mapping table
3. Produce thematic map from serotine HSI column in the IHS map table
4. Select grassland with grazing polygons adjacent to woodland and multiply by 1.5 (up to the maximum value of 1)

5. Select polygons over 7.5 hectares and multiply by 0.5 (7.5 hectares is an arbitrary figure but represents the fall in density of serotine bat presence in more open landscapes (Verboom & Huitema, 1997)

**Species Occurrence Mapping**

The following stages are carried out in order to develop a Species Occurrence map:

1. Add roost sites to HSI map, distinguishing maternity, hibernation and other roosts. Buffer maternity roost sites by 520 metres to allow for roost switching behaviour (LRA) [Simon *et al*, 2004]. In-flight records are not mapped but can be used for GAP analysis.

2. Buffer maternity roost sites by foraging range of 5.7 kilometres (EHR and LHU are considered to be synonymous) [Boye & Dietz, 2005]

3. Buffer other roosts by 1.25 kilometres (EHR) (EHR and LHU are considered to be synonymous) [Simon *et al*, 2004; Boye & Dietz, 2005]

**Brown Long-eared Bat**

*Resting Place*

Brown long-eared bats summer roosts are usually in tree holes, but also use crevices, loose bark and quite often bird or bat boxes (Boye & Dietz, 2005). However, in the UK brown long-eared bats prefer buildings, such as houses, churches and barns. In Scotland houses over 150 years old close to abundant woodland are preferred. (Enwhistle & Swift, 2008) Preferences for older buildings with partitioned roofs that are within 0.5 km of woodland and water have been recorded. They are crevice roosters when light levels are above 2 Lux (Bat Conservation Trust, n/d).

Brown long-eared bat maternity colonies are typically small, numbering about 20 adults (Dietz *et al*, 2009). Maternity colonies in tree holes or bat boxes are changed every second to forth day but those in the lofts of buildings usually remain for the entire summer. (Boye & Dietz, 2005)

Brown Long-eared bats roost in small colonies of an average between 15 and 20, with the actual colony size being on average 30 to 50 individuals. Inter colony movement is rare and only between neighbouring colonies (<1%) in dispersal. (Enwhistle & Swift, 2008)

Brown long-eared bats make use of night roosts whilst foraging. These are often in open barns and farm buildings (Enwhistle & Swift, 2008)

*Food*

. Their diet consists of moths, beetles and flies. In analysed faecal samples moths consisted 41% of the diet, beetles 22%; caddis flies 16%; midges and crane flies 10%; and houseflies, lacewings, earwigs and spiders making up less than 3% each. Noctuid moths are frequently consumed. The diet changes according to availability through the summer. (Enwhistle & Swift, 2008)

*Habitat Use*

Brown long-eared bats glean prey from foliage and other surfaces and will take insects in flight (Enwhistle & Swift, 2008).

*Home Range*

The home range of brown long-eared bats is related to habitat structure and has a size of between 1 and 40 hectares. Individual home ranges overlap to some extent. Maternity colonies seem to have territories. During the rearing of young the home range of a maternity colony is about 1 $km^2$ but during dispersal extends out to about 10 $km^2$ (Boye & Dietz, 2005) The average foraging range is 1.5 kilometres, 60% fly less than 500 metres to feed, whilst 8% travel up to 2.8 kilometres. Brown long-eared bats have known to commute up to 7.4 kilometres in Yorkshire (Daymond, 2002; Swift, 1998).

However, most bats spend most of their time within 500 metres of the roost (Dietz *et al*, 2009)

Hunting grounds of brown long-eared bats are from about 4 hectares up to 11 hectares with a smaller core foraging area (Dietz *et al*, 2009). Each bat has a core foraging area of 0.75 to 1.5 hectares and is less than 1.5 kilometres from the roost (Boye & Dietz, 2005).

*Mapping*

The basic requirement for a population of brown long-eared bats is a roost site. Without such a roost site habitat cannot be exploited even though it suitable. Note OS Mastermap does not produced distinct hedgerow polygons. Therefore, further interpretation is needed for evaluation or assessment purposes.

**Habitat Suitability Index**

The following stages are carried out in mapping:

1. Evaluate and score IHS codes for brown long-eared bats to produce HSI

2. Apply HSI scores to IHS map table

3. Produce thematic map from brown long- eared column HSI column in the IHS map table

**Species Occurrence Mapping**

The following stages are carried out in order to develop a Species Occurrence map:

1. Roosts are correctly located, distinguishing maternity, hibernation and other roosts (LRA). Include woodland records as roost sites by digitising the woodland (it is assumed that feeding areas contain maternity roost sites). (LRA)

2. Buffer maternity roosts and woodland areas by 2.8 kilometres. Buffer other roosts sites by 500 metres (EHR)

3. Produce mapping from likely habitat use through consideration of flight lines from the roost sites through aerial photographic interpretation. This will in effect distinguish habitat that is currently available to the species. (LHU)

4. To produce the LSH buffer the LHU by 200 metres to include prey producing habitat.

*Likely Supporting Habitat*

The LSH for brown long-eared bats is calculated as follows. The principle prey species for brown long-eared bats is from Lepidoptera families (Enwhistle & Swift, 2008). Female pheromones attract male Lepidoptera from about 200 metres (*Cydia nigricana*) (Wall & Perry, 1987) and up to 500 metres for *Agrotis segetum* (Reynolds *et al*, 2007). Dulieu *et al* (2007) found that the furthest distance travelled by a single individual noctuid moth was 1169.52 metres (a Setaceous Hebrew Character) in a capture/ mark/ recapture exercise in an agricultural landscape. However, 54% were recaptured at the trapping point.

Beetles can make up a significant proportion of the diet

Tipula, another main element of lesser horseshoe bat diet, have populations separated by distances of 250 metres according to Freeman (1964), who states that little interchange takes place within that distance.

**Water Vole**

Water voles are typically associated with slow flowing permanent water, a dense fringe of aquatic macrophytes and steep banks (Macdonald *et al*, 1998).

*Resting Place*

Each water vole uses a series of burrows that extend back to about 2 metres from banks above water. Earth banks are important for tunnelling and providing vegetative cover. Steep banks allow water voles to construct burrows at a number of levels above and below the waterline. A nest is built of reed and grasses at the back of the tunnel (Macdonald *et al*, 1998).

Water voles nest communally in winter, with a female, her daughters and unattached males sharing a nest (Macdonald *et al*, 1998).

*Habitat*

Water voles are typically found on rivers, ditches, canals, ponds, lakes, marshland and land drains, as well as on blanket bogs, upland and peatland habitats, and occasionally on man-made reservoirs. (Woodroffe *et al*, 2008)

Water voles are found most on waterways less than 20 metres wide and 2 metres deep (Macdonald *et al*, 1998). Optimum habitat requirement is for greater than 60% marginal and emergent vegetation with less than 20% tree cover and a watercourse less than 1 metre wide and 1 metre deep, which has static or sluggish water flow rates, and is adjacent to fens, rough grassland, improved grassland or urban areas. The best sites have a highly layered bankside vegetation with tall grasses, stands of loosestrife, willowherb, nettles or meadowsweet often fringed with a thick stands of sedges, rushes or reeds. (Strachan & Moorhouse, 2006)

*Habitat Use*

Above ground terrestrially, water vole activity is usually confined to runs in dense vegetation within 2 to 5 metres of the water's edge. They avoid heavily grazed, trampled or over shaded areas. (Strachan & Moorhouse, 2006)

Preferred vegetation includes *Urtica dioica* and *Phragmites*. Sub optimal habitat may include tall banks with vegetation such as *Polygonum*, *Phalaris*, *Sparganium* and *Juncus* spp. Water voles are predominately vegetarian feeding on bank side plants and favouring grasses, common reed, sedges and rushes and dicotelydons, such as watercress and brooklime. In winter roots, rhizomes and bark such as willow or sallow is eaten. Occasionally they will eat insects and molluscs. Many food items are taken underground and stored. (Macdonald *et al*, 1998; Strachan & Moorhouse, 2006)

*Home Range*

Home ranges are linear along the banks of a water body. Most females occupy a territory, which is exclusive, between March and October. In Scotland the length of this territory ranged between 25 and 47 metres. Elsewhere it is reported that female territories extend between 30 and 150 metres. Males do not defend territories, with a larger specimen having a larger home range and more females within it. In Oxford a male's home range was around 800 metres. Mean distance between colonies is 500 metres overland. Dispersal movements are frequent and extensive. Males travelled between 1.38 and 1.95 kilometres in Scotland. (Strachan & Moorhouse, 2006; Woodroffe *et al*, 2008)

The size and extent of water vole populations is determined by the size and quality of habitat available as well as the presence of American mink (*Mustela vision*), which is major predator of the species. Densities of water voles can vary with habitat type and season. Estimates of population density along watercourses range from 2.4 per 100 metres in West Lancashire, 3.3 per 100 metres in the North Yorkshire Moors to 6.1 per 100 metres in the Brue marshes, Norfolk and 14 per 100 metres at Slimbridge. (Strachan & Moorhouse, 2006)

In lowland areas populations of water voles can be very large, frequently containing hundreds of individuals. However, these often subdivide into colonies of smaller numbers. Very small populations are vulnerable to extinction through fluctuations in annual breeding rates, presence of predators and environmental factors such as flooding. A population can experience a 70% loss of numbers. Therefore, a loss to a population of 10 would be 3 individuals left whereas a population of 100 would leave 30 voles. A minimum viable population is therefore likely to be 30 to 40 individuals at the beginning of the breeding season and in excess of 100 individuals at peak breeding season occupying 1.5 to 2 kilometres of good quality habitat. Smaller populations are viable if not spatially isolated. (Strachan & Moorhouse, 2006)

Water voles colonies can have a high turnover rate with colonies disappearing during winter and new colonies founded by immigrants (Aars *et al*, 2001). Approximately 20% of water voles disperse prior to breeding. They can disperse long distances overland and will settle in occupied and empty habitat (Telfer *et al*, 2001). Telfer *et al* (2001) state that '*Local populations were linked by high rates of juvenile dispersal but much lower levels of adult dispersal. In the spring breeding population, 19% of females and 33% of males had left their natal population of the previous year. The average interpopulation dispersal distance was 1.8 km (range 0.3–5.2 km)*.'

*Mapping*

**Habitat Suitability Index**
The following stages are carried out in mapping:

1. Evaluate and score IHS codes for water vole to produce a HSI for the species

2. Apply HSI scores to IHS map table

3. Produce thematic map from water vole HSI column in the IHS map table

**Species Occurrence Mapping**
The following stages are carried out in order to develop a Species Occurrence map:

1. Records under five years old are correctly located and buffered by 800 metres (EHR) [Woodroffe *et al*, 2008]

2. Watercourses are digitised within the EHR and buffered by 10 metres. To produce the LHU sections that are unsuitable for water voles are then removed, e.g. where trees overshadow the water (Strachan & Moorhouse, 2006).

3. Where there are gaps in the watercourse, such as those created during the formation of the LHU, these and the watercourse on the far side of the gap are mapped as IE.

4. The LHU should also then be buffered by 1.8 kilometres (Tefler *et al*, 2001) and any watercourses within the dispersal distance digitised and buffered by 10 metres as IE if not occupied by another water vole colony.

*Likely Supporting Habitat*
Not applicable.

**Kingfisher**

*Resting Place*

Kingfishers are a riverine bird species which use nesting burrows are usually 60 - 90 centimetres in length and approximately 6 centimetres in diameter with a nest chamber at the end.
http://www.theanimalfiles.com/birds/kingfishers_relatives/common_kingfisher.html

Nest sites can be up to 300 metres away from a watercourse in the roots of a fallen tree or sandpit, usually in woodland (Flegg, 2001).

*Food*

Kingfishers feed on small fish, most commonly bullhead, minnow, stickleback and small chub and also aquatic insects such as mayflies, stoneflies, dragonfly nymphs and water beetles (Holden & Cleeves, 2002).

*Habitat*

Kingfishers require relatively shallow and slow moving watercourses with vertical banks of fairly soft material in which to excavate nesting burrows linked with thriving populations of small fish on which to feed. They need overhanging tree branches and snags in the watercourse on which to perch during hunting. (Boag, 1982)

*Habitat Use*

Kingfishers are highly disturbed by the presence of walkers and dogs. '*Human disturbance of nesting birds is a serious problem, since the broods fail if something upsets the feeding routine*'.
http://www.rspb.org.uk/wildlife/birdguide/name/k/kingfisher/survival_and_threats.asp

*Home Range*

Kingfisher's breeding and feeding territories are separate and both are defended. There are no fixed rules about the size of territories, as it will vary according to the population and the availability of fish. Each bird would require at least 1 kilometre of river and some territories may cover from 3 to 5 kilometres, which may include nearby lakes and side streams. (Boag, 1982) They pair in February or March and form breeding territories usually between 1 and 1.5 kilometres long (Holden & Cleeves, 2002).

Juvenile kingfishers disperse after becoming independent of their parents but rarely travel more than 15 kilometres from their natal nest site. (Holden & Cleeves, 2002) Dispersal of juveniles usually takes place in winter while the adults remain with the male and female using separate stretches of watercourse until spring (Hayman & Burton, 1976)

*Mapping*

**Habitat Suitability Index**
The following stages are carried out in mapping in this study:

1. Evaluate and score IHS codes for kingfisher to produce a HSI for the species

2. Apply HSI scores to IHS map table

3. Produce thematic map from kingfisher HSI column in the IHS map table

**Species Occurrence Mapping**
The following stages are carried out in order to develop a Species Occurrence map:

1. Records less than five years old are correctly located and buffered by 3 kilometres (EHR). (Boag, 1982)

2. Records of nesting sites are buffered by 100 metres (LRA)

3. Watercourses are digitised within the EHR to form the LHU and buffered by 5 metres.

*Likely Supporting Habitat*
Not applicable.

# Appendix 3: Legal Requirements of European Protected Species

***The 'Habitats Directive'***

The Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora under Article 2 set out the requirements for the protection of species of Community interest, listed under Annex II, IV and/or V (Annex V are those which may be taken subject to management measures). These species are required to be maintained at 'favourable conservation status' (FCS), which is defined as when:

- population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and
- the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Article 12 states that 'Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV in their natural range, prohibiting:

(a) all forms of deliberate capture or killing of specimens of these species in the wild;

(b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration;

(c) deliberate destruction or taking of eggs from the wild;

(d) deterioration or destruction of breeding sites or resting places.

Annex II species are those for whose conservation require the designation of Special Areas of Conservation (SAC). Any potential impacts affecting the integrity of a SAC, including those designated for Annex II species, are required to undergo an 'Appropriate Assessment'[10].

Annex IV species are defined as 'animal and plant species in need of strict protection.'

[10] See DCLG, 2006; Dodd *et al*, 2007

Under Article 16 avoidance of impacts should be sought and lists the circumstances for where derogation may be applied. In planning development may only be progressed if in circumstances of over riding public interest.

The goals of the Habitats Directive for species conservation requires two basic conditions:

- Quality of habitat (allowing enough for reproduction)
- Habitat area (to prevent extinction by accident)

(Opdam *et al*, 2002)

***The Conservation of Habitats and Species Regulations 2010***

The Conservation (Natural Habitats, &c.) Regulations 1994 transposed the Habitats Directive into U.K. law. Amendments to the 1994 Habitats Regulations in 2007 and 2009 came about as a result of a European Court of Justice ruling in October 2005. The Conservation of Habitats and Species Regulations 2010 now consolidates and replaces this legislation.

The Regulations make it an offence (subject to exceptions) to deliberately capture, injure, kill or disturb (populations) the animals listed in Schedule 2. Protection from disturbance to individual EPS remains within the Wildlife and Countryside Act 1981 (as amended)

With regard to populations under regulation 41 of the Regulations it is an offence to deliberately disturb wild animals of EPS in such a way as to be likely to:

a) impair their ability—
(i) to survive, to breed or reproduce, or to rear or nurture their young; or
(ii) in the case of animals of a hibernating or migratory species, to hibernate or migrate; or

(b) affect significantly the local distribution or abundance of the species to which they belong.

This definition of 'disturbance' incorporates two elements adapted from the Habitats Directive Article 12 guidance document produced by the European Commission (European Commission, 2007). The first element is that disturbance must be likely to significantly affect the ability of a European Protected Species ('any significant group of animals' was removed following the 2009 amendment) to survive, breed, or rear or nurture their young. The second element is that the disturbance must be likely to significantly affect the local distribution or abundance of the species. For disturbance to occur, either of these conditions must be met.

When assessing the risk of an activity disturbing an EPS the following points should be considered:

- The likelihood that EPS occur in the area of potential disturbance impact of the activity;

- The likelihood that the local distribution or abundance of a EPS will be significantly affected by the activity;

- The characteristics of the activity and potential factors of disturbance;

- The mitigation measures in place to avoid committing an offence.

If there is a risk, which cannot be removed or sufficiently reduced by the taking of mitigation measures, then an EPS licence may be granted by the regulatory authorities. Licences are available for a number of categories of activities or "purposes", as set out in Regulation 53 of the Habitats Regulations. Licences can only be issued, however, where there is no satisfactory alternative, there is over-riding public interest and where the activity will not be detrimental to the maintenance of the populations of the species concerned at a FCS in their natural range

The Habitats Directive Article 12 guidance (European Commission, 2007) states that '…*it would also seem logical that for disturbance of a protected species to occur a certain level of negative impact which is likely to be detrimental must be involved*'. Disturbance covers a whole range of activities. At the lower end of the scale is the disturbance of a single individual outside the most sensitive seasons (breeding, rearing, hibernation and migration). At the upper end might be disturbance of large groups that would cause the permanent disappearance of a local population of a rare species.

The Commission's guidance further states that '...*any disturbing activity that affects the survival chances, the breeding success or the reproductive ability of a protected species or leads to a reduction in the occupied area should be regarded as a 'disturbance' in terms of Article 12*'.

Disturbance is therefore interpreted as an action that has a significant effect on the ability of a European Protected Species to survive, breed, rear or nurture young; or as having a significant effect on a species' local distribution or abundance (the term 'significant' with regard to populations was removed in the 2009 amendment. Therefore, the Regulations apply to any group of animals). Loss of or changes to habitat is considered one of the main factors to cause disturbance (JNCC, 2007). For instance, Natural England will require a licence application where a hedgerow used by bats is to be removed (pers. comm. Natural England).

Disturbance can also be indirect, such as from noise and sources of artificial light. It is also recognized that different species have different sensitivities to disturbance. (European Commission, 2007)

To assess disturbance consideration must also be given to its effect on the FCS of the population as defined under the Habitats Directive (see above).

In addition and as a consequence of the 2005 judgment and the resulting 2007 amendments, the majority of the defences originally put into the 1994 Regulations have been removed. This includes the '*incidental result defence*', which applies to acts that could constitute an offence but were the incidental result of an otherwise lawful activity and could not reasonably have been avoided. In the absence of such a defence, the offence prohibiting disturbance of EPS has been amended to better reflect the terms of the Directive and to allow trivial acts of disturbance to continue without constituting an offence and therefore requiring a licence.

This implies, for forward planning, that there should be a sound knowledge of the distribution of an EPS within a geographic area. Those carrying out activities that may affect EPS will now have to give even more careful consideration to their presence and also their breeding sites and resting places. With this knowledge planners may choose an option that avoids affecting the EPS, if that is possible. Otherwise, the developer may have to apply for a licence to carry out an activity that would otherwise now be unlawful. Potentially this may cause delays or stop implementation of site allocations.

Regulation 9(5) of the 2010 Regulations requires all public bodies to have regard to the requirements of the European Habitats Directive when carrying out their functions. A court case decision in May 2009 (Regina versus Cheshire East Borough Council) clarified that it was not sufficient for planning authorities to claim that they had discharged their duties by imposing a condition on a consent that requires the developer to obtain a licence from Natural England.

It is South Somerset District Council's responsibility to ensure that the 'favourable conservation status' of EPS is maintained, aside from any licensing requirement. Before granting planning permission to the Ecotown development the Council needs to ensure that the development is not detrimental to the populations of the EP species' 'favourable conservation status' as defined by Article 1 of the Directive and Regulation 41 of the Conservation of Habitats and Species Regulations 2010, i.e. that there are no adverse effects on the distribution and abundance of the local population from the development. South Somerset District Council must be satisfied that each of the three tests for EPS is met:

- The development is of over-riding public interest;
- There are no satisfactory alternatives; and
- That the development will have no detrimental effect on wild populations of the species concerned.

# Appendix 4: Bats and Wind Turbines

## Introduction

It has been known since the 1960s that bats could suffer mortality from wind turbines. However, it is only in recent years that studies, mostly in the United States and Europe, have been carried out to determine the scale and causes of these deaths. At some wind farms few or no casualties are recorded whilst others bats are killed in large number. Another study in Brandenburg determined the average collision rate was 0.23 per year, although this figure was not corrected for carcasses scavenged prior to recording. (Hötker *et al*, 2005)

When applying the Directive and Regulations to local populations, it is necessary to define a threshold level between significant and insignificant impact. The wind turbine development would be insignificant when the mortality of juveniles and adults caused by operation would not cause any changes in the long-term survival chances of a local population. The intervention would be significant when the mortality increased so drastically that even a higher reproduction rate could not even replace losses, so that the chance of long term survival of a local population would decrease. However, data on local populations are largely unobtainable and threshold should be set low to support conservation. (Brinkmann *et al*, 2006)

Although bats are long lived they have a slow reproduction rate with usually one young being produced each year. This does not allow for a new mortality factor to be compensated for easily as with several smaller mammals and bird groups. (Ahlén, 2003) Therefore, the recruitment rate of bat populations can be affected by relatively small numbers of fatalities from wind turbines. At sites with high numbers of deaths the decline is even more marked as mortality exceeds recruitment. (Betts, 2004) Population models (VORTEX[11]) reveal that relatively small additives of 0.1% added to annual mortality rates may cause significant decreases in populations (Hötker *et al*, 2005).

Initial European studies of bat casualties at wind farms indicate that most casualties occur during migration and more recent findings have found evidence that resident bat populations are vulnerable, particularly where turbines are sited close to woodland. Locating a wind farm along a bat migration route would increase the risk of casualties, as would siting a single turbine along a flight path next to a nursery roost, or at a woodland edge. (Mitchell-Jones & Carlin 2009; Matthews *et al*, 2009)

Wind turbines have effects on bats and their populations in several ways. As well as mortality from turbine blades, bats may be affected by loss of foraging habitat; the blocking commuting or migration routes; and ultrasound emission by wind turbines.

[11] http://www.vortex9.org/vortex.html

**Mortality for Turbine Blades**

Risks of bats being killed by wind turbines will vary at different times of day and at different times of year. Higher mortality tends to occur in low wind speed conditions (Matthews *et al*, 2009)

Bats are killed at turbines either by direct contact or more frequently by barotrauma causing hemorrhaging of the lungs. Bats contacting rotor blades of turbines have been recorded on thermal imaging video by Horn *et al* in 2008. The study showed that blade rotational speed was a significant negative predictor of collisions with turbine blades, suggesting that bats may be at higher risk of fatality on nights with low wind speeds. However, in a Canadian study (Baerwald *et al*, 2008) it was found that 90% of the 75 bat fatalities examined were killed by burst blood vessels in the lungs. As the wind moves through a wind turbine's blades the air pressure drops behind them drops by five to 10 kilopascals (a pascal is a unit of pressure). Any bat flying into such an undetectable low pressure zone would find its lungs and blood vessels rapidly expanding and, quickly, bursting under the new conditions.

There are several hypotheses as why bats are attracted to wind turbines or their structures. Bats may be attracted to patches of insects present at turbines. Pipistrelle bats have been observed feeding within 1 metre of rotor blades in Germany (Betts, 2004). In Sweden Ahlén (2003) observed bats hunting insects close to, and even flying through, turbine blades with dead bats subsequently found below. Bat activity appears to be associated with high insect density around wind turbines where insects may be attracted to heat radiation from the upper parts of a tower, including the blades and the generator (Betts, 2004)

Large variation in numbers of both bats and insects were observed on a nightly basis in a 2008 study. It was found that there was a significant correlation between insect and bat activity suggesting that bats may be attracted to patches of insects, although it was considered that weather patterns might amplify this relationship. Modifications to woodland resulting from construction of wind energy facilities, including the creation of open space in which turbines are installed and the linear planting along access roads, may create favorable foraging grounds for insectivorous bats. Woodland edges may be favourable to insect activity and to the ability of bats to capture them in flight. (Horn *et al*, 2008)

As well as hunting around turbines Horn *et al*, 2008 observed bats actively investigating both moving and motionless turbine blades. Bats were seen to alight upon and investigate turbine blades and monopoles suggesting that bats could be attracted to the wind turbines themselves. One possible hypothesis put forward to explain this behaviour is that bats view these tall structures, standing in open space, as roost trees. Woodland bats often seek out large trees and snags as desirable roosting habitat. The openings and woodland edges that wind sites can provide may represent favourable conditions for roosting. (Hötker *et al*, 2005)

Furthermore, most bat fatalities at turbines have, to date, been recorded occurring during late summer and autumn and involve species that roost in trees. Cryan (2008) hypothesises that tree bats collide with turbines while engaging in mating behaviours that centre on the tallest trees in a landscape, and that such behaviour stems from two different mating systems (resource defence polygyny and lekking). Bats use vision to move across landscapes and might react to the visual stimulus of turbines as they do to tall trees. If mating bats are drawn to turbines, wind energy facilities may act as population sinks, which would be a risk that is hard to assess prior to the turbines being installed.

**Bat Migration**

In the United States and Europe higher casualty rates to bats from wind turbines occur during migration between summer and winter roost sites. It is not clear why this is but one suggestion is that bats orientate themselves other than by echolocation during migration and so be less able to detect turbine blades. In Sweden Ahlén (2003) observed that bat used echolocation but the calls had a slower rhythm during migration. (Betts, 2004)

Migratory flights also may account for increased bat density around wind farms as individuals or groups of some species make stopovers to feed, drink, and roost in trees. As with resident populations, migrants or groups of bats making stopovers may be similarly attracted to these areas to feed. (Horn *et al*, 2008)

However, little is known about bat migration in Britain although research has been done in Europe. For example, Nathusius' pipistrelle bats have been found on oil rigs in the North Sea and two bats of the species captured in Sweden were later recovered in Germany and Belgium. (Betts, 2004)

In Britain there is evidence for migration of individual greater horseshoe bats between roosts in Gloucestershire, through Somerset to the Isle of Purbeck in Dorset. It is not known at what height these bats migrate (Jon Flanders, University of Bristol). Movement of bats does occur between summer and winter roost sites and this can be some kilometres distant.

**Bat Species at Risk**

Evidence from Europe suggests that some species of bats are more likely to be killed by wind turbines than others. Noctule and pipistrelle species are the most commonly found casualties. Leisler's and serotine bats also suffer more casualties compared to horseshoe (*Rhinolophus*), *Myotis*, such as Daubenton's bat, and long-eared (*Plecotus*) species, which have known to be killed in low numbers. (Eurobats, 2005; Hötker *et al*, 2005)

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Common pipistrelle bats are found in disproportionately high numbers where wind turbines are located close to trees and hedgerows. The same does not apply to noctule bats, which as a species form a significantly higher proportion of the total bat casualties (Hötker *et al*, 2005).