Barn Owl *Tyto alba* Survey Methodology and Techniques
for use in Ecological Assessment

Developing Best Practice in Survey and Reporting

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References made in this report to legislation, planning policy and its interpretation, are intended as a guide. New laws and policies are introduced and others amended from time to time. It is the responsibility of the ecologist to ensure that they are up to date with these. Independent legal advice should be sought on any detailed points of law.

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1. INTRODUCTION

1.1 Ornithological Surveys

Surveys are a sampling activity where discrete information is gathered from a specific site or wider area. They usually represent a single case study but can involve repeat visits to a site. A survey is distinguishable from monitoring which usually takes place at regular intervals, often yearly, the main aim of which is to investigate the progress of a research or conservation objective and may involve the study of population dynamics in the species concerned.

The primary objectives of surveying are to:

- document a species' presence/absence; and/or
- determine the species' distribution and abundance

To meet the statutory requirements and obligations of national and international wildlife law, a consistent standard for ecological assessment appropriate for the protection and conservation of barn owls is required.

This guidance focuses on the surveying objectives described above and provides a standardised protocol for those conducting and commissioning barn owl surveys in the UK. It also provides information for ecologists, developers, planners and the statutory and non-statutory organisations, which are often required to review and consider the findings and recommendations of protected species surveys.

1.2 Barn Owl Surveys

The barn owl has been described as one of the most difficult of British birds to survey accurately (Gibbons *et al.* 1993). Field survey methods were first developed during the Barn Owl Survey of Britain and Ireland (Shawyer 1983) and these were later adapted for Project Barn Owl, the most recent survey of the species in the UK (Toms 1995 and Toms *et al.* 2001).

Over the last decade, increasingly demanding survey methods have been required to meet the statutory obligations and policy requirements for protected species in the planning process and the discerning needs of Environmental Impact Assessment (EIA). As a response to this, the Wildlife Conservation Partnership, alongside its supervision and development of Project Barn Owl (Toms *et al.*), the British Trust for Ornithology (BTO) Barn Owl Monitoring Programme (Leech *et al.* 2009, Dadam *et al.* 2011) and its ten-year conservation and monitoring programme with the Environment Agency (Shawyer 2007), has sought to refine the methods used in these projects and provide a relevant and structured approach to barn owl surveys for use in ecological assessment.

It is anticipated that the survey protocol will be updated from time to time and revised and distributed following scientific peer review.

2. THE NEED FOR A BARN OWL SURVEY

2.1 Background

Barn owl surveys undertaken by trained volunteers for bird organisations such as the BTO or County Bird Clubs (CBCs) have been an important part of bird census work since 1932, when the first countrywide survey of barn owls was undertaken (Blaker 1934).

The survey methods described in this report, although appropriate for fieldworkers undertaking their own studies or contributing to wider projects involving survey and monitoring (Hardy *et al.* 2009), focus on those required by ecologists undertaking protected species surveys. These surveys are often a necessary precondition for proposed development schemes in the UK, either as part of Environmental Impact

Assessment (EIA) or for the determination of non EIA planning applications, where the granting of planning consent in the absence of sufficient information, can risk legal challenge.

2.2 Conservation and Legal Significance

The barn owl is a relatively scarce breeding species for which there is conservation concern in the UK, the population having declined by about 70% between 1932 and 1985, from an estimated 12,000 to 3,800 breeding pairs in England and Wales, 600 in Scotland and 40 in the Channel Isles (Shawyer 1987). The most recent survey of the UK, which was completed in 1997, recorded a similar breeding population of about 4,000 pairs (Toms *et al.* 2001). Similar levels of decline have occurred across Europe and elsewhere in the world (Colvin 1985, BirdLife International 2004).

The barn owl qualified under international criteria as a Species of European Conservation Concern, SPEC Category 3 (Tucker and Heath 1994, Hagemeijer *et al.* 1997) because of its 'moderate decline' in Europe. Since 2002, it has been included on the Amber List of Birds of Conservation Concern in the UK (BoCC) because of its 'declining breeding range of between 25 and 49%' and it's listing as a species with 'unfavourable conservation status in Europe' (Eaton *et al.* 2009a).

A UK Species Action Plan (SAP) for the barn owl was first developed by the Joint Nature Conservation Committee (JNCC) and the RSPB (Williams and Galbraith 1992). Most of the detail of this action plan is included within the Barn Owl SAPs that have since been produced by Governmental and other national bodies, such as the Highways Agency, Crown Estates and Association of Drainage Authorities (Wynne *et al.* 1995, Highways Agency 2002, Shawyer 2009). In addition, a large number of local Biodiversity Action Plans (LBAPs), including those of water companies, such as Anglian Water, internal drainage boards and numerous counties such as, Warwickshire, Sussex, Devon and Norfolk (Shawyer 2011), have been produced to include the barn owl under Agenda 21 of the International Convention on Biodiversity.

The conservation importance of the barn owl can also be judged by its inclusion on the UK Government Farmland Bird Index of Sustainable Development, its Public Service Agreement target to reverse the decline in the index by 2020 and its appearance in the annual publication The State of the UK's Birds (Eaton *et al.* 2009b).

By 2009, the barn owl population in the UK, with the exception of Northern Ireland, is believed to have increased to over 6,000 pairs, most of the major increases having occurred in those areas where concerted efforts have been made to conserve this bird ([1]Shawyer 2009). A demonstrable increase in population since 1997 is also consistent with the preliminary findings of the BTO/JNCC/RSPB Breeding Bird Survey (Dadam *et al.* 2011).

Aside from concern about its conservation status, the barn owl is specially protected on Schedule 1 of the Wildlife and Countryside Act 1981 from intentional or reckless actions that may cause disturbance in the breeding season. As such the barn owl is one of a number of protected species in the UK and the Republic of Ireland whose presence must be given high nature conservation priority and special legal protection when a potential development is being considered (see: Appendix I - Wildlife Law and Planning Guidance).

2.3 Impacts of Development

Development projects which often involve the loss and fragmentation of habitats and can include the demolition or improvement of old buildings and felling of hollow trees, are recognised as having the most significant impacts on barn owls in the UK.

A survey is required before any site clearance or other works are undertaken if there is any possibility that barn owls may be resident at a place where development is under consideration. The Government recognises, however, that because of the 'delay and cost that may be involved, developers should not be required to commission and undertake surveys for protected species unless there is a reasonable likelihood of the species being present and affected by the development' (ODPM Circular 06/2005 see Appendix I).

The purpose of the survey is to determine the:

i. distribution, abundance and breeding status of barn owls in the area of interest;
ii. extent to which barn owls are likely be affected by a proposed development;

and where the presence of this bird has been confirmed

iii. to enable an appropriate mitigation strategy to be designed and implemented.

In particular the survey is necessary for the purposes of:

i. ensuring legal compliance;
ii. determining planning applications;
iii. avoiding the enforced cessation of development work should an active breeding site be discovered that would be damaged or disturbed through continuance of the work.

The survey methods described focus on those most appropriate for the purposes of planning and development. Accurate information is required by both the developer and the local authority to determine an application lawfully, in a timely fashion and enable informed decisions to be made about the potential impact of the proposed development and any ecological constraints to it (Shawyer and Johnson 1990, Dewar 1996).

2.4 Survey Requirements

Developers and their agents are advised to approach the planning authority before the planning application stage to seek advice on the information required for an application, which will often include a barn owl survey. If insufficient information is provided by the applicant this may render the application invalid or lead to deferral or refusal of planning permission.

Failure to consider the risk of harm or disturbance to this protected bird before land clearance, demolition, development or redevelopment of a site begins, through for example, an appropriate survey, could be deemed 'reckless' in law. This could lead to criminal prosecution should the risk be taken or ignored and the actions result in any damage to barn owls, their 'nests', eggs or young or disturbance to them whilst they are breeding. These offences can be punishable by fines of up to £5,000 for each nest, egg or chick and/or result in a six-month custodial sentence for those committing the offence. Barn owl surveys should, therefore, be given high priority at those sites where a development or change in use is under consideration.

2.5 Survey Outcomes

If a protected species, such as barn owl, is found breeding on a proposed development site, this will rarely preclude the development. It is, however, likely to restrict the timing of activities (so as to avoid the breeding period) or the distance at which these activities are permitted from the breeding site (see: Appendix II, Barn Owl Disturbance and Protection Zones). It is also likely to require appropriate mitigation measures to maintain the long-term future of the species at or near to the site in question in order to ensure the viability of the breeding population in the wider area (Shawyer and Holmes 2009).

Unlike the situation with some protected mammals and reptiles there is no provision within the WCA for the translocation of protected birds.

Where recommendations are made by the survey to mitigate against, compensate for or enhance the effects of any development works, they should be proportionate to the conservation status of barn owls (at the local, regional and national levels) and the scale of the potential impacts upon them.

2.6 Methodological Considerations

General breeding and wintering bird surveys are often conducted as part of an ecological site assessment but are usually insufficient on their own to detect some species or groups of bird. When for example, particularly elusive birds, such as barn owls (or other protected raptors such as hobby *Falco subbuteo*, peregrine *Falco perigrinus*, honey buzzard *Pernis apivorus* or goshawk *Accipiter gentilis*) might be anticipated in the area, a dedicated species survey is usually essential.

Like many other birds, barn owls are under particular threat from disturbance whilst they are breeding and because they are protected by special penalties in law at this time, the survey's focus should be on determining whether or not active nest sites are present. This information is normally all that is required in those situations where a proposed development involves a single building or cluster of buildings contained within a small parcel of land.

Barn owl surveys, however, often need to be conducted over more extensive areas. This is often the case where road, rail, residential, commercial and recreational developments are involved. For these schemes, surveys should also include the identification of barn owl foraging habitats. This is because Local Planning Authorities will often expect this level of detail when determining a planning application so that appropriate compensation measures can be applied for any loss or fragmentation of habitat that may result from the scheme.

Like most surveys, barn owl field surveys provide a snapshot of activity for the period during which they are carried out and may be constrained by weather conditions and access to the site. When they are undertaken across large areas they can be highly challenging and require particular skill and effort to demonstrate beyond reasonable doubt that barn owls are not present. Surveys of this type, which will often include difficult terrain, the climbing of trees and cliff faces and the inspection of disused or derelict building interiors, can also involve considerable health and safety risks which need to be fully addressed before any work is undertaken. Those commissioning surveys should provide Method Statements and Risk Assessments to ecologists/surverors before work is undertaken.

2.7 Commissioning Surveys

Surveys for bird atlas studies conducted for organisations such as the BTO, RSPB and local bird clubs, are usually undertaken by volunteers who have wide ornithological experience. Barn owl surveys commissioned as part of land or built development schemes must be carried out by competent and skilled persons who have a good working knowledge of this species and of its ecology. In addition, they should be chartered environmentalists, chartered biologists or specialist ornithologists who hold appropriate public liability and professional indemnity insurance for this type of work. Landowners, developers, their agents and architects, who normally commission this type of specialised survey work, should be provided with evidence of the insurance certificates held by surveyors before granting access to undertake work on the land in question.

It is important that applicants who are seeking planning permission understand that they, themselves, are rarely qualified to determine whether or not barn owls or other protected species are present or absent at the application site and that an expert normally needs to be engaged to undertake a formal survey. Evidence of a surveyor's competence and professional status is, in any case, usually required by the local planning authority when they are considering the findings of a protected species survey submitted as part of a planning application.

Surveyors who intend to approach barn owl nests or view their contents, must possess a licence permitting them to disturb nesting barn owls. This licence is granted under Section 16 (1) (a) of the Wildlife and Countryside Act 1981 (as amended by the Environmental Protection Act 1990). It is issued for the purposes of conservation, science, research and education by the relevant Statutory Nature Conservation Organisation (SNCO); Natural England, Scottish Natural Heritage, Natural Resources Wales and Northern Ireland Environment Agency, to those applicants able to demonstrate the necessary skills and competency to visit these nests and nesting areas, safely (IEEM 2011). For ecologists who have demonstrated this level

of expertise they would normally be permitted to examine nest contents using the method of observation only and the licence would usually include a condition restricting the activity to 'examining nests in relation to development proposals'. A licence is not intended to constitute a qualification or accreditation and the SNCOs clearly state that the licence should not be used as such.

If an unlicensed surveyor unexpectedly encounters breeding barn owls at a previously unknown nest site, then that person must withdraw immediately and if close examination of the nest site is considered necessary, a licensed surveyor must be engaged.

Accurate determination of fledging dates is sometimes required by developers in order that they can programme to begin or resume their work soon after barn owls have left the nest and the young have become independent of the breeding site. Ageing of barn owl chicks using measurements of wing chord (relaxed) and feather length (primary feather 7) are, during the first 50 days of a chicks life, accurate to plus or minus one day (Shawyer 2006, Shawyer in prep). Particular experience is needed to undertake these measurements and this type of activity, which requires the handling of barn owls at the nest, is not permitted under the disturbance licences normally issued to ecologists for barn owl surveys.

Ecologists who, for the reasons described above, need to be involved in the close monitoring and handling of barn owls or their eggs to weigh or undertake other measurements, should, in addition to the skills needed above, be able to demonstrate the level of expertise required by the BTO for nest recording and ringing. This requires expert mentoring, formal training and regular peer review. However, this level of monitoring, which requires a licence to 'temporarily take and control' a Schedule 1 bird is usually undertaken by biologists who are undertaking research or conservation studies and is rarely needed as part of ecological assessment.

One of the purposes of a disturbance licence is to prevent duplication of visits to the nests of birds listed on Schedule 1 of the WCA 1981, so as to avoid unnecessary levels of disturbance. Licensees should not attempt to inspect nest sites of barn owls, particularly nestboxes, owl lofts or owl towers (many of which incorporate identification labels which include the name and contact details of the licensee) even if they have landowner permission, until they have first taken steps to ensure that these sites are not already being monitored as part of a long-term barn owl research project or species recovery programme which may be operating in the area. Failure to ensure this would be considered an infringement of professional etiquette and can breach the conditions of a disturbance licence where, for example, consultation is a requirement of the licence. Details of established species recovery programmes (defined as Species Recovery Areas (SRAs) and which form part of the UK's Barn Owl Recovery Network (BORN), can be provided by contacting the Wildlife Conservation Partnership (WCP). Currently, an estimated 3,000 active barn owl breeding sites are established within these SRAs.

2.8 Designing the Methodology

This section provides background to the range of techniques available to ecologists and ornithologists undertaking barn owl surveys and describes those methods best suited for ecological assessment, where accuracy as well as time and cost are important considerations. The structure and practical detail of the survey methodology is described in section 3.

2.8.1 Initial Steps

The barn owl is widely distributed throughout the UK (with the exception of the north west Highlands of Scotland, Outer Hebrides, Orkney and Shetland) occupying about 50% of the 10 km National Grid squares. There is, therefore, a high probability that this bird will be present within the area of many proposed development schemes in the UK (Shawyer 1987, Gibbons *et al.* 1993). A desk study is a pre-requisite during a baseline assessment and this should be conducted within a wide geographical area of the site in question. The purpose of this initial study is not only to assess the probability of barn owl occurrence on the site, but to provide an estimate of its population size and relative abundance at the local, regional and national levels. This enables the significance of any adverse effect from a proposed development to be determined not only

on the site itself but within the wider area and provides important guidance for any future mitigation strategy.

Altitude, latitude, climate, habitat availability and the concentration of human habitation largely govern whether or not barn owls are likely to be found within a given area. This species, which is at the northern limit of its world range in the UK, also avoids places where winters are harsh. This means that it is most commonly found in low-lying regions where snow cover is least prolonged. In the 1982-1985 Barn Owl Survey for example, only 8% of the UK population was found to breed above 150 m above sea level, a probable consequence of the harsh, snowy winters that had occurred during the 40 year period prior to the survey (Shawyer 1987). During the period from the mid-1980s until 2008, winters were relatively mild resulting in a higher proportion of barn owls being found breeding above 150 m above sea level and at more northerly lattitudes.

Less than 1% of barn owls in the UK are recorded breeding within conurbations such as towns and cities (Shawyer 1987), their requirement for open grassland habitats and sensitivity to intensive human activity, causing them to avoid such areas. The major constraints imposed on this species by climate, altitude, latitude and urbanisation are demonstrated by the barn owl distribution and abundance maps, which have previously been published (Figure 1).

Barn owls show a high fidelity to their breeding sites and maintain similar home ranges from year to year and through successive generations, resulting in many sites of great antiquity. Therefore, historic data can provide a valuable contribution to any desk study and when combined with contemporary information, can offer a more complete picture of the population status of barn owls in the area of study.

Where the initial desk study has revealed a reasonable likelihood that barn owls may be present in the general area of interest (and in many rural areas of Britain this will be a high probability) or where a barn owl recovery programme is suspected or has been identified there, a field survey must then be undertaken.

Field surveys are essential to determine the full status of the species in the study area, the potential effect of the development and the mitigation, compensation or enhancement measures to be applied. They should aim to locate and confirm the distribution, abundance and breeding status of barn owls as well as the relative importance of the habitats they utilise within the survey area.

2.8.2 Types of Field Survey Technique

The barn owl is a shy and generally elusive bird existing at low population density in many areas of the UK. Although it can sometimes be seen in the daytime, particularly in the early part of the year during courtship and when feeding young in the summer months, it is largely nocturnal, rarely vocal and does not defend a clearly defined territory. All of these factors make this species a very difficult bird to locate and survey accurately. As a consequence, traditional methods of bird survey which largely rely on observation and listening to confirm or deny the presence of a species and establish its movements, are less appropriate when attempting to survey barn owls. Observational surveys for this species during darkness, even when using image intensifiers are, in any case, impractical and rarely time or cost effective when dealing with extensive study areas (over 75 ha) of the type which, for example, involve road construction or similar large-scale development schemes. This is because observational methods are constrained, in the absence of a team of qualified fieldworkers, by the inability simultaneously to watch, within a realistic time frame, those potential nest sites and the habitats suited for foraging and movement, many of which can be widely distributed within large survey areas.

However, vantage point bird surveys, which largely rely on the observation and identification of birds in flight, can be used with some success for barn owls when this involves a single barn or group of farm buildings or where a small number of potential nest sites have been identified in small study areas which offer uninterrupted views to the observer. In situations such as these observational surveys, provided that they are conducted at the optimum time of the year, can be useful for confirming whether or not potential nest sites are actively being used by barn owls and for identifying their flight routes and feeding areas in the area of interest.

Observational surveys can also be of importance when attempting to discover if breeding is occurring within nest chambers which are inaccessible to the survey worker or where the classic signs of nesting had not previously been revealed outside the confines of the nest itself. Typical of these sites are bale-stacks, high tree cavities and rock fissures.

When observational surveys are to be conducted, these are best attempted during the late breeding season, usually between mid June and during July (August to October for late or second broods). These are the months when prey deliveries to the nest become most frequent and can more commonly occur at dawn and dusk or sometimes, during daylight hours.

Broadcast surveys, which use playback recordings, usually of territorial or courtship calls and which require a licence if carried out during the breeding season, are one of the most commonly-used techniques to locate and survey many species of owl and delineate their territories. Although barn owls will occasionally respond both vocally and visually to these recordings, this technique is considered largely ineffective when surveying for this species in the UK (Shawyer 1994). This is probably because barn owls do not defend a territory in the true sense and have less need to vocalise away from the immediate area of the breeding site.

2.8.3 Adopting an Appropriate Methodology

Because of the difficulties of locating barn owls using methods that rely on observation or broadcast, dedicated field surveys should focus on the detection and interpretation of the characteristic field signs provided by this bird. This is particularly important for large study areas within which nesting and roosting opportunities can sometimes be abundant. Surveys of this type are also valuable because they can be undertaken efficiently during daylight hours and within a wide area by just one or two experienced fieldworkers. In addition, they enable barn owls to be detected outside the breeding season, at a time during the winter months, when many adults will have vacated their nest sites.

Unlike roost sites which are often strewn with pellets, droppings and feathers, the areas around and beneath active breeding sites, particularly those in tree cavities or other outdoor sites such as nestboxes, rarely reveal the tell-tale signs of the bird's presence, even when breeding has taken place repeatedly over many years. This, coupled with the fact that many barn owls are entirely nocturnal and females are highly reluctant to leave their eggs or young and reveal their presence even when close attempts are made to inspect their nest, means that unless special efforts are made, this bird can easily be overlooked during field surveys.

With the increase in knowledge about barn owl behaviour and ecology in recent years, the signs left by these birds can now be interpreted more robustly. This enables fieldworkers, experienced in the breeding biology of barn owls, to determine if sites are currently being used for breeding, if they have been used in the recent past and the frequency and seasonal use of any roosting places which are found. Barn owl surveys should not only attempt to identify all breeding and roosting sites in the study area, clusters of which can be used to help define the home ranges of individual birds, but also the places which are used by them for foraging and movement.

During the breeding season, adult barn owls commonly range between 1.0 km and 1.5 km from their breeding sites (Shawyer 1990) so that night-time observations aimed at revealing the specific places used by this bird for feeding and movement are, once again impractical for most survey workers. Attempts to detect these by observation and thereby to conclude those habitats of most value to barn owls for feeding and dispersal can also be flawed because they do not take account of the variation in habitat usage that can occur at different times of the year or when a change in breeding partner occurs. The potential value of the area to barn owls in terms of prime foraging and dispersal habitat can be determined most reliably and efficiently by identifying and recording the type, size and distribution of grasslands present.

The survey methods and techniques that are now described take account of the latest research into the breeding biology of barn owls and offer greater precision for identifying nest sites and determining the breeding or non-breeding status of barn owls during ecological assessment. They are applicable to most of the UK but some modification may be required in Northern Ireland, the Republic of Ireland and the Isle of

Man where home ranges, prey selection, foraging habitat and nest site usage can vary markedly to that found on the British mainland (Bunn *et al.* 1982, Shawyer 1987, Lusby pers. comm).

3. SURVEY PROTOCOL

The barn owl survey is divided into four parts. The methodology for each of these is described alongside details of the knowledge, skills and experience required to undertake this work.

The four parts to the survey are as follows:

- **Desk Study**: to assess the likely status of barn owls in the area of interest.

This is followed by:

- **Stage 1: On-site Scoping Survey** to identify and record those features of the landscape which are broadly suited to barn owls.
- **Stage 2: Investigative Field Survey** to determine which of the features identified in the Stage 1 survey offer potential nest sites, roost sites and habitats for foraging and movement.
- **Stage 3: Nest site Verification Survey** to confirm which of the potential nest sites identified in the Stage 2 survey are actively used by barn owls for breeding.

3.1 Desk Study

The desk study has two main aims:

- to determine if the proposed development is within the geographical range of barn owls (thereby helping to inform the need for a future field survey); and
- to determine the *significance of effect* of the development on the species at the local, regional and national levels.

The elusive nature of barn owls means that they often go unrecorded. As a result data can be very patchy in the area of study, but the lack of any records should not be taken to mean that the species is not present there. Research has shown that unless specific barn owl surveys have been conducted, the records held by Local Recording Centres (LRCs), CBCs and other local groups rarely account for a significant proportion of the actual number of breeding pairs in a region or county (Shawyer 1987, Cayford 1992). Therefore, desk studies although valuable, are insufficient on their own to fully and reliably inform an environmental impact assessment.

Barn owl data (both current and historic) should be sought within 5 km of the boundary of the proposed development scheme, or for small sites, 5 km from its mid-point. This will allow for what is considered the maximum extent of winter movement (Cayford 1992) and represents the area within which breeding barn owls are most likely to be affected.

If the data provided for the Desk Study includes sightings of barn owls between the months of September and January it must be borne in mind that these birds may not necessarily be those that are resident and breeding in the area under investigation. Young barn owls, which normally fledge between July and September, begin moving away from their natal areas at this time, with the median natal dispersal distance being 12 km. Dispersal is not usually over until early February the following year (Wernham *et al.* 2002) and it is not until later in February that the young owls have normally chosen the place where they wish to settle and pair up. After this they usually maintain a strong and intimate association with the area and their partner for the rest of their lives.

The Wildlife Conservation Partnership (WCP) can advise on where to obtain barn owl breeding records for use in desk studies especially in those areas of Britain where Species Recovery Areas (SRAs) and Barn

Owl Recovery Networks (BORNs) are located and the Barn Owl Conservation Network is operating. LRCs, CBCs and local wildlife groups may also hold some data. Other sources of information can include local farmers, landowners, foresters and reserve wardens, although consideration must always be given to the possible misidentification of barn owls, which is not uncommon in this group of birds.

Barn owl records, a significant proportion of which are usually of sightings rather than known nest sites, are often provided to county recorders at the 1 km-square level. However, because of the protected status of this species (Schedule 1: WCA 1981) and in some cases, the requirement for data suppliers to obtain agreement from the original collector to release site specific information, records may only be available at the wider tetrad (2 km-square) or 10 km-square level. In any case, data confidentiality and ownership restrictions must always be respected.

Large development schemes may have wider effects by disrupting the integrity of existing barn owl habitat networks which are today, largely responsible for the increasing numbers of this species in the UK. Where sections of these networks (BORNs) fall within the study area they should be identified and reported as part of the Desk Study (see Appendix 1, Part 3).

3.1.1 Evidence of Breeding

Although the records provided for desk study will often be delivered in a range of formats, evidence of breeding can be defined in the following way (adapted for barn owls from Sharrock 1976):

Confirmed Breeding: breeding can be described as *confirmed* when a pair of owls is recorded occupying a potential nest site during the breeding season or when eggs, egg shells, chicks and/or juvenile down are identified at or near to a *potential nest site*.

Probable Breeding: breeding can be described as *probable* at a *potential nest site* when a barn owl is observed carrying prey into the site, a pair is seen or heard calling during the breeding season or when a collection of *active roost sites*, food cache and/or female moulted wing feathers are identified at or near the site.

Possible Breeding: breeding can be described as *possible* when an occasionally-used spring or summer roost has been identified in an area containing one or more *potential nest sites*, but where there is no other evidence of breeding.

3.1.2 Receipt of Data

Those requesting data from groups which hold biological records should expect to receive a tabulated summary of the known breeding records within 5 km of the boundary of the proposed development area and whether or not the Desk Study Area constitutes part of a Barn Owl Species Recovery Area (SRA) or wider Barn Owl Recovery Network (BORN). Where the data provider is able to estimate the extent of local survey or monitoring effort for barn owls this should also be recorded using the following broad categories '*patchy coverage*'(<25%), '*partial coverage*'(c50%), '*dedicated survey coverage*'(>80%). This allows the recipient of the data to assess, with greater confidence, the population density in the Desk Study Area thereby enabling the magnitude of effect of any proposed development on the local, regional populations of this bird, to be interpreted more robustly.

The tabulated summary, accompanied by a 1:50,000 scale map detailing each record, should include:

- the grid reference for each site;
- the date/year of the most recent observation or nest visit;
- the category of breeding (confirmed, probable or possible); and
- a broad description of the breeding site.

Where requests are made for data of this type, a fee to cover the cost of its retrieval, preparation and dispatch, should normally be expected.

To protect barn owls and to maintain landowner privacy, specific locations of any breeding sites provided as part of a Desk Study to a resolution of six figures (100 m) should be treated in confidence by the recipient and must not be transferred to a third party. These site-specific data should not be published in any public document, related or unrelated to the scheme at a resolution greater than four figures (1 km^2 level). *Figure 3* provides an example of a completed Desk Study.

3.2 Stage 1: On-site Scoping Survey

The Stage 1 survey should aim to broadly establish and record those features, such as built structures, mature trees and habitats, which on later more detailed inspection (during the Stage 2 Survey) might offer potential nest sites, roost sites or foraging habitats for barn owls.

3.2.1 Defining the Survey Area

For most residential, commercial or land development schemes, including pipeline construction, the most significant impacts are those that result in the permanent loss of breeding barn owls from a site. Displacement can also arise from the destruction or disconnection of key habitat features including nesting, roosting and foraging sites. For schemes such as these the survey area is normally defined as that which falls within the development footprint. However, where a site offers potential foraging habitat and where barn owls do not breed within the site boundary, but may do so just outside, the survey area may need to be extended to ensure that a full assessment can be made of the site's value.

Additional impacts can arise from other types of development such as transport schemes (road, rail and air), wind generation and overhead power line schemes. Barn owls have for example, been shown to modify their behaviour in response to road traffic noise (Shawyer and Dixon 1999). More significantly they experience direct mortality from collision with road vehicles, trains and aircraft as well as wind turbines and their associated infrastructure. Nocturnal activity is probably one reason why collisions with objects pose a particular hazard to this species. Even in those situations where collisions may be judged as infrequent, these can have a significant impact on local barn owl populations (Shawyer 1987, Shawyer and Dixon 1999).

Traffic collisions, for example, often result in the depletion of local breeding populations within 1.5 km of a major trunk road, motorway or main line railway, causing the permanent loss of breeding barn owls within these 3 km wide habitat corridors. In countrywide terms too, the magnitude of road traffic collision events as a proportion of the breeding population, is the highest of any British bird, removing an estimated 20% of the barn owl population (3,400 adults and juveniles) each year in England alone (Shawyer and Dixon 1999).

Although the impact of roads on barn owls and their local breeding populations is well known, the extent to which barn owls are affected from collision with wind turbines in Britain is less clearly understood. Raptors and bats are, nevertheless, considered to be vulnerable (Janss 1998, Orloff and Flemming 1999, Thelander *et al.* 2003, Whitfield *et al.* 2005 and Bat Conservation Trust 2010). In the UK, barn owls along with other raptors, including hen harrier *Circus cyaneus* and white-tailed eagle *Haliaeetus albicilla*, have been found and reported beneath turbines (BOCN Advisers pers comm., Scott 2009, Lucey 2011) and mortality resulting from collision with their associated infrastructure, such as overhead power lines, is not uncommon (Shawyer 1987).

Barn owls, although defined as '*High Sensitivity*' in terms of their conservation importance by Scottish Natural Heritage and the British Wind Energy Association, are sometimes given scant attention during ecological surveys of proposed wind generation projects (micro and macro) in the UK. This is of particular concern because large numbers of wind farms have been built or are being proposed in those areas where barn owl species recovery programmes are operating and which are established as SRAs. SRAs have emerged over the last 20 years as a result of long-term local and regional conservation programmes which were set up and developed to meet the requirements of the UK Barn Owl Action Plan.

One reason that barn owls are given low priority or sometimes disregarded when assessing the impact of wind generation schemes is the inherent belief of some ecologists, that this bird confines its flight activity to

within a few metres of the ground and is unlikely to encounter the area swept by turbine blades. In reality however, this bird will fly at considerable height on fixed flight trajectories, when moving from its nest or roost site to outlying feeding habitat or when ferrying prey back to the nest. Potentially, this flight behaviour places barn owls, like many other birds of prey, at significant risk of collision with wind turbines.

For land developments that involve transport schemes (road, rail and air) and wind farms, where direct mortality can potentially have a significant effect on the viability of barn owl populations, field surveys should always extend 1.5 km from the proposed route alignment or 1.5 km from the boundary of the development.

3.2.2 Conducting the Stage 1 Survey

The Stage 1 Survey involves an initial walkover of the site during daylight hours to broadly define those habitat features of potential value. The findings can be incorporated as target notes into an Extended Phase 1 Habitat Survey where this is to be undertaken as part of the overall site assessment. The Stage 1 Survey is best conducted from clear vantage points alongside public roads, footpaths, farm tracks and field margins, where the near landscape can be scanned using binoculars. It is best undertaken in the late autumn, winter or early spring at a time when most trees are devoid of foliage and the land and its associated habitat features are most visible and accessible.

Barn owls are mainly found in rural parts of Britain where rough grassland in the form of fields, field margins, ditches, dykes and riverbanks are available for foraging. They generally select nest and roost sites free from excessive human disturbance; most commonly those associated with agricultural buildings and mature trees which stand alone in fields or those in hedgerow or along woodland edge.

Cavities, mostly those located in the main trunk or crown of mature hollow trees, provide almost one-third of natural breeding sites in the UK. This type of nest site is known to be more common in the eastern half of Britain, parts of South Wales and the Welsh Marches (*Figure 2*). Today tree-mounted and building-mounted nestboxes also have a similar distribution. Fissures in rock faces, including quarries, make up a small proportion of other breeding sites, particularly in northern Britain.

Whilst many built structures are likely candidates for recording, only those mature standard trees, which stand prominently in fields, hedgerows or are on or near the woodland edge with trunks of a sufficient girth to permit the formation of a large cavity, should be considered at this stage. The susceptibility of trees to decay and hence their suitability as a nest site for barn owls, varies with species and age.

The trunk diameter at chest height provides a guide to those trees which should be recorded in the Stage 1 Survey:

- ash *Fraxinus excelsior*, sycamore *Acer pseudoplatanus* and crack willow *Salix fragilis*: 0.5 m diameter or more (>80 years old),
- horse chestnut *Aesculus hippocastanum* and beech *Fagus sylvatica*, 0.75 m diameter or more (>150 years); and
- oak *Quercus robur*, 1.5 m diameter or more (>250 years).

Trees with trunk diameters less than this will rarely possess cavities of a suitable size for nesting barn owls and can normally be disregarded during the survey, unless they have experienced premature decay as a result of a lightning strike or wind damage, exhibit prominent crowns, often the result of early pollarding, or contain a nestbox suited to barn owls.

Following concerted conservation efforts during the last two decades, large numbers of artificial nests, including owl lofts, owl towers and nestboxes, have been installed (Shawyer and Johnson 1990, Dewar and Shawyer 1996, Shawyer and Sheppard 2006). In 1997 these structures represented 38% of all known breeding sites in the UK (Toms *et al.* 1998) and by 2006 this was reported to have increased to about 70% (Shawyer 2006). As a result, artificial nests are likely to be the most common type of nest site encountered by fieldworkers undertaking barn owl surveys.

Based on the setting and structure of these habitat features, the Stage 1 survey requires that those features which are considered broadly suitable to barn owls can be recorded at two levels, *moderate* or *high*. The survey does not at this stage require the fieldworker to enter the confines of buildings or to climb trees or cliffs to establish if these habitat features contain a suitable nest chamber or cavity.

3.3 Stage 2: Investigative Field Survey

The purpose of the Stage 2 Survey is to carefully inspect and identify those built structures, mature trees or rock fissures, originally recorded in the Stage 1 Scoping Survey to determine if they offer a *Potential Nest Site (PNS)* or an *Active Roost Site (ARS)* for barn owls. Habitats in the survey area, which on the basis of their appearance and structure offer *Potential Foraging or Commuting Habitat (PFH),* must also be identified at this stage and along with PNS and ARS, accurately recorded using a hand-held global positioning system (GPS) or similar device (mobile phone).

3.3.1 Defining and recording a Potential Nest Site (PNS)

Trees and built structures identified during Stage 1 Scoping Survey, should now be observed at close quarters to establish if, behind the hole or entry point, they possess a cavity or chamber which provide the necessary features for a potential breeding site. This requires appropriate climbing equipment such as a ladder or mechanised work platform. When close inspections of this type are being undertaken during the breeding season a disturbance licence must be obtained from the relevant SNCO.

Only those sites which possess a hole of at least 80 mm diameter (about tennis ball size) or vertical slot of this width backed by a sufficiently large and dark chamber with a floor area normally greater than 250 mm x 250 mm, should be recorded, as a PNS. Barn owls can access holes of only 70 mm in diameter, but adult females (which are larger than males during the breeding season) are usually unable to access holes smaller than 80 cm. Nest chambers themselves should be considered unsuitable if they are open-fronted, illuminated by natural or artificial light or have a floor area smaller than that described above.

Potential Nest Sites typically include:

- agricultural or old industrial buildings with suitable access and possessing an upper floor, loft, roof void, blocked chimney, wide wall plate, bale-stack, empty water tank, ducting or large nestbox;
- disused or derelict cottages or industrial buildings such as aircraft hangers, which possess an open joist, broken ceiling panel, water tank, disused chimney or large nestbox;
- mature trees, isolated or in clusters in open fields, hedgerow or on the woodland edge, containing a hole >80 mm backed by a large, dark cavity, including those which have rotted-out to ground level but which offer no obvious access to ground predators through an open root structure;
- outdoor nestboxes on poles, trees, buildings or owl towers, which offer a darkened chamber;
- outdoor bale-ricks;
- cliffs and quarries with caves or fissures;
- waterway, rail or road bridges containing suitable cavities etc. within their structure; and
- churches, mainly rural, and the chimneys of intermittently-used holiday homes.

During the planning phases of a barn owl field survey it is important to recognise that throughout many agricultural landscapes in the UK, potential nest sites in trees can commonly exceed those in buildings by five to one and this disparity can be even greater, for example, in parts of South Wales, Hertfordshire and Nottinghamshire where recent field surveys have been conducted by the author. Project Barn Owl revealed that in the UK as a whole, potential nest sites in trees outnumbered those in buildings by two to one (Toms et al 1988). Notable exceptions do however occur, such as in northern Britain, the fenlands of East Anglia and mosslands of Lancashire where buildings can make up a greater majority of potential barn owl nest sites and in parts of Scotland, particularly the Western Isles, where rock fissures can predominate.

3.3.2 Defining and Recording an Active Roost Site (ARS)

Active Roost Sites (ARS), containing any signs of barn owls, should also be identified during the Stage 2 Investigative Survey.

An ARS is defined as a place at which breeding does not occur, but where the bird is seen or heard regularly or its current or recent presence (last 12 months) can be recognised by signs of thick, chalky - white, streaky droppings (commonly referred to as 'splashing', 'whitewash', 'mutes' or 'liming') which is usually accompanied by regurgitated pellets and moulted feathers. Pellets and feathers are diagnostic and provide evidence that the roost site is that of a barn owl rather than another bird of prey such as a kestrel *Falco tinnunculus*, little owl *Athene noctua* or tawny owl *Strix aluco*. All of these species can also excrete, projectile chalky-white droppings but can be distinguished from one another by the clear differences in size and appearance of their moulted feathers and pellets (see: Shawyer 1994 for species pellet identification).

Like nest sites, roost sites can be found in old buildings, bale-ricks, trees or rock faces. Unlike nest sites however, they can sometimes occur quite close to the ground and often in open-fronted buildings that are well lit. Roost sites are commonly on a beam, length of upright timber leaning against an interior wall, fence post, exposed tree branch, in a dense conifer or ivy-clad tree or inside a 'witches broom' (usually associated with mature lime trees *Tiliaceae sp*). Occasionally, roost sites can be found in woodland, particularly in those areas where more typical roosting opportunities in open buildings or isolated trees are in short supply.

An ARS should be recorded as one which is *occasionally-used* or *regularly-used*, depending on the amount of pellets, droppings and feathers that are revealed at the site. An ARS should also be recorded as a *winter, spring, autumn* or *summer* roost. This can usually be determined by the age of pellets and the presence or absence of moulted wing and tail feathers at the site. It is also possible to tell from these signs, together with pellet debris and droppings, if the site has been used in the recent past (between 12 and 36 months) or historically (3 years ago or more). A service has been provided by the BOCN since 1990 to assist ecologists and others in the identification and ageing of owl pellets (Shawyer and Johnson 1990).

When moulted primary or secondary wing feathers are found it is often possible from their colour and intensity of marking to determine if the roost site is that of an adult male or female (Shawyer 1996) and by measuring the length of any wing feathers that are found, the probable age of the bird (Shawyer in prep). Although this information can be useful, this level of detail is rarely necessary for barn owl surveys of the type undertaken by ecologists.

3.3.3 Defining and Recording a Temporary Rest Site (TRS)

Small spots of thick, chalky cream-coloured droppings that can often be seen underneath a tree, in a building or on a fence post and which are sometimes accompanied by an occasional pellet or body feather, can indicate a temporary night-time stopping-off place of a barn owl. Although this level of observation is not an essential requirement of a barn owl survey, when these signs are identified they are best described and recorded as a *Temporary Rest Site (TRS)* rather than an ARS.

3.3.4 Defining and Recording Potential Feeding and Dispersal Habitat (PFH)

Specific surveys are required within the study area to interpret the importance of the feeding and dispersal habitat to barn owls and these are also assessed and recorded during the Stage 2 Survey.

Barn owls can utilise a variety of different habitat types but the majority of prime foraging habitat in mainland Britain, is provided by fields of rough grassland and young plantations, and in particular by rough grassland corridors along watercourses, roadsides, arable field margins, woodland edge and occasionally along wide woodland rides (Shawyer 1987).

In Britain, a pair of owls will typically occupy a home range of 3-7 km^2 during the breeding season. Within this they normally require 30-50 ha of rough-grassland when comprised largely of whole fields (Shawyer 1996, Askew 2006). For barn owls which occupy arable areas where grass fields are largely absent, 15-25

km* of rough-grassland margin (i.e. 7.5-12.5 km of twin margin when associated with watercourses and hedgerow) a minimum of 3 m wide (4.5-7.5 ha) is normally required within the home range, for successful breeding to occur (Shawyer 1987). In parts of south-west Scotland where rough grassland habitat is largely confined to woodland edge, 9-11 km* of grass margin is considered necessary for maintaining a stable population (Taylor 1989, 1994).

During the Stage 2 Investigative Survey, grassland habitats should be systematically identified within the study area in terms of their suitability as a feeding resource. These can be largely defined by their structural composition (Shawyer and Dixon 1999).

3.3.5 Defining Habitat Types

(i) Type 1 Habitat
Type 1 Habitats are those which provide optimum habitat to field voles *Microtus agrestis* (for breeding, foraging and shelter) and are of the highest value to barn owls. This habitat type is usually permanent, unimproved or semi-improved grassland, rank and heterogeneous in appearance, often of mixed height, with fully or partly collapsed dead grass stems (straw) often dominating the leaf sward. This grassland possesses a high abundance of raised tussocks per unit area (typically 4-40/m^2) coupled with a basal litter layer or 'thatch' of straw, at least 30 mm deep (Shawyer 1998). Type 1 Habitats usually receive no real management or anything other than periodic light grazing by farm animals. Long-term set-aside grassland and unmanaged fields, wasteland, ditches, riverbanks, field margins and road verges are the most common examples of this habitat type. When viewed in the wider landscape, Type 1 Habitats can usually be recognised, particularly in the autumn, winter and early spring, by their golden or green/brown appearance, and are sometimes described as 'white grassland'.

(ii) Type 2 Habitat
Type 2 Habitats are sub-optimal to field voles and are of intermediate and often transient value to barn owls. This type of improved or semi-improved grassland is characterised by having a homogeneous, more even-height sward, sometimes displaying some lush and emerging tussock structure but little sign of a litter layer or 'thatch'. It can sometimes constitute a mature clover/grass ley and usually receives some level of farm management such as occasional fertilization, annual topping or light grazing. When seen in the wider landscape, Type 2 Habitats normally have a more uniform, dark green appearance, than Type 1 Habitats.

(iii) Type 3 Habitat
Type 3 Habitats offer very poor habitat for field voles and most other small mammals and as such are of low value to barn owls. These improved grasslands are characterised by having a homogeneous sward, which is often kept short throughout much of the year, no tussock structure and are devoid of any litter layer at their base. They are usually mown closely for hay or silage, heavily grazed by sheep, horses or cattle or used for public amenity. They normally display a uniform bright green appearance when viewed in the wider landscape. Acid grasslands and those grasslands overgrown with scrub which can restrict barn owls from hunting, also fall into this habitat category. Type 3 Habitat is not normally illustrated on the final survey map because of its low suitability to barn owls.

Other Habitats
Non-grassland habitats, such as arable fields and mature woodland are generally of little or no value as a permanent foraging resource to barn owls. Arable fields containing cereals, rapeseed, or other food crops do not provide suitable habitat for field voles, although at certain times of the year, such as during harvest, they can, for short periods, expose wood mice *Apodemus sylvaticus* and temporarily attract barn owls. Prior to harvest, however, arable crops are largely impenetrable to foraging barn owls because of the stiff nature of the crop and high density of planting. For the purpose of the survey, arable fields without grass margins and woodlands (except those possessing wide grass rides or young plantations) are, therefore, considered unsuitable for barn owls and are not illustrated on the eventual survey map.

*Edge habitats such as rough grassland margins which are over 3 metres wide, usually provide a much higher density of field voles, per unit area, than whole fields of rough-grassland. For this reason the degree of prey richness is more reliably expressed in terms of unit length where grass margins are the predominant habitat type, rather than unit area.

3.3.6 Defining a road Traffic Accident Blackspot (TAB)

For road and rail development schemes, the bisection of prime foraging habitat (Type 1 and 2 Habitats) by a newly proposed major route will predispose this location as a future road/rail traffic accident 'blackspot' for barn owls. For these types of development, potential 'blackspots' should be identified and recorded as part of the feeding and dispersal habitat survey, since they can direct future attention to specific types of landscape design at these locations and help mitigate the adverse impacts of road and rail networks on barn owls (Shawyer and Dixon 1999).

3.4 Stage 3 - Nest site Verification Survey

3.4.1 Confirming an Occupied Breeding Site (OBS)

A Stage 3 survey should be conducted if the earlier Stage 2 Survey identified the likely presence of one or more PNS or ARS.

To confirm the presence of an *Occupied Breeding Site (OBS)*, *e.g.* one where breeding was taking place or where it had done so in the recent past, the Stage 3 Survey requires a detailed inspection of the PNS and ARS previously identified during the Stage 2 Survey. This is accomplished by checking for the presence of adult barn owls, their moulted feathers, pellets, eggs, egg shells, chicks or down.

The Stage 3 Survey must be conducted with the necessary disturbance licence from the relevant SNCO (Natural England/Scottish Natural Heritage/Countryside Council for Wales/Northern Ireland Environment Agency). Even when in possession of a licence the surveyor should first ensure that the nest sites they intend to visit are not already being monitored by another licensee or are part of a research or conservation project in the area.

Licence holders are obliged to keep any disturbance caused during this part of the survey to the minimum necessary to obtain the required information. All efforts should be made to avoid close inspection of occupied nest sites during the months of March, April and May. This is when barn owls are normally in the process of selecting their nest site or laying eggs and there is a particular risk of permanent nest desertion.

Even in early June, great care must be exercised when approaching nests to try and avoid the adults leaving the confines of the nest chamber. During egg-laying adult females will increase their body weight by up to 50% and often commence their wing moult. At this stage of the breeding cycle, hens in their second and third year of life can moult up to half of their primary and secondary wing feathers and their ability to fly becomes weakened. If birds are disturbed from the nest at this time they are often unable to achieve sufficient height to return to the nest and resume incubation. In this situation grounded females become prone to exposure, starvation and potential predation and nests are subsequently abandoned.

Nest abandonment can be significant during the early part of the breeding cycle so that nest verification surveys are best undertaken during mid-June, July and early August. This is also the time when nests can be detected most easily because chicks are often vocal and food deliveries by the adult birds (sometimes as many as 30 prey items in 24 hrs) are most frequent. Late or repeat clutches are usually laid in the latter half of June, whilst second clutches are often not begun until the end of July or early August. These events are likely to be missed if surveys are conducted too early in the year. It is also worth noting that for late or second breeding attempts, hatching may not begin until the end of August with chicks present in the nest until October or November (occasionally, December) when dispersal out of the natal area can occur as late as February.

Barn owls do not construct a nest but usually lay their eggs on a cushion of pellets the female has actively shredded. In buildings, pellets and droppings can often be found in abundance in the vicinity of nest sites, but only because the adult male commonly roosts nearby at this time. However, these remains are rarely deposited beneath the nest chambers of outdoor sites such as trees and nestboxes. This means that many breeding sites are commonly overlooked by fieldworkers. Often, the only indication that breeding may be taking place is the presence of a single long streak of chalky-white dropping deposited on the ground a

metre or so from the nest as the bird emerges or an occasional pellet or egg shell that has been caught up in the talons and accidentally dragged out of the nest chamber. In the case of tree nests, an isolated patch of droppings and an occasional pellet can sometimes be found on the ground beneath a prominent overhanging branch. It is here where the male will often sit prior to hunting and when guarding his partner in the nest chamber, a few metres away.

Young barn owls will often remain in and around their nest chamber for a few weeks post-fledging, sometimes into early winter. It is only at this time of the year that pellets and droppings will often begin to accumulate, usually in discrete patches, beneath or alongside an occupied nest cavity, often revealing its presence for the first time.

From the ground and with the use of binoculars *Occupied Breeding Sites* can often be identified by the presence of juvenile down (white 'snowflake-like' wisps of fine feathery fronds attached to a short and tiny quill) or a small body feather caught up in a cobweb or by tree bark, alongside a potential nest cavity or found downwind in nearby vegetation. The presence of blowflies around the entrance of a potential nest which are attracted by food remains within the nest, can also be indicative of an *Occupied Breeding Site*.

Observations of these signs from ground level are sometimes insufficient on their own to confirm the presence of an active nest and it is usually necessary to check the contents of any cavity or chamber as quietly as possible, using a ladder, climbing harness or mechanised lift platform. Although tawny owls nest earlier than barn owls they may occasionally be encountered during barn owl surveys. When tawny owls are suspected, a strong face mask (chainsaw visor), hard hat and heavy jacket should be worn for protection since, unlike barn owls, this species can sometimes be aggressive in the defence of its young.

Although male barn owls often attend their mates close to the nest chamber and will often fly when approached, brooding females can sit very tight and will rarely move away until direct eye to eye contact has been made with the surveyor. Even then the owl may 'play dead' or shuffle into the deeper recesses of the chamber in an attempt to hide. To confirm or deny breeding, therefore, the chambers and cavities of all *Potential Nest Sites* need to be inspected closely using a pencil torch. Where direct viewing is restricted a small digital/inspection camera can be held at arm's length inside the entrance hole and multiple exposures made in different directions within the chamber. This method of detection is usually successful in revealing its contents. It is particularly valuable for recording and thereafter confirming or denying the presence of adults, their eggs or young, and any other signs of breeding, such as food caches, egg shells, moulted juvenile down or adult wing feathers, all of which can be hidden deep within some nest chambers.

It should be remembered that the Wildlife and Countryside Act does not permit the removal of abandoned or unsuccessful eggs. This can only be undertaken under an individual licence or at nestboxes between 1st August and 31st January, under the General Licence issued by the SNCO's in England, Wales and Scotland. This licence is issued for the purpose of conserving wild birds and permits the removal and immediate destruction of unsuccessful eggs, before the next breeding season. For the surveyor, any identification of eggs or egg shells must take place *in situ* and a photographic record can be helpful.

If evidence of breeding remains inconclusive during the Stage 3 Survey because buildings may have been considered too unsafe to enter or for other reasons, observational surveys to detect the arrival of adults with food and thereby confirm or deny breeding can be conducted at dawn or dusk and at a discrete distance from the site. Fledglings will also emit food-begging calls at this time which are often audible from a distance of up to about 100 m. However, great care should be taken not to confuse the calls of young barn owls with those of young little owls, which are similar, both species often co-existing in some parts of England and sometimes nesting together in the same building, bale-stack or tree.

For development schemes which are small in size (below 75 ha), observational surveys can also be useful when attempting to establish those places which are being used for movement and feeding by the resident barn owls. They can complement the Stage 2 Survey where potential feeding and dispersal habitats have already been identified and recorded. For wind farm developments, details of barn owl movements and flight heights should also form part of the barn owl survey in order that any adverse impact to barn owls from their potential collision with wind turbines and their associated infrastructure, can be fully evaluated.

Although barn owl nest verification surveys are best undertaken during the breeding season, they can also be conducted successfully by experienced barn owl ecologists after the owls have vacated their nest site, during the late autumn and winter months. At this time the nest chamber will often fail to show the signs of occupancy normally characteristic of this bird and to the untrained fieldworker would appear that the site has not been used for breeding in the recent past. However, confirmation of a recent breeding attempt can usually be determined from subtle signs left behind. These can include the confetti-like scattering of scales from the quills of developing wing feathers over compacted nest debris, matted dirty-grey down caught on rough surfaces, or the more obvious clues, such as unhatched white eggs (not to be confused with those of stock dove *Columba oenas*, other owls or duck species, which to the untrained eye, can look very similar), adult female wing feathers or the remains of dead young. Sites where breeding has been confirmed as having taken place prior to the survey should also be referred to as an *Occupied Breeding Site*.

Although many barn owls do not venture into their nest chamber after the breeding season and during the winter months they will often maintain an occasional presence near the breeding site. In the case of outdoor nestboxes and trees an occasional pellet or dropping can sometimes be seen on the roof, beneath the landing ledge or under a nearby branch, but outside the breeding season these signs are rarely discovered inside the nest chamber itself.

It is important to understand that although wild adult barn owls are considered to be short-lived (2-5 years on average) they have been known to live for up to 15 years in the UK (Shawyer 2011) during which time they remain very faithful both to their partner and the breeding site that they have chosen in their first year of life.

It should be recognised that if the survey fails to identify the presence of breeding barn owls it does not necessarily mean that the species is not normally resident in the area being studied. In some years when food abundance is very low barn owls will fail to breed or may not begin breeding until later in the year in July, August or September after the survey has been completed.

Considerations of time and cost sometimes require that the Stage 1, Stage 2 and Stage 3 surveys are undertaken concurrently, in which case the optimal time for this combined survey is during the months of mid-June and July.

3.5 Recording and Presentation of Data

Potential Nest Sites (PNS), Occupied Breeding Sites (OBS), Active Roost Sites (ARS) and Temporary Rest Sites (TRS) which have been accurately recorded, normally using a handheld GPS, are tabulated alongside the site name or site reference (*Figure 4*). These spatial data together with the Type 1 and Type 2 Habitats which were identified during the Stage 2 Survey are then transferred to a minimum accuracy of eight OS Grid figures, either by hand onto a 1:25,000 base map or if opportunities are available, by direct downloading onto an appropriate GIS computer mapping programme.

The following colour mapping palette is recommended when generating the 'Barn Owl Survey Map' which will form part of the final written report. PNS can be illustrated as solid green circles, ABS in solid red, ORS in solid orange and TRS in solid yellow. For road/rail development schemes, solid black circles can be used to record *Potential Barn Owl Traffic Accident Blackspots (TAB)* or those places where road/rail casualties have positively been identified during the survey.

Type 1 Habitat can be illustrated on the map as solid green areas for whole fields and single green or dual green lines for grass margins. Type 2 Habitat can be depicted as green hatch. Field margins which have been classified as Type 1 and Type 2 Habitats can be illustrated on the final map as solid green or dashed green lines (*Figure 5*). Type 3 Habitat and other habitats which are largely considered unsuited to barn owls, such as arable farmland, woodland blocks and urban areas, although initially recorded on a field by field basis during the walkover survey, are not usually illustrated on the final Barn Owl Survey Map.

For development sites which involve wind turbines it is also necessary to establish the flight routes taken by barn owls, the flight heights they adopt and the feeding areas they are using. These details, which are necessary to establish the collision risk and hence the full impact of wind farms to local or dispersing birds,

should be carefully illustrated on a 'barn owl activity map' and this should also accompany the final survey report (*Figure 6*).

As well as providing an illustrative summary of the distribution and abundance of barn owls and habitats in the survey area, the completed survey map along with its associated data can be used to quantitatively assess the number of individual home-ranges or the number of breeding pairs that the area might potentially support. This information should be provided in the *conclusions* section of the final survey report.

During the course of the Stage 3 Survey, the breeding sites of other birds which may select large cavities may be discovered at potential barn owl nest sites. These commonly include stock dove, jackdaw *Corvus monedula*, tawny owl, kestrel, little owl, feral pigeon *Columbia livia* and occasionally tree-nesting ducks and geese such as Mandarin *Aix galericulata*, wood duck *Aix sponsa*, Egyptian goose *Alopochen aegyptiaca* and goosander *Mergus merganser*.

Confusion can sometimes arise in distinguishing between the unattended or deserted nests of barn owl, tawny owl, little owl and stock dove since none of these birds construct nests of any significance, and all produce medium-sized white eggs, which in the case of barn owl, stock dove and occasionally little owl, can overlap in size. If any of these species or any other cavity-nesting bird is found at a potential barn owl nest site then these should be recorded. Kestrel and stock dove can be of particular interest since they are both species of conservation concern and on the *Amber List* of BoCC in the UK.

3.6 The Survey Report

The final survey report should include background information about the purpose or rationale of the survey, the methods used and its findings and conclusions, which should define the value of the barn owl resource at the area, local and national levels.

If the report is likely to be open to wide public scrutiny, for example, as part of an Environmental Statement or Public Enquiry, breeding sites which have been provided as part of the Desk Study or located during the Field Survey at the six-figure grid level (accurate to 100 m), should be detailed in the final report at the four-figure grid level (accurate to 1 km). A footnote should be included to read: '*because of the specially protected nature of this species, to protect landowner confidentiality and to maintain the future security of the site from potential criminal activity or disturbance, barn owl breeding records are detailed in this report at the 1 km^2 level*'.

3.6.1 Report structure

The report should include clearly identified and numbered chapters. These should include a summary, an introduction providing a background to the site or survey area, the aims and objectives of the survey, conservation status of the species, the legislative context within which the work is set and a brief description of report's structure. This should be followed by a chapter detailing the methods which have been used, including any limitations or constraints of the survey such as, sub-optimal timing, inaccessibility to parts of the survey area, poor weather conditions etc. followed by chapters which discuss the results, conclusions and recommendations of the survey. References should be provided to support the methods which have been employed and any assumptions which may have been made. Further information on the recommended structure and content of survey reports can be found elsewhere (CIEEM 2011).

3.7 Report Recommendations

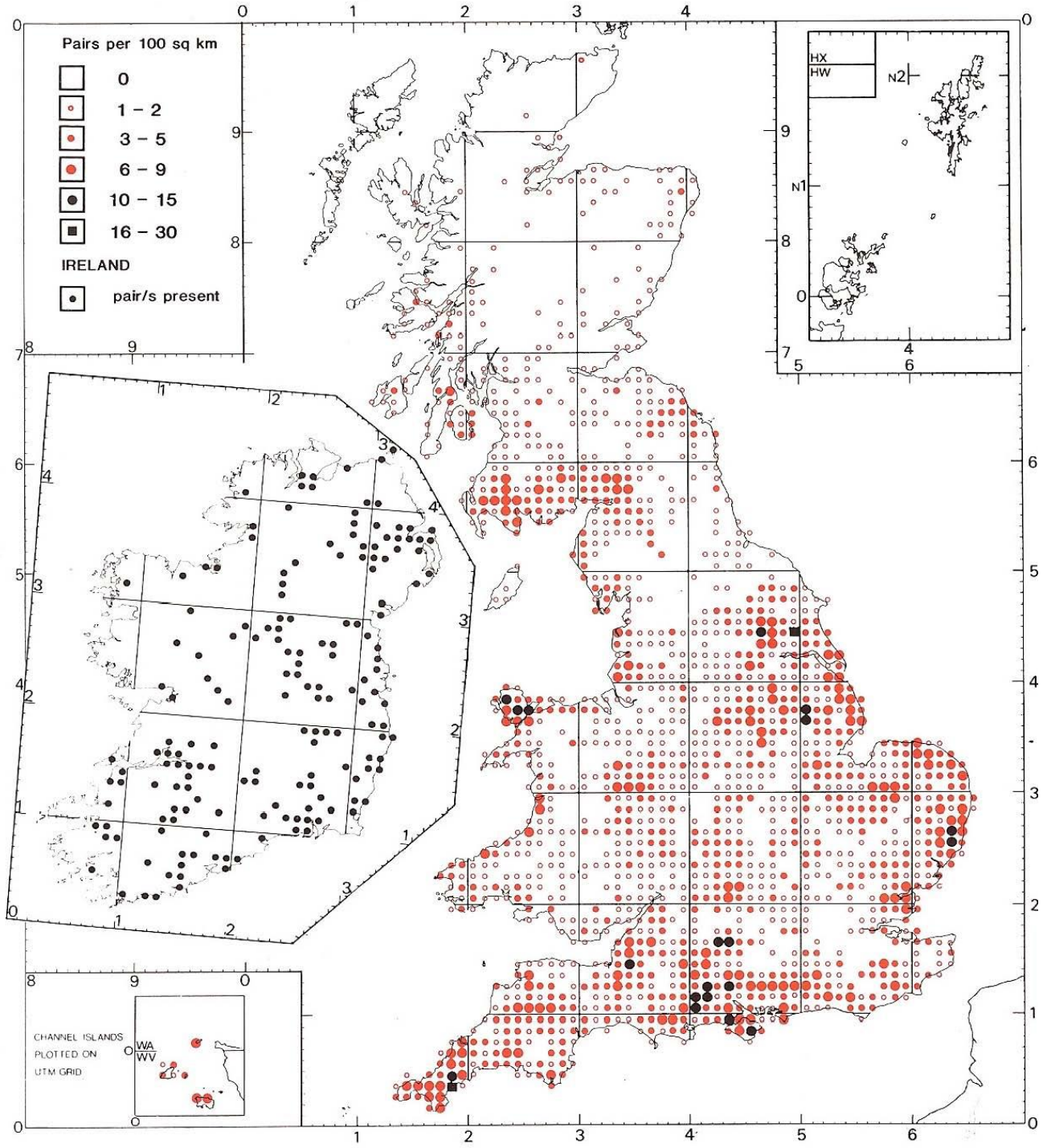
The recommendations should attempt to ensure that the project delivers conservation gain. They should include details for mitigating against or compensating for the impact of the development. This may involve the creation or enhancement of habitat and the installation of nestboxes or other artificial sites such as owl towers (Shawyer 2006, Shawyer and Holmes 2009) on or close to the development site (See Appendix III) or where transport schemes and wind farm developments are concerned, at least 1.5 km from their site boundary. In most cases measures such as these would be instigated and completed well in advance of any site clearance or other development works.

The recommendations section of the report may for example, also detail the need for a suspension of potentially disturbing activities during the breeding season or where activities are permitted at this time, the setting up of an appropriate stand-off distance or protection zone, the acceptable distance of which should be based on professional judgement (Appendix II). This may need to be accompanied by a *Species Risk Assessment* which would detail the potential risk of disturbance to barn owls at the site in question and prescribe methods of working to avoid or reduce this risk. The Assessment also demonstrates that the risk to this specially protected bird has been properly considered by the landowner, developer or their agent.

If the survey failed to identify the presence of breeding barn owls even though there was evidence of past breeding in the area, then the surveyor should recommend a repeat survey of all potential nest sites before the commencement of any works. A repeat survey must also be conducted if a period of nine months or more has elapsed between the initial survey being conducted and a planning application being submitted or approved and clearance or development works begin at the site.

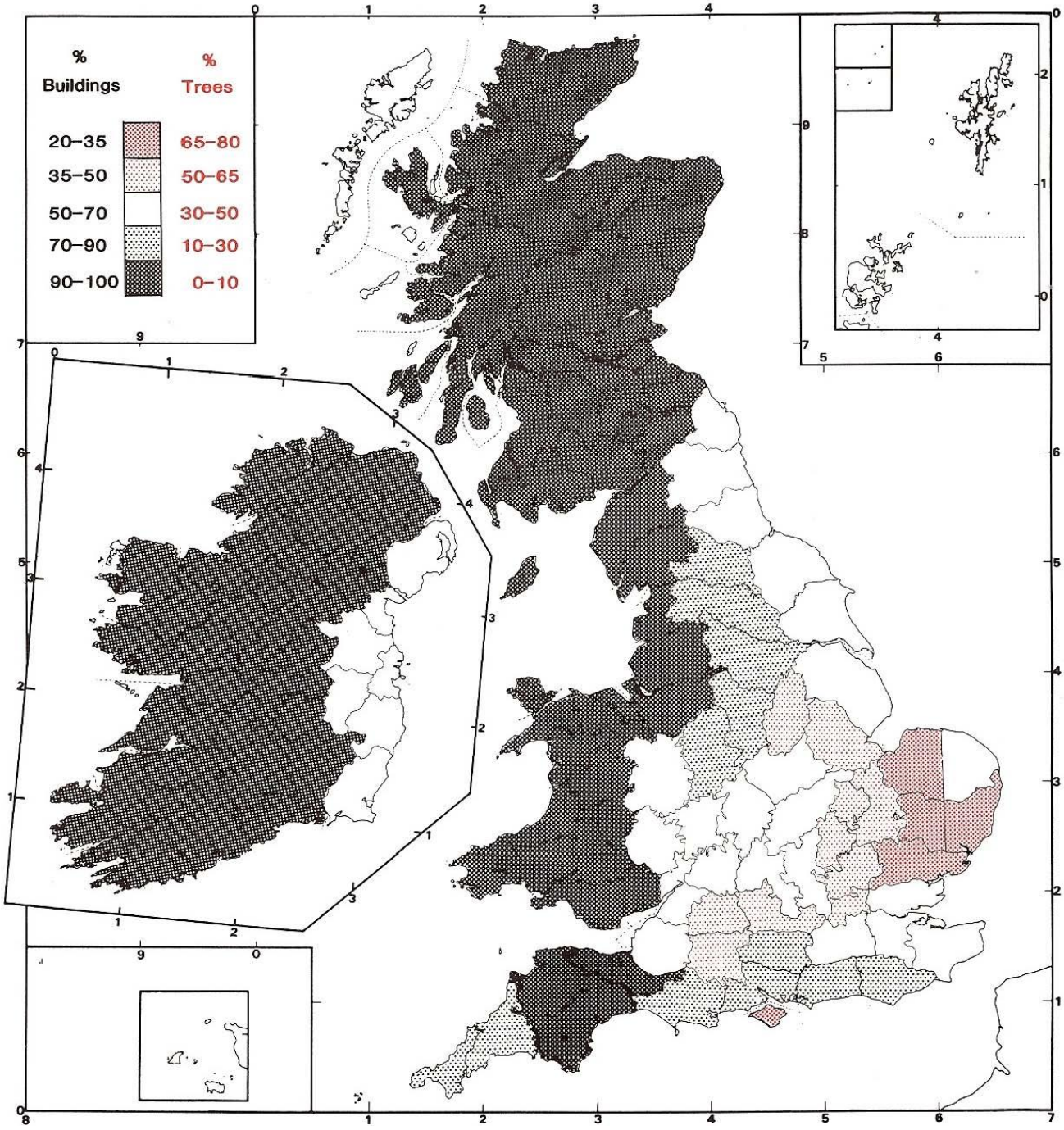
Regular monitoring during the period of development and for a minimum of three years post-development would normally be one of the key recommendations of the report. Monitoring procedures would seek to identify current occupancy at breeding sites, potential nest sites and the foraging habitats which had been identified by the survey, together with those places where any mitigation works had been undertaken. These results would be used to determine any displacement or enhancement effect of the scheme on barn owls. For wind farm projects, post-construction monitoring should also include a programme of collision monitoring for barn owls on the site so as to provide a complete understanding of the potential impact of the development itself and inform future projects of this type in the UK.

Figure 1. Distribution and abundance of breeding Barn Owls in Britain and Ireland



From: Shawyer 1987

Figure 2. Distribution of natural breeding sites (trees v. buildings) in Britain and Ireland



From: Shawyer 1987

Figure 3. Provision of data (table & map) to inform a Desk Study (hypothetical housing proposal)

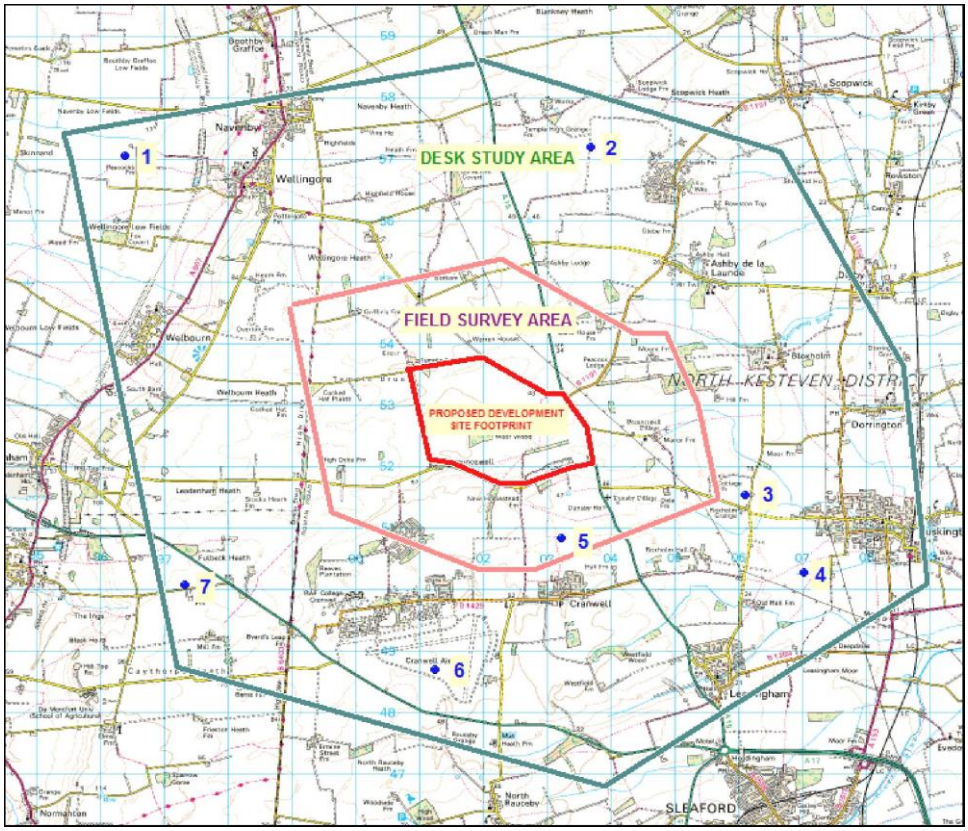
Desk Study

Barn Owl Breeding Records within 5 km of Proposed Development Site

CONFIDENTIAL
Schedule 1 (WCA 1981)

SITE	GRID REF.	BREEDING RECORD TYPE	NEST SITE TYPE	MOST RECENT RECORD
1	SK XXX XXX	Confirmed	Nestbox in barn	May 2007
2	TF XXX XXX	Probable	Cavity in oak tree	July 2009
3	TF XXX XXX	Confirmed	Nestbox in shed	June 2010
4	TF XXX XXX	Confirmed	Cavity in ash tree	July 2008
5	TF XXX XXX	Possible	Nestbox on pole	May 2010
6	TF XXX XXX	Confirmed	Barn loft	July 2010
7	SK XXX XXX	Probable	Hole in bale rick	June 2009

CONDITIONS OF USE
SITE DETAILS ARE CONFIDENTIAL. They have been provided for the specific purpose of informing a Desk Study in respect of the proposed development. The information must not be transferred to a third party or published in any public document to a grid accuracy greater than four-figures (1 km-square). This is to protect the breeding sites of birds on Schedule 1 of the WCA 1981, landowner confidentiality and ownership of the data.



Estimated level of current survey coverage in the Desk Study area: **Dedicated Coverage (>80%)**

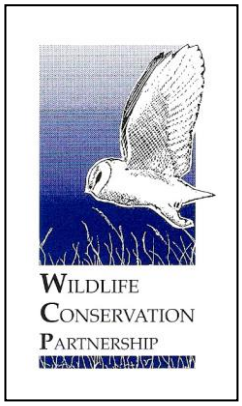
Is the Desk Study part of a Barn Owl **Species Recovery Area** (SRA)? **YES** / ~~NO~~

If **YES**

Does the SRA form part of a regional **Barn Owl Recovery Network** (BORN)? ~~YES~~ / **NO**

Figure 4. Barn Owl survey recording form (hypothetical rail scheme)

Date of Survey	12-14/09/2010
Place	Wheathampstead
Centre Grid Ref.	TL 177 136
County	Hertfordshire
Licence holder	John Smith
Species Recovery Area (SRA)	No
Surveyors	John Smith
Survey Method	*Shawyer 2011*
Licence/Permit Ref.	2012 01234
Licensing Authority	Natural England
Total survey time	10.5 hours



Nest/roost site type		**Description**		**Grid Ref.**
Built structures				
PNS	Derelict cottage		roof void	TL 1535 1607
ARS occasional/spring roost	Outdoor bale stack		between bales	TL 1591 1645
Trees		**Approx. girth**		
TRS	Ash tree	0.5 m d	dead outer branch	TL 1664 1568
PNS	Sycamore tree	2.0 m d	cavity in main trunk	TL 1698 1512
PNS	Oak Tree	3.0 m d	cavity in crown	TL 1643 1490
Cliffs				
OBS	Quarry		fissure in north face	TL 1660 1499
Artificial structures				
PNS	Nestbox		in tree	TL 1543 1522
PNS	Owl loft		in converted barn	TL 1519 1575
OBS	Nestbox		on pole	TL 1535 1610
ARS regular/winter roost	Nestbox		in barn	TL 1612 1675
Traffic accident 'blackspot' (road development schemes only)	**Description**			**Grid Ref.**
TAB	River bank/road	intersection	Type 1 habitat	TL 1727 1439
TAB	Green lane/road	intersection	Type 1 habitat	TL 1839 1442
TAB	Ditch bank/road	intersection	Type 2 habitat	TL 1666 1456
Grassland habitat type (all schemes)	**Description**			**Grid Ref. centre point**
PFH Type 1 Habitat	Field	Rank	unmanaged	TL 1766 1498
PFH Type 2 Habitat	Meadow	cattle	lightly grazed	TL 1672 1538
Type 3 Habitat	Pasture	sheep	intensively grazed	TL 1719 1545
PFH Type 2 Habitat	Meadow	vacant	occasionally mown	TL 1729 1487
Type 3 Habitat	Woodland block	pine	commercial	TL 1700 1390

Key:
PNS = Potential Nest Site. OBS = Occupied Breeding Site. TRS = Temporary Rest Site. ARS = Active Roost Site. PFH = Potential Foraging Habitat.

Figure 5. Barn Owl Survey Map (large hypothetical road development scheme)

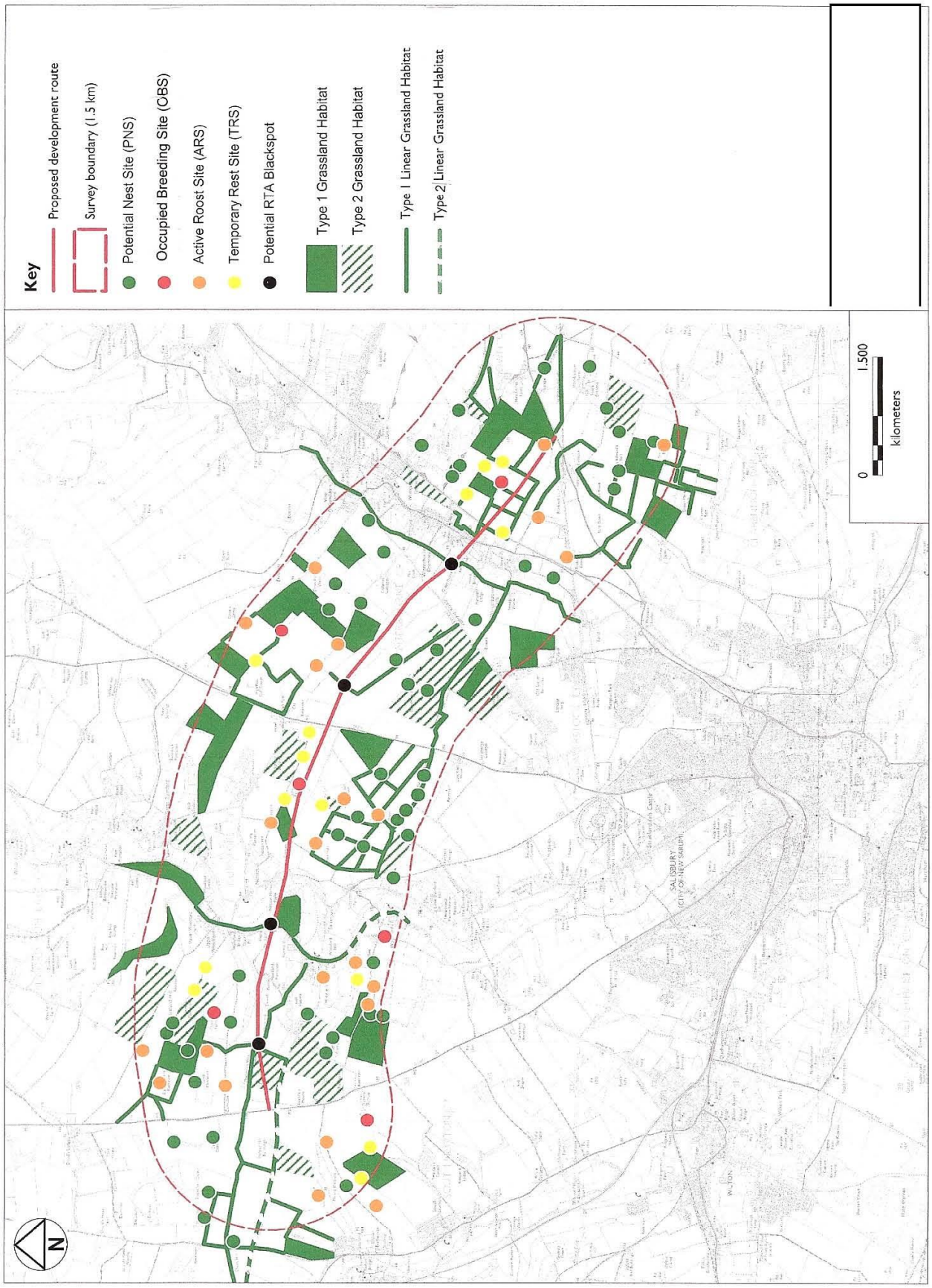
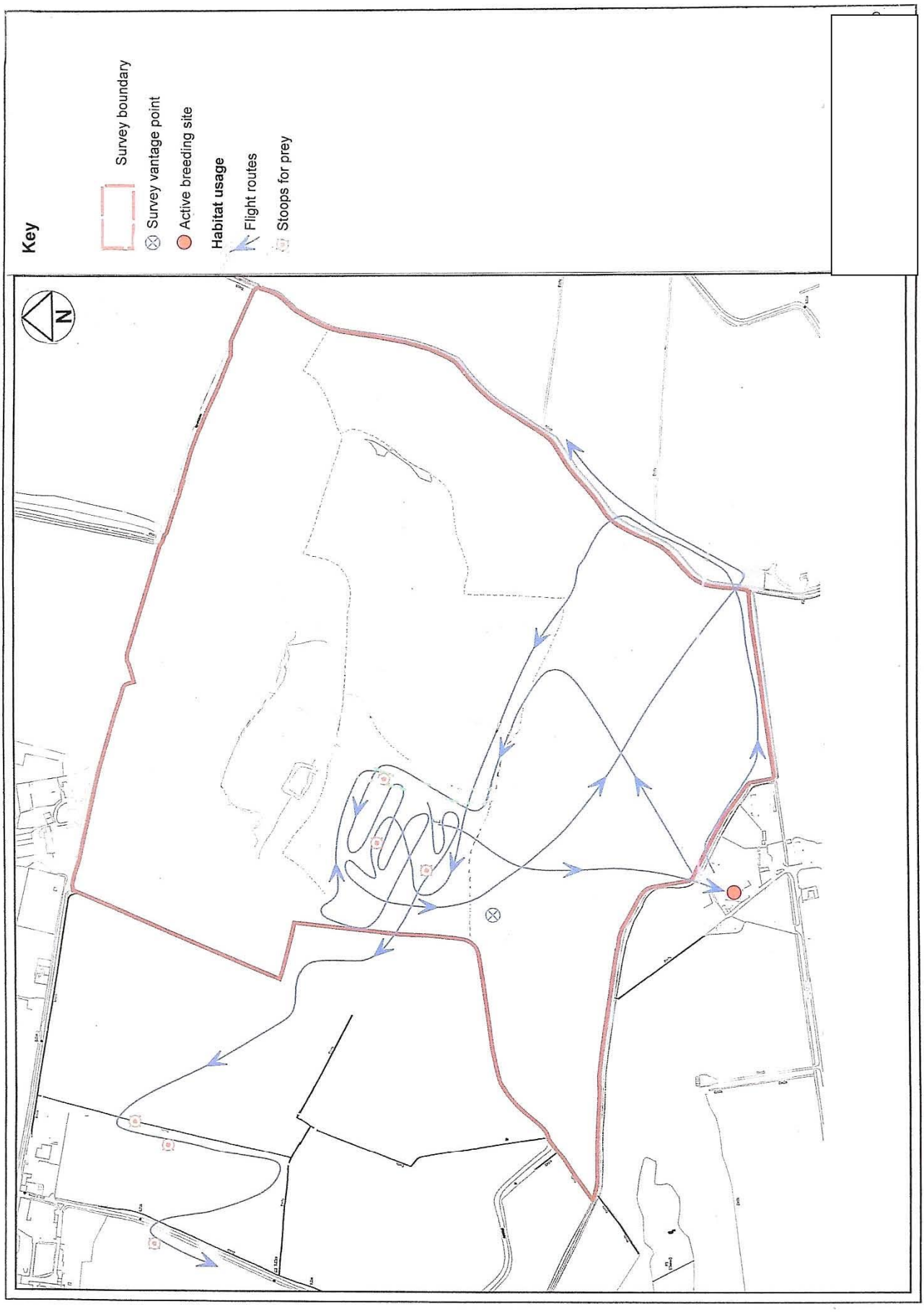


Figure 6. Barn Owl Activity Map (small hypothetical wind farm development proposal)



APPENDIX 1

Barn Owls in the UK: Status, Protection, Conservation, Legislation, Licensing Provisions and Planning.

Part 1 – Status

The barn owl is a relatively scarce breeding species that underwent a substantial population decline in the UK during the 20th century. Between 1932 and 1985 barn owl numbers fell by about 70% from an estimated 12,000 to 3,800 breeding pairs (Blaker1934), 600 in Scotland and 40 in the Channel Islands (Shawyer 1987). In 1997 a barn owl survey of the UK recorded a similar figure of 4,000 pairs (Toms *et al.* 2001). Since the 1980's declines in barn owl numbers have also occurred throughout much of northwest Europe and elsewhere in the world (Colvin 1985, Tucker and Heath 1994, Birdlife International 2004).

In the UK Biodiversity Steering Group Report (1995), the barn owl is listed as globally threatened, being on the list of 'Species of Nature Conservation Concern'. In Europe the species is listed as a 'Species of European Conservation Concern' (SPEC Category 3), having declined throughout most of its European range (Tucker and Heath 1994).

In the UK the barn owl is included in Red Data Birds in Britain (Batten *et al.* 1990), a book that catalogues those birds which are rare or in danger of extinction and Natural England identified the barn owl as 'High Priority, List 2 (Brown and Grice 1993). In 1992, the barn owl was placed on the '*Amber List*' as a species of '*Medium Conservation Concern*' in Birds of Conservation Concern in the UK (BoCC) (Eaton *et al.* 2009a) on account of '*a moderate decline (25%-49%) in the UK breeding range over the previous 25 years and as a species of European concern*'.

In Northern Ireland the barn owl is a Priority Species in the Northern Ireland Biodiversity Strategy and is 'Red Listed' in *Birds of Conservation Concern in Ireland*, which includes the Republic.

Guidelines developed by Scottish Natural Heritage and the British Wind Energy Association categorises the barn owl as a '*High Sensitivity Species*' when being considered in the context of wind farm developments.

Part 2 - Protection

The Convention on Biological Diversity, signed in Rio de Janeiro, Brazil in 1992, required parties to develop national strategies and to undertake a range of actions aimed at maintaining or restoring biodiversity. The UK Biodiversity Strategy was produced in response to the Convention.

Concern about the fragile status of the barn owl prompted the establishment of a UK Action Plan for the species which formed part of a wider document, *Biodiversity Challenge: an agenda for conservation in the UK* (Wynne *et al.* 1995). This took account of the RSBP/JNCC *Species Action Plan for the Barn Owl, 0735* (Williams and Galbraith 1992).

In England the barn owl is also included as a priority bird by the Environment Agency (EA) and is included in the biodiversity action plans of the Highways Agency (HABAP), the Trunk Roads Estates (TREBAP) and in those of other organisations such as Anglian Water, the Association of Drainage Authorities (ADA) and the Crown Estates. The barn owl is also included as a specific SAP within numerous Local Biodiversity Action Plans (LBAPs) in the UK, sometimes as part of a wider action plan for farmland birds. These have been produced under Agenda 21 of the International Convention on Biodiversity.

The importance of the barn owl in the UK can also be judged by its inclusion on the UK Government Farmland Bird Index of Sustainable Development and its Public Services Agreement target to reverse the index by 2020 and its appearance in the annual publication, The State of the UK's Birds (Eaton *et al.* 2009b).

Part 3 - Conservation

As a consequence of the barn owl's vulnerable conservation status and its inclusion in numerous BAPs this bird is the subject of a large number of *species recovery programmes* in the UK. These programmes which began in 1988 and are operated locally and regionally by Advisors of the Barn Owl Conservation Network (BOCN) are described as 'Species Recovery Areas' (SRAs) and are largely responsible for the increases in the breeding population which are currently being seen in the UK (Shawyer, 1989, 2002, 2007). Although SRAs are a non-statutory designation, they form part of regional and national 'Barn Owl Recovery Networks' (BORNs) which are of critical importance for the future recovery of barn owls.

Protection and enhancement of ecological networks are emphasised by the National Planning Policy Framework (NPPF, March 2012) as requiring specific consideration when planning applications are being considered by local authorities and when planning policy is being developed. Barn Owl Recovery Networks should, therefore, be given high priority during the scoping phase of a proposed development project when the ecological baseline conditions of the site or wider area are being assessed. This ensures that the effects of the proposed development on the integrity of existing barn owl habitat networks are fully considered. Details of established SRAs and BORNs in the UK are available from the Wildlife Conservation Partnership (WCP).

Part 4 - Legislation

Wildlife legislation in Britain is complex due to the requirements of various international conventions and European Directives. These include the:

International Conventions

Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats)
This convention, to which the UK is a contracting party, aims to conserve wild flora and fauna and their natural habitats. The barn owl is included in the list of strictly protected fauna and appears in Appendix II of this convention. Three articles of this convention are of direct relevance to the protection of barn owls.
Article 4 requires contracting parties to take appropriate legislative and administrative steps to maintain and preserve the habitats of species listed in Appendix I and II.
Article 4(2) requires contracting parties to take account of the requirements of such species in their planning and development policies so as to prevent the deterioration of such areas.
Article 6 requires contracting parties to prohibit deliberate capture, keeping or killing of Schedule II species or the destruction or disturbance of their breeding sites and the taking of both viable and non-viable eggs.

European Union Directives

Conservation of Wild Birds (2009/147/EEC) replacing **(1979/409/EEC)**
All EU countries are required to be signatories to this directive, commonly known as the **Birds Directive**. Article 1 of the Birds Directive extends the protection of this directive to all species of naturally occurring wild birds, in the European territory of a member state. This means that all species of wild bird which occur in any EU member state will receive protection in all EU member states whether that species ordinarily occurs in that country or not.

Appendices to the Directive list those birds which are accorded special protection, and those which are exempted and which may be treated as pests, hunting species etc. The barn owl receives general protection under this Directive, but is not listed in the annexes. Article 2 of this Directive requires member states to maintain the population of all species protected by this Directive at a level which corresponds to ecological scientific and cultural requirements, or to adapt the population to that level, and in order to achieve this. Article 3 requires member states to preserve, maintain or re-establish habitat for these species. Article 4 of this Directive requires the creation of Special Protection Areas (SPA's) for the most endangered species of birds, areas which in turn will form part of the NATURA 2000 network formed by virtue of the EU Habitats Directive below. Article 5 requires that member states establish a general system preventing killing, injuring, taking etc. of protected species or their eggs.

Conservation of Natural Habitats and of Wild Fauna and Flora 2009 (1992/43/EEC)
All EU countries are required to be signatories to this Directive, commonly referred to as the **Habitats Directive**, which together with the Birds Directive forms the EU's response to the Berne Convention. The Habitats Directive principally provides for the designation of Special Areas of Conservation (SAC's) for the protection of selected habitats (Annex 1) and the habitats of selected species (Annex II), but additionally lists species of flora and fauna, excluding birds, which are in need of strict protection anywhere in a member state (Annex IV). Article 3 of this Directive requires the establishment of a Europe-wide coherent network of SPA's and SAC's to be established under the title NATURA 2000 for the protection of the habitats of species of wild flora and fauna throughout all stages of their life cycles.
Article 10 requires member states to take account, where they consider it necessary in their land use, planning and development policies, to consider landscape features important for migration, dispersal and genetic exchange. This article makes specific reference to linear and continuous features such as field margins, river banks (which are of particular importance for maintaining and restoring barn owl populations) and stepping stone features such as ponds and small woods.
Unlike some EU directives neither the Birds Directive nor the Habitats Directive are directly applicable in UK law. The requirements of these Directives are transposed into national legislation through various provisions of the domestic legislation. These are now referred to.

UK Domestic Legislation

The Conservation of Habitat and Species Regulations 2010
These Regulations implement the EU Habitats Directive for the UK. They consolidate all of the amendments made since 1994 to the Conservation (Natural Habitats etc.) Regulations 1994 (S1 1994/2716).

The Wildlife and Countryside Act 1981
There are four parts to the Wildlife and Countryside Act (WCA) of which Part 1 sets out the protection that is afforded to all wild birds and certain animals and plants. Sections 1-8 relate to the protection of birds. The WCA is the primary legislation affecting birds in England, Wales and Scotland. This Act is amended in England and Wales by the Environmental Protection Act 1990, Countryside and Rights of Way (CRoW) Act 2000 and the Natural Environment and Rural Communities (NERC) Act 2006 and in Scotland by the Nature Conservation Scotland Act (NCSA) 2004 and the Wildlife and Natural Environment (Scotland) Act 2011. See below for details of these more recent Acts and their relevant amendments.

Section 1(1) of the WCA makes it an offence (in the absence of an appropriate licence) to intentionally kill, injure or take (capture, possess or control) any wild bird or anything derived from that bird, or intentionally to take damage or destroy its nest, eggs or young. (This requires that persons who are not qualified ringers but wish to handle any live bird to undertake biometric studies, must apply for a special licence to do so).
Section 1(2) makes it an offence to possess or have in your possession any live or dead wild bird or anything derived from such a bird, or any wild bird egg whether it is viable or abandoned. (A general licence is issued by the SNCO's in England, Wales and Scotland which permits the removal and immediate destruction of unsuccessful eggs from nestboxes between 1st August and 31st January, before the next breeding season, for the purpose of conserving wild birds).
Section 1(5)(a) and 1(5)(b) also affords additional and special protection to barn owls and certain other vulnerable species of birds, which are listed on Schedule 1 making it unlawful to intentionally and recklessly disturb these birds whilst they are building a nest or are in, on or near a nest containing eggs or young (5a) or to disturb their dependent young (5b). Barn owls do not 'build a nest' in the true sense but this activity is replaced by the shredding of pellets on which eggs are eventually laid. (Schedule 1 Species are those of high nature conservation priority or those in special need of legal protection but are not necessarily Red or Amber List species or Priority Species in the UKBAP).
Section 4(2)(c)) states that in England and Wales, a person shall not be guilty of an offence under Section 1 if his actions were ***the incidental result of a lawful operation and could not reasonably have been avoided***. This means that should a person's actions leading to the committing of an offence in these two countries be of an accidental or unforeseen nature as the result of an otherwise legitimate action, this could offer a defence to the offence of disturbance. In Scotland, a number of specific caveats, conditions or tests apply to this particular defence. In either case it would be for a court to decide whether this defence could be relied upon.

The barn owl is also listed on *Schedule 9* of the WCA, which controls the release of certain species to the wild (Department of the Environment 1992), making it an offence to release or allow a barn owl held in captivity to escape into the wild, except in the case of a disabled/injured wild bird which has been successfully treated and rehabilitated.

In addition to the Sections in the WCA (as amended by subsequent legislation) which include birds and other fauna and flora, Section 28 charges the SNCO of the relevant country with a duty to select and designate Sites of Special Scientific Interest (SSSI) and in Northern Ireland, Areas of Special Scientific Interest (ASSI), and to notify these to the owner/occupier of the land, relevant planning authority, Environment Agency and Secretary of State for the Environment.

The Countryside and Rights of Way (CRoW) Act 2000
Part 3 of Countryside and Rights of Way Act 2000, deals with nature conservation. In England and Wales this amended the WCA and created a new offence of recklessly disturbing a Schedule 1 bird whilst it is at, on or near an active nest or its dependent young. Actions are likely to be considered reckless if no thought was given to whether or not there was a risk of disturbance, that there was a failure to consider disturbance as an obvious risk or the risk of disturbance was foreseen and the risk was taken.

The Nature Conservation Scotland Act (NCSA) 2004
In Scotland the word 'reckless' was not only added to the WCA by the NCSA as an offence in respect of the disturbance to a Schedule 1 bird at an active nest but is also included in the general protection afforded to other wild birds. Protection under this Act also refers to the harassment of birds on Schedule 1A (for raptors; White-tailed Sea Eagle *Haliaeetus albicilla*) outside the breeding season and whilst away from the nest and/or the intentional or reckless damage or destruction to their nests whilst not in use (Schedule A1).

Both the CRoW Act 2000 and the NCS Act 2004 also increased the penalties for those offences relating to protected species under the WCA 1981. Breach of protected species legislation can give rise to a criminal offence under the Act, resulting in a maximum fine of £5,000 for every nest, egg or bird which is disturbed, damaged or destroyed and/or seizure of equipment and/or a custodial sentence of up to six months.

The Wildlife and Natural Environment (Scotland) Act 2011
The Act became law in April 2011 and introduced a new criminal offence of 'vicarious liability' for those who direct or turn a blind eye to bird of prey persecution.

The Wildlife (NI) Order 1985 performs a similar function in Northern Ireland to the WCA and is the primary legislation affecting all wild birds and certain animals and plants. Here the barn owl is listed under Schedule 1, Article 4 of this Order and is protected in a similar way to elsewhere in the UK.

In addition:
The Wildlife and Natural Environment (Northern Ireland) Bill, backed by the Northern Ireland Assembly in early 2011, provides increased powers of enforcement for wildlife crime and in particular gives protection for those nests of birds of prey which re-use their nests each year.

The Natural Environment and Rural Communities (NERC) Act 2006
This Act increased protection for biodiversity imposing a duty on all public bodies, including local authorities and statutory bodies, in exercising their functions, '*to have due regard, so far as is consistent with the proper exercise of those functions, for the purpose of conserving biodiversity*' [Section 40 (1)] and similarly in Scotland the NCSA 2004 imposes a duty on every public body and office holder, in exercising any function '*to further the conservation of biodiversity so far as it is consistent with the proper exercise of those functions*' [Section 1 (1)].

A provision under the NERC Act 2006, not unlike that of the NSCA, makes it an offence to take, damage or destroy, at any time of the year, the nesting places of particularly vulnerable birds of prey which re-use their nests and are listed on Schedule ZA1. These birds are Golden Eagle *Aquila chrysaetos*, White-tailed Eagle and Osprey *Pandion haliaetus*. This year-round protection does not, however, apply to the nest sites of other Schedule 1 birds such as barn owls.

Part 5 - Licensing Provisions

Provisions within Section 16 (1) (a) of the Wildlife and Countryside Act 1981 (as amended by the Environmental Protection Act 1990) enable licences to be granted to allow certain persons to undertake a specific activity involving a wild bird which would otherwise contravene the Act. These licences are issued by the SNCOs Natural England, Countryside Council for Wales, Scottish Natural Heritage and Northern Ireland Environment Agency. In addition the British Trust for Ornithology (BTO) under a licensing arrangement with the SNCOs, issues permits for ringing or marking and for those submitting details to the Nest Record Scheme of the BTO.

Licences are granted by the SNCOs to permit the activity of *disturbance* to a bird on Schedule 1of the WCA or the Wildlife (NI) Order 1985, whilst it is at or near its nest, for the purpose of *research, science, education* or *conservation*, by the method of *observation*. In England, where this involves ringing, marking or the observation of these marks, a disturbance licence is issued by the BTO on behalf of Natural England.

In Scotland, Wales and Northern Ireland (NI), applications for the ringing of a Schedule 1 bird are assessed by the BTO and passed on to the appropriate SNCO for issue. Licences permitting the disturbance of a Schedule 1 bird for the purpose of conserving wild birds or photography are issued directly by the SNCOs.

There is however, no provision within the Act for licensing the disturbance of a Schedule 1 bird, such as the barn owl, for any activity associated with development such as, construction, site maintenance and land management or for those events which involve leisure or recreation.

In this respect conservation bodies and some LPAs receive public expressions of concern about the possible disturbance of breeding barn owls. This usually involves sites where a change of use, or a development, involving land or buildings is either being contemplated or is underway. In some situations a barn owl survey has not been undertaken or when it has, barn owls have been overlooked. For large-scale construction schemes, insufficient attention is often paid during survey to those sites which are to be used as work compounds where personnel assemble and materials, equipment and heavy plant are being delivered, stored and operated. Often farmyards are leased by local landowners to the development company for this purpose and it is in situations like these where unlawful nest disturbance will often occur.

Demolition of buildings does not normally require planning permission, unless it is associated with a rebuilding programme. As a consequence, barn owl surveys are rarely undertaken in this situation and because this bird is often overlooked at sites such as these, it is not only prone to disturbance but can perish during the process of demolition. Where there are valid concerns for the breeding success of barn owls or for their welfare at sites undergoing demolition or at development sites generally, they should be referred to the local Police Wildlife Liaison Officer for investigation.

Unlike the situation with many other protected animals, such as bats, water voles, certain amphibians and reptiles, where licences can be granted to enable their capture and translocation (to prevent their injury, death or disturbance), there is no such provision within the Act for the capture or translocation of protected birds, such as barn owls.

Although there is provision within the Act for the issue of a disturbance licence for the purpose of preserving public health, public safety, air safety, preventing the spread of disease or for preventing serious damage to livestock, crops, growing timber, fisheries or inland waters, this provision has never been applied to barn owls in England and Wales.

The Licensing Act 2003

This Act came into force in 2005. It licences certain events such as open air music festivals and other regulated entertainment activities. Objections to the event or activity can be made by interested parties, such as the police or local residents, to the licence application. Legal advice, sought by the Merseyside Police in 2009, advised that the presence of protected wildlife, in this case breeding barn owls and the potential infringement of the WCA, namely the disturbance to a bird on Schedule 1 of the Act, constituted a reasonable and valid objection to licence an event on the grounds of '*the prevention of crime and disorder*' (David Peers *pers comm*).

Part 6 - Planning: Guiding Principles

Planning control is the process by which changes in land use are controlled in the UK and is a statutory duty of local authorities. Developers must apply to local planning authorities to change the use of land or built structures and to build commercial or residential developments.

Planning Authorities, in exercising their planning functions, must take account of various statutory obligations and policy requirements for nature conservation as well as advising developers that they must comply with statutory species protection provisions. By the use of the planning system, therefore, local and national governments have the opportunity to significantly affect the extent to which barn owls are protected and their populations enhanced. Indeed national government expects the planning system to help meet its objectives to conserve, enhance and restore the populations of naturally occurring species and biodiversity in general and this is reinforced by the Natural Environment and Rural Communities Act, 2006. The role and responsibilities of planning authorities and other competent authorities in the discharge of their duties in respect of protected species (European protected species in this case) were corroborated in a judicial review judgement (Judicial Review 2009).

National Planning Policy Framework (NPPF, March 2012)
In England guidance about species and habitat conservation is set out by the Government's *National Planning Policy Framework (NPPF)* which replaced *Planning Policy Statement 9 (PPS9), Biodiversity and Geological Conservation* (August 2005). One of the key principles of the NPPF and the aim of planning decisions is to conserve and enhance the natural environment by minimising impacts on biodiversity and provide net gains in biodiversity and protect priority species populations.

In particular the NPPF requires that the planning system

- should *'contribute to and enhance the natural and local environment'* by *'minimising impacts on biodiversity and providing net gain in biodiversity where possible'* thereby *'contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures'* (Section 11/109).

- *'plan positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure'*. (Section 11/114).

and that planning policies

- *'should identify and map components of local ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity, wildlife corridors and stepping stones that connect them and areas identified by local partnerships for habitat restoration or creation'* (Section 11/117).

- *'promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations, linked to national and local targets'* (Section11/ 117).

NPPF forms the basis of the planning system in England. Planning powers in Scotland, Wales and Northern Ireland are matters for their own assemblies, some of which are currently under review.

In Scotland
Scottish Planning Policy (2010), Section (14) Natural Heritage sets out national planning policy in relation to Scotland's heritage. All public bodies in Scotland including planning authorities have a duty to 'further the conservation of biodiversity' under the *Nature Conservation (Scotland) Act 2004.* The SPP highlights that this should be reflected in development plans and development management decisions. *The Environmental Assessment (Scotland) Act 2005 Schedule 3* specifically identifies measures which should be taken when determining the ecological value of a site, including its biodiversity.

The SPP is supported by Planning Advice Notes (PANs). *PAN 58 1999 Environmental Impact Assessment* and *PAN 60 Planning for Natural Heritage* are relevant.

In Wales
Technical Advice Note (TAN) 5 *Nature Conservation and Planning (2009)* supports *Planning Policy Wales, (Edition 4 - February 2010).*

In Northern Ireland
The Northern Ireland Department of Environment is responsible for planning and is supported by Planning Policy Statements (PPS). *PPS 2: Planning and Nature Conservation 1997* is currently under review as *PPS 2: Revised Natural Heritage.*

Compliance with Wildlife Legislation and Policy
Part 1, Section 25 of the Natural Environment and Rural Communities Act, 2006 places a duty on all local authorities in the UK to do what they consider expedient to bring the provision of the Act relating to protected species to the attention of the public and they are empowered to institute proceedings against any person committing an offence under Part 1 of this Act. Councils, for example, are expected to advise developers that they must comply with any statutory species' protection provisions affecting a proposed development site and the applicant must ensure that any activity undertaken, regardless of the need for planning consent, must not contravene wildlife legislation.

Aside from the Act itself, the presence of a protected or priority species, such as the barn owl, is referred to in the `Government Circular: Biodiversity and Geological Conservation Statutory Obligations and their Impact within the Planning System` (ODPM Circular 06/2005) as:

'a material consideration when a planning authority is considering a development proposal that if carried out, would be likely to result in harm to the species or its habitat.'

and planning authorities are expected to:

'promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations linked to local and national targets' where appropriate, by using planning conditions, obligations'` or Section 106 Agreements.

The British Standards Institute has published a Public Available Specification '*PAS 2010 Planning to halt the Loss of Biodiversity: Biodiversity Conservation Standards for Planning in the UK Code of Practice*' for LPAs on how they should address biodiversity in their planning work. Specifically it refers to the way in which they should discharge their functions in a manner that is compliant with statutory obligations, government policy and good practice. Some of the intentions and obligations imposed by the Biodiversity Convention, such as Biodiversity Action Plans (BAPs) under Agenda 21 of the Convention, have been given effect by the CRoW Act, Section 74(1) which imposes a duty on government departments to have regard for the purpose of conserving biodiversity (restoring or enhancing a population or habitat) when carrying out their functions.

Local planning authorities are expected to advise applicants seeking planning permission that they commission appropriate up-to-date ecological surveys of the proposed site by competent and qualified persons prior to the determination of an application in order that this material consideration is fully addressed in the making of any decision. LPA's recognise that the lack of sufficient ecological information is a legitimate reason for refusal of planning permission and that to determine the application and grant consent in the absence of this information, can risk legal challenge to the LPA via judicial review.

It is, therefore, in the interests of landowners and developers to ensure that adequate information is submitted with any planning application (Natural England 2011). They should ask their LPA for advice or direction about the need for a barn owl survey before they submit an application. When a survey is required it should be conducted at an early stage in order that its findings and supporting information, which will often include a mitigation strategy, can accompany the planning application.

Paragraph 99 of the Government Circular states that '*it is essential that the presence of a protected species, and the extent that they may be affected by the proposed development, is established before the planning permission is granted'*. The Circular also states that '*bearing in mind the delay and cost that may be involved, developers should not be required to undertake surveys for protected species unless there is a reasonable likelihood*

of the species being present and affected by the development'. Because of the barn owl's widespread distribution throughout lowland Britain it would, however, be difficult to claim that there was no '*reasonable likelihood*' of the species being present or that they would not be affected by development at those sites which contained potential nesting and roosting sites or where suitable grassland habitats were available to this bird.

Natural England does not regard the conditioning of surveys to a planning consent as an appropriate use of conditions and only in exceptional circumstances should surveys be left to coverage under a planning condition. Exceptions to this can occur when, for example, a development receives approval but when land clearance or construction it is unlikely to occur for a year or more after the original survey was conducted. In these cases a repeat or update barn owl survey might be attached as a condition of the planning consent.

A judgement was made, Regina v Cornwall County Council *ex parte* Jill Hardy 2001 Journal of Planning Law 786, that the granting of planning permission by the local authority was not lawful as it was unable to rationally conclude that there were no significant conservation effects because it did not have the relevant information from appropriate EIA surveys. It should not have granted planning permission as it was not in a position to know whether it had the full environmental information. A number of public enquiries have also resulted in the dismissals of appeals by Inspectors on the grounds that inadequate protected species data was available to the local authority, rendering the original planning decision unsound (Oxford 2007).

Planning Conditions and Obligations

In situations where barn owls are known to be breeding at a site or where they have been identified during a site survey, appropriate planning conditions are usually attached to the approval or planning obligations entered into, under which steps can be taken to secure the long-term protection and conservation of this bird. Conditions may be imposed to mitigate the impact of the development by controlling the timing of the work or detailing the distance at which operations take place in proximity to an active breeding site. Conditions are also likely to involve the installation of alternative nest structures on the development site or in the neighbouring area, in order to maintain and/or enhance the local breeding population.

It is often the case that planning conditions, which may require land clearance or exploratory inspection of the site for structural survey or archaeological investigation, are initiated after those which are specifically designed to prevent disturbance to protected species. In some cases the former activities can result in the disturbance of breeding barn owls and the abandonment of nests. Authorities should, therefore, prioritise planning conditions, particularly where these include protected species, in the order that they should be undertaken and discharged by the landowner, developer or their agent. In summary therefore, it is imperative that LPAs ensure that conditions relating to barn owls are satisfactorily discharged during the work schedule, at the optimum time and in the correct sequence.

Where it has been established that barn owls have recently bred or currently breed at a site for which planning permission has been sought, the following conditions can be attached to the subsequent planning approval:

- *'No development or associated works, such as buildings inspection, land clearance or maintenance, shall take place between the months of March to August (the normal breeding season for barn owls) unless the LPA has received details in writing that, as a result of appropriate mitigation, it can be shown that barn owls are no longer breeding on the site or in close proximity to it..'*
- *'Prior to commencement of the development, no works shall take place until alternative, artificial nest/roost sites have been provided. The type of site to be used and timing of any installation shall be in accordance with details submitted to, and approved in writing by the LPA.*
- *'Annual monitoring of the site shall be conducted for a minimum of (two/three/or more years) by a qualified person, licensed by the appropriate SNCO to undertake barn owl nest inspections'.*

The reasons for the imposition of these conditions are:

- *'In order not to disturb breeding barn owls, a species specially protected by the Wildlife and Countryside Act 1981(as amended by subsequent legislation)'.*

- *'To make adequate long-term provision for the nesting and roosting of barn owls in order to maintain/enhance their local abundance and distribution'.*
- *'To determine the effect of the provisions made for barn owls'.*

The local authority can also apply planning conditions to sites where there has been no evidence of the presence of barn owls but where they require that beneficial biodiversity features, such as artificial nest sites or feeding habitats are built into the scheme.

Councils are expected to adopt the precautionary principle when considering development proposals likely to have an adverse effect on rare or protected species or habitats and the NPPF requires that 'if significant harm resulting from a development cannot be avoided (through locating an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused'.

When barn owl foraging habitats and/or nest sites likely to be affected by a proposed development, such as a residential development, by for example, the depletion of rough-grassland habitat or changes to its management such as the introduction of intensive grazing by horses, cattle or sheep, then appropriate compensation measures, including habitat enhancement and long-term habitat management, may be required through planning conditions, obligations or a 106 Agreement.

LPA's may also set up a 106 Agreement for the acquisition of land elsewhere to compensate for the loss of habitat or breeding sites on the development site itself. This type of Agreement will usually include a long-term management and monitoring plan for the area (Shawyer and Holmes 2009).

Planning conditions and 106 Agreements which form part of a planning approval are obligatory and those who fail to undertake the works stipulated by the LPA can be subject to criminal prosecution under the Town and Country Planning Act.

Habitat Protection

Since the early 1990's the restoration of barn owl numbers in the UK has been critical for the successful establishment of a nationwide network of habitat corridors, the *Barn Owl Recovery Network* (BORN), to link what had previously become, isolated populations of this bird (Shawyer 1987, Brazil and Shawyer 1989). Relevant to this the NPPF highlights the need to preserve, restore and re-create networks like these, which for barn owls, provide safe prey-rich habitats for dispersal and an integrated network of artificial breeding sites. [The value of habitat networks has recently been the subject of a government review (Lawton *et al* 2010)].

As such barn owl habitat networks (SRAs and BORNs) should be given high ecological priority by planning authorities in their local and regional plan strategies, and where they are likely to be affected by development, planning applications should be refused or appropriate planning conditions or obligations critically applied.

One of the roles of the Environment Agency is the establishment of wildlife corridors. The Agency has, for example, in association with the Wildlife Conservation Partnership, been instrumental in delivering 1,500 km of rough grassland foraging habitat and 800 new barn owl nest sites to the riparian habitat network in England and parts of Wales. The connectivity of habitat which has been achieved by this project, 'Operation Riverside Link', has contributed and continues to contribute in a substantial way to the conservation successes that are now being seen with barn owls in the UK.

In addition to the protection of natural networks, NPPF requires that when a development proposal is considered, even if protected species or habitats have not been found, that planning authorities should, when determining planning applications, apply the principle 'to incorporate biodiversity in and around developments' (Section 11/118) using planning obligations where appropriate. Developers should in any case, exercise best environmental practice and consider supporting practical conservation measures to maintain and enhance habitats on or outwith the site and in the case of barn owls, provide nestboxes, owl lofts or owl towers, to help attract this species.

References made in this report to legislation, planning policy and its interpretation, are intended as a guide. New laws and policies are introduced and others amended from time to time. It is the responsibility of the ecologist to ensure that they are up to date with these. Independent legal advice should be sought on any detailed points of law.

Stages in the Planning Process - A Summary

A. Pre-application stage: Responsibility of the Developer

1. **Liaise with the LPA to determine:**
   the need for an EIA or for individual protected species/habitat survey (see - Trigger List for LPAs below).

2. **Establish probability of barn owls in the area by:**
   engaging an experienced and qualified ecological consultant to undertake a Desk Study by contacting appropriate data providers.

3. **If the presence of barn owls is a possibility:**
   engage an ecological consultant to survey the application site for barn owls using best practice methodology.

4. **If barn owls are found:**
   engage an experienced ecological consultant to assess the impact of the development on any barn owls and where necessary provide an effective mitigation plan.

B. Application stage: Responsibility of the Local Planning Authority

1. Consider validity of survey findings and the suitability of the proposed mitigation.

2. Request any additional information, negotiate any required amendments and confirm any mitigation plan with the developer.

3. Determine the application in the light of the information provided with regard to NPPF and wildlife law, taking account of the statutory provisions for barn owls.

4. Attach Planning Conditions or Obligations to any planning permission which is granted, to ensure implementation of the mitigation plan, repeat surveys (where necessary) and future monitoring of the site.

5. Advise developers that any Conditions imposed relating to barn owls (and other protected species) must be discharged before other Conditions that may put at risk the species' well-being or may cause disturbance to them whilst breeding.

C. Post-application stage: Responsibility of the Developer & Local Planning Authority

1. The developer to engage a specialist ecological consultant to monitor and manage the site to ensure that the planning conditions related to habitats and wildlife are met, the mitigation plan is adhered to and the effectiveness of the plan properly assessed.

2. The LPA to ensure that the mitigation and monitoring actions are appropriate for the site in question and that those actions which have been agreed and which have been included in conditions or obligations, are discharged at the appropriate time and that they are enforced.

Local Planning Authority: Trigger List

The aim of the following list is to help identify those sites where the presence of barn owls could reasonably be anticipated and where landowners, developers or their agents would normally be expected to engage a licensed specialist to undertake a barn owl survey for submission to the LPA:

General
For proposed developments, normally below 250 m asl and those specifically below 150 m asl in most non-urban areas of England, Wales and Scotland.

Specific
For proposed developments or changes of use in the above general category which include:

- open land containing mature standard trees over 75 years old, present in field or woodland margins, hedgerows or contained within fields;
- all agricultural buildings, such as old barns, cattle sheds, dovecotes, disused farmhouses and modern agricultural buildings, including open Dutch barns;
- disused or derelict houses, cottages, with or without open chimneys and ancient/historic buildings;
- all buildings such as aircraft hangers, old warehouses, military installations and commercial buildings which are disused or used infrequently;
- churches in rural or semi-rural locations;
- bridges, viaducts and aquaducts;
- quarries/cliff faces containing crevices or fissures;
- flood lighting or the spot-lighting of buildings or construction sites (temporary or permanent) associated with the above;

and

- any site where the presence of barn owls has been notified to a landowner, developer or their agent by a conservation body, data holding organisation, competent authority such as an SNCO or planning authority.

APPENDIX II

Barn Owl Disturbance and Protection Zones

Protection Zones, otherwise known as Stand-off or Set-back Distances, are often prescribed by conservation managers to minimise the impact of disturbance to protected wildlife and habitats. In particular they are used to restrict or exclude certain construction, land management or other human activities (including outdoor recreational events) in the vicinity of the active breeding sites of barn owls and other birds which are specially protected under Schedule 1 of the WCA 1981 (as amended), from intentional or reckless disturbance whilst they are breeding.

Disturbance can influence breeding success, feeding behaviour and survival of a species. If disruption of a site or area becomes permanent this can cause the abandonment of traditionally-used nesting sites and may affect the distribution and abundance of the species in the area concerned.

As barn owls are a cavity-nesting species and do not breed in exposed open nests, they are largely buffered from all but the most extreme external stimuli. Because of this they can show a relatively high tolerance to human activity or sudden changes to it in the vicinity of their nests, although the degree of tolerance is usually dependent on the stage of the breeding cycle (Percival 1990, Taylor 1991).

The distance at which a potential disturbance stimulus is tolerated can be determined by the use of remote nest cameras to observe the bird's static behavioural response (movement of head or body whilst on the nest) or, using direct observation, to determine flight initiation or displacement response (movement away from the nest) (Fernandez-Jurick and Schroeder 2003). Cameras can also be valuable for determining how quickly barn owls re-adjust to disturbance and when this involves temporary nest desertion, the capability of eggs (at various stages of incubation) and small young to remain viable in the absence of brooding (Shawyer in prep).

A study (Ruddock and Whitfield 2007, Whitfield *et al.* 2008) has investigated the distance at which nesting birds become intolerant to the approach of humans. The reported distances for individual species varied widely, partly because the study relied on collective expert opinion. For barn owls the disturbance distance for an approaching person, potentially one of the least disruptive types of human activity, yielded an upper limit of 50-100 m although the majority of respondents to the study considered disturbance (as displayed by the bird's departure from the nest) only occurred within 10 m.

Although there was little evidential basis for the distance quoted, a Forestry Commission guidance note (Forestry Commission 2006) recommended a safe working distance for nesting barn owls of between 100 and 250 m for those activities which they considered potentially most disruptive. These activities included mechanised tree harvesting and leisure events such as car rallies, orienteering, clay pigeon shooting and outdoor music concerts.

During nest monitoring by the author (under NE/CCW/SNH Disturbance Licence and BTO Ringing Permit) which has involved almost 10,000 nest visits and regularly brings him within less than a metre of nesting barn owls, only slight movement on the nest is usually detected from those females which have laid their full clutch or are brooding young and there is rarely any attempt by them to vacate the nest chamber. Females which are preparing to nest, are in the process of laying eggs or are sharing the site with jackdaws are more sensitive however and along with their male partners will vacate the nest chamber when the fieldworker is within about 10 m. Nest cameras have revealed that when the ambient air temperature is between about 15-20 degrees, clutches of barn owl eggs which have been incubated for between one and ten days can remain viable and hatch successfully following temporary desertion of the nest, for up to at least nine hours. The resilience of eggs is, however, likely to be influenced by the degree of incubation and for eggs with medium or large embryos and those close to hatching, death may occur within a significantly shorter time period.

Perhaps the most extreme levels of human activity are those which occur to barn owls which nest directly beneath the flight path of low flying jet aircraft or in areas which place them alongside other forms of

military exercise which can include the aerial bombing of static targets and the explosion of large artillery shells. These explosions not uncommonly occur at distances of between 20 and 200 m from active nests in some parts of Britain (Shawyer *pers obs* and Lewis *pers comm*). Although little attempt has been made to determine the behavioural response of barn owl to these extreme human stimuli (which produce intense shock waves and are some of the loudest, and potentially the most disruptive to be experienced in the British countryside), long-term nest monitoring at these sites during the last 20-30 years has not revealed unexpected levels of nest failure or any adverse effects on annual breeding success in this species.

Distances, within which barn owls might be disturbed by human stimuli and which have the potential to disrupt incubation, brooding or the delivery of food, can vary considerably. When setting Protection Zones consideration must also be given to the stage of the breeding cycle as well as other natural factors such as food stress (*e.g.* 'low vole years') adverse weather conditions and the presence of predators (predatory mammals, corvids and raptors such as buzzard *Buteo buteo* and goshawk). All of these factors can heighten the barn owl's sensitivity to human disturbance and hence their vulnerability at active nest sites.

After Protection Zones or Stand-off distances have been prescribed, it is sometimes necessary for the active breeding site to be visually screened from the source of human activity by, for example, the use of high fine mesh netting (Shawyer and Holmes 2009). These screens are designed to shield the birds visually from sudden changes in activity levels which can inevitably arise during land development operations and also serve to delineate the area of sensitivity and help prevent encroachment, by for example, construction workers, their materials and equipment. Works may also be programmed so that the activity, the response to which can be monitored by remote cameras, is progressively increased over a period of days to give the resident birds the opportunity to acclimatise to the new event.

As a further safeguard to the establishment of a protection zone, programmes are usually put in place to confine continuous working activity to daylight hours, when barn owls are largely inactive and generally exhibit a higher tolerance to disturbance.

In circumstances where the disturbance outcome is likely to be uncertain and difficult to predict, a camera coupled with a visual recording system may be installed to monitor the day-to-day behavioural response of the birds to the activity. This can enable remedial action to be taken to prevent any future disturbance and avoid potential nest desertion or nest failure. DEFRA required the use of such equipment as a condition for licensing works (on the grounds of maintaining public health and safety) in the vicinity of nesting Peregrines (Shawyer 2004). Lessons learnt from the use of visual recording equipment in these situations can also help support the decision-making process when, for example, Protection Zone Distances for a bird on Schedule 1, need to be prescribed in the future.

Examples of Protection Zones previously applied by WCP and determined by the responses of breeding barn owls to different stimuli, using direct observation and remote nest cameras.

There have been no empirical studies of potential disturbance distances related to barn owls or other species of bird in the UK. Stand-off or Set-back distances, for example, which are aimed to reduce or avoid the risk of disturbance, have in the past been derived from opinion based on varying levels of scientific expertise. As a result attempts have been made by the author to investigate and define the tolerance levels displayed by barn owls to various levels of activity in relation to land management and construction works. The results of these are detailed in *Figure 1*. The distances described have not been derived from rigorously conducted experimental studies but have been investigated empirically at numerous sites during the last ten years, where the response of barn owls to various types of stimuli (as displayed by a significant behavioural response at the nest) has been recorded in the field using direct observation, remote cameras and other recording systems.

Most construction and outdoor leisure activity occurs during daylight hours at a time when barn owls are least active. The examples of Protection Zones shown in the table below refer to those activities which take place during daylight hours and may need to be increased if they are to occur at dusk or during the night. These distances also apply to the periods just prior to egg-laying, during incubation and the brooding of small young (normally March to early June) and relate only to those pairs which are already accustomed to the site and which have bred there before.

Once the oldest chick reaches between 20 and 30 days of age, the young no longer require further brooding by the adult female. At this time she normally vacates the nest, only returning occasionally, to deliver food. During this stage of the breeding cycle young barn owls rarely demonstrate any behavioural responses which are suggestive of being disturbed by human activity around the nest and Protection Zone Distances, particularly for the medium to high risk types of activity, can sometimes be reduced from those shown in the table below. Distances must, however, remain sufficient so as not to inhibit the adults from delivering prey to the nest, particularly for those barn owls which habitually forage during daylight hours.

In contrast it is likely that Protection Zone Distances would need to be increased from those shown below when barn owls are occupying the site for the first time, when nest sites are located in very open and exposed landscapes or where there is no natural buffer zone or screening of the nest by, for example, buildings or high vegetation. Where extreme and prolonged external stimuli are involved, particularly those producing high noise levels, vibration and explosions (artillery/bombing ranges, firework events, outdoor music festivals etc.) the precautionary principle should be applied and Protection Zones may, in some instances, need to be increased up to 350 m.

Activity Type	**Example**	**Disturbance Risk** (displacement from the nest)	**Protection Zone** min.	**Disturbance Risk** (displacement from the nest)	**Protection Zone** min.
		Continuous activity		**Occasional activity**	
Pedestrian movement	Construction workers walking near nest	**Low/Medium**	20 m	**Low**	10 m
Artificial lighting	Arc lights illuminating works but (not directed toward the nest)	**Low/Medium**	30 m	**Low**	20 m
Vehicular movement	Vehicles or heavy plant moving past the nest	**Medium**	40 m	**Low**	30 m
General building and landscape works	Laying of concrete, bricks, roofing using mechanised plant	**Medium/High**	60 m	**Medium**	40 m
Heavy construction works	Ground levelling, pile-driving, concrete crushing etc. using heavy plant	**High**	175 m	**High**	150 m

APPENDIX III

Mitigating Adverse Impacts and Habitat Compensation

Preventing Disturbance

At those sites where future land clearance or construction is likely to damage or disturb barn owls at previously used breeding sites or where potential nest sites have been identified, temporary measures (described later in this Appendix) should be undertaken to discourage nesting during the period of works. These measures allow works to proceed safely and avoid infringement of wildlife law.

Measures must be undertaken prior to commencement of any work and outside the breeding season. Great care should be exercised when undertaking these to ensure that resident owls which may be roosting are not left trapped within the building or tree cavity and that alternative artificial nest sites are installed prior to these exclusion works taking place.

For nest sites that are in buildings where barn owls enter through a clearly defined opening such as an open door, then this can be closed and tightly secured. When a broken window, missing brick, wooden panel or roof tile may permit entry, then any holes can usually be plugged or covered securely with plywood panels or caps.

For open-fronted buildings, or those which are in an advanced state of disrepair, entry points are often large and numerous. Attention, therefore, has to be given to those specific features of the building where barn owls have been identified as having bred in the past and those which might offer potential nest sites in the future. Typically these include dark and spacious chambers or platforms within the building, such as dry water tanks, corn drying ducts, grain hoppers, wide wall plates, broken ceiling panels, old cupboards, hay loft floors, and blocked chimneys. Normally active nests, past breeding sites and potential nest sites, can with experience, be easily identified.

To prevent future use by barn owls, these structures should be carefully boarded over, capped, plugged or where bale stacks, crates or large disused stick nests (*e.g.* jackdaw) are present, removed from the building. Likewise holes in trees (>80 mm) can be treated in a similar way. Cavities in old or veteran trees can be large and extensive and difficult to treat by capping but where possible any old nests of jackdaw should be removed since these can provide a breeding platform for barn owls. Before caps or plugs are finally secured tree cavities should be carefully inspected to ensure that no barn owls or other forms of wildlife are present. The caps can be removed once the works have been completed and disturbance is no longer considered a risk. Ideally they should not be fitted too closely and by leaving a small gap of about 20 x 40 mm this allows bats to escape from the cavity should they have been overlooked.

Actions of this type, which are designed to render nest sites untenable, either temporarily or permanently, must be accompanied by appropriate conservation action to mitigate for their loss. This normally involves the provision of alternative nest sites, such as nestboxes on trees, buildings or poles, near to the breeding site but at sufficient distance so that if these new sites become occupied by barn owls, they would not themselves experience disturbance from the development works. Although these artificial nest sites are primarily designed to attract barn owls whilst the works are in progress, they should remain in place after completion of the works to provide long-term breeding opportunities, even when purpose-made facilities, such as an owl loft or owl tower are being provided in the conversion itself. This is important because the increased level of human activity which generally occurs following development (often accompanied by landscaping which is unsympathetic to wildlife), will commonly discourage barn owls from using those facilities which have been purposely constructed for them.

Protection from Disturbance

In some cases barn owls may nest near to the proposed works rather than within the development area itself. Where nest sites are judged to be within a distance where disturbance could arise, it is advisable to

screen the nest from the construction activity to offer the barn owls a safe and secluded entry into the site. High posts supporting fine mesh screens are recommended for this purpose, particularly where tree nests are concerned. If the bird's entry into the breeding site and the nest site itself is already hidden from the activity, by for example, the wall of a building or by dense foliage, then artificial screens of this type are not normally required.

Mitigating Adverse Impacts

This is required when barn owl breeding sites or breeding territories are likely to be lost permanently to development or when they will become untenable due to increased levels of disturbance or habitat loss. It is important that in areas where a species recovery programme for barn owls is already underway, those responsible for planning mitigation strategies, particularly involving medium or large-scale development projects (*i.e.* transport and windfarm schemes) liaise closely with fieldworkers who are operating the recovery programme. This is to ensure that the mitigation plans do not compromise the programme and that maximum local benefit is achieved for the species.

The methods which are used to mitigate against, or compensate for the loss of barn owl breeding sites and which are usually applied and enforced as a condition of planning by the Local Authority, should be proportionate in terms of their scale, construction and cost, to the type of nest site which is to be replaced. The methods and structures chosen for mitigation should also take account of whether or not the site is used for breeding or is simply one of a number of alternative roosting places in the area. Examples are given below.

Small-scale development
If barn owls nest, for example, in a derelict cart shed which is to be converted to a modern stable, then it would not be unreasonable to mitigate for the potential loss of these birds by installing two exterior nestboxes nearby, rather than resorting to more complex and expensive structures. However, when nestboxes are used in this way they should be of an accepted size, weight and design and have a minimum lifespan of 15 years (*e.g.* Dewar and Shawyer 1996). They should also be installed at a safe height of about 3-4 metres for ease of future maintenance and monitoring and lined with about 30 mm of small grade wood chippings.

Correct siting of nestboxes is critical. Most importantly, the entrance hole should overlook rough grassland habitat and offer barn owls an uninterrupted flight-path into the nestbox. Those which are sited in trees must not be obscured by dense foliage. The nestbox can face any compass direction, but where the opportunity arises it should be backed onto the prevailing wind. The places which are selected for the installation of nestboxes and for mitigating the impact of the development should be quiet, relatively undisturbed and close to prime feeding habitat (Dewar and Shawyer 1996). Nestboxes should be positioned within about 50-350 m of the development boundary, the distance being dependent on the level and intensity of current works at the site and any activities that are anticipated there in the future (see Appendix II).

Medium-scale development
Where renovation or conversion of a farm building to residential or business use is to be undertaken, then the construction of an owl loft within the roof space (assuming the increased level of human activity which accompanies the new building and its surrounds is not excessive and would not disturb breeding barn owls), would be considered the most appropriate means of long-term mitigation for the anticipated loss of this species. Owl lofts were first described in the UK as a conservation procedure by the author (Shawyer 1987). These were later included in advisory leaflets which have been used widely by local planning authorities and developers in the UK (Shawyer and Johnson 1990, Dewar 1996, English Nature 2002).

To help ensure that barn owls are not lost from the site in the short-term during the process of development works, it is important that alternative nesting and roosting sites are included in the mitigation plan and that they are fitted at an early stage. Two exterior nestboxes on trees or poles are normally recommended. They should be installed at between 50 and 350 m from the development boundary at a distance which is sufficient to provide an adequate zone of protection from any ongoing works (Appendix

II). Ideally these nestboxes should be installed a year in advance, but no later than mid-February prior to the commencement of any work.

Many medium-scale developments which involve converted or renovated farm buildings, inevitably lead to increased levels of human activity. Because of this and in spite of the provision of an owl loft, these buildings are often not re-tenanted by barn owls, the birds usually choosing to occupy nestboxes sited at distance from the new building. Information which has been gathered during the last 25 years has, for example, demonstrated that breeding occupancy rates for owl lofts, which have been provided by way of mitigation, are below 15% whilst those for nestboxes sited in good habitat, are about 80%. In recognition of this and because barn owls often select nestboxes permanently for breeding, only those of an accepted design and quality should be used (*e.g.* Dewar and Shawyer 1996). For medium-scale developments, therefore, ecologists should, when preparing their mitigation plan for the site, assess the relative merits of these different types of long-term nest provision in the light of the level of increased human activity which might be anticipated following a building conversion.

After development has been completed and appropriate mitigation works have been accomplished, nest monitoring involving one to two visits per annum should be undertaken at the site for a minimum of two years. This should normally constitute one of the planning conditions, thereby helping to ensure that the mitigation measures are properly evaluated.

Large-scale development

Where farm buildings or other built structures are to be demolished or hollow trees felled to make way for a residential or commercial development and barn owls are to be displaced, then one or more owl towers, sited on the fringes of the new development or in places which may have been specifically set aside for wildlife, can offer the most advantageous form of mitigation (Shawyer and Sheppard 2006). Although owl towers are a relatively new concept for barn owl mitigation, they have been shown to be very effective. Three-quarters of those which have been installed (about 40 to date) are now used regularly by barn owls.

Monitoring of the site during the development phase and on one to two occasions per annum for a minimum of three years post-development, should constitute part of the mitigation plan for large-scale developments. This should be applied as a planning condition to this type of development.

Compensating for Adverse Impacts

Government expects the planning system to help meet its objectives to conserve, enhance and restore the populations of naturally occurring species and biodiversity in general, this being reinforced by the Natural Environment and Rural Communities Act, 2006. Development projects, even those which are small or medium-scale, but especially those larger schemes which involve road, rail or other transport schemes, pipelines, housing estates, industrial complexes and wind farms can not only lead to the destruction of barn owl breeding sites and potential nesting or roosting places, but the loss of rough grassland foraging habitat.

In order to compensate for the adverse impacts of development and to maintain or encourage the presence of barn owls in the area, landowners, developers and their agents will be expected to enhance existing foraging habitats and where this is not possible, to provide new habitats at or near to the development site. This is likely to be a condition of any planning approval and may require, in advance of any works, the provision of artificial nest/roost sites or the procurement of land of a sufficient size where the necessary habitats can be created to attract owls to feed and nest. The land will also require future long-term management in order to optimise and maintain its value to the local barn owl population.

In the case of road and rail developments where breeding sites are to be lost on the path of the proposed route and where barn owls breed within 1.5 km and are likely to succumb to road/rail traffic accidents, resulting in the depletion to local populations, then the provision of compensatory breeding sites will normally be a minimum requirement for the scheme. Compensatory work usually involves the installation of a string of nestboxes at intervals of 2 km, sited in trees, on buildings or poles, 1.5 km from the route and parallel to it.

Careful design of new road and rail verges can also help avoid high levels of mortality at traffic accident 'blackspots' which occur where a grassy corridor alongside a watercourse, farm track or wide field boundary, intersect the route. 'Blackspots' are identified as part of the initial barn owl survey (usually undertaken as part of the Environmental Impact Assessment) and it is at these locations that specific mitigation measures to reduce mortality (high vegetation screens on raised earth bunds) are recommended (Shawyer and Dixon 1999).

In some cases, land may be considered for built development or a change of use (*e.g.* to turn an area of rough grassland into a wetland or reedbed) at sites where barn owls have not previously bred but where potential feeding and nesting habitat will be lost. In these situations beneficiary barn owl habitats should be built into the scheme, usually outwith the development area itself, in order to compensate for the loss of habitats favoured by this vulnerable bird.

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