N4 Collooney to Castlebaldwin, *Proposed Road Development*

APPENDIX NO. 12.4

BAT REPORT

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1 INTRODUCTION

1.1 Aims of the Assessment

This report presents the results of a number of bat surveys that have been undertaken along the corridor of the proposed N4 Collooney to Castlebaldwin Realignment, during the period 2005-2013. The surveys included four seasonal bat surveys undertaken along the corridor during the period October 2005 and June 2006, followed by updated surveys undertaken during September 2010, September and October 2012 and July 2013. The purpose of the original year-long study was to provide a broad-brush temporal and spatial investigative survey of the entire study area. The purpose of the follow up assessments during 2010, 2012 and 2013 was to undertake selected assessments (i.e. inspections of buildings, landscape elements, targeted activity surveys) within the study and update the bat assessment to ensure that the original 12 month study remained valid. This is considered an appropriate approach, with reference to results of the original detailed study.

Overall, bat populations and bat habitats in the study area did not change significantly between the original detailed yearlong study and the selected validation studies undertaken in 2012 and 2013 confirmed this. If anything it was found that bat activity and habitat availability decreased through the survey period. It is considered that a robust and detailed assessment of bat populations in the study area is now available by using all this data from the period 2005-2013. Consultation with the local staff of the National Parks and Wildlife Service (NPWS) was also undertaken during these studies.

The main objective of bat assessment is to record and document the potential value and significance of the proposed development area and its surroundings for bats, assess the activity of bats in the area affected by the proposed realignment, and assess the impact of the construction and operation of the proposed realignment on bats and their habitats. This report was prepared following guidance set out by the Institute of Ecology and Environmental Management '*Guidelines for Ecological Impact Assessment*' (IEEM, 2006); relevant National Roads Authority (NRA) guidance was also followed including:

- '*Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes'* (NRA, 2005a);
- '*Guidelines for the Treatment of Bats during the Construction of National Road Schemes*' (NRA, 2005b);
- '*Guidelines for the Assessment of Ecological Impacts of National Road Schemes – Revision 2*' (NRA 2009);
- '*Ecological surveying techniques for protected flora and fauna during the planning of National Road Schemes – Version 2*' (NRA 2008a);
- '*Environmental Impact Assessment of National Road Schemes – A practical guide*' (NRA 2008b);
- '*Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*' (NRA 2008).

1.2 Overview of the study area

The study area is located between Collooney (northern end of study area) and Castebaldwin (southern end of study area). The proposed new road will broadly run close to the existing N4 road with the new realignment at no more than 500 meters from the existing road. The study area was within a corridor extending to 0.5 km or more either side of the proposed N4 Collooney to Castlebaldwin Realignment. The roost survey extended to 5km in certain places in order to identify any previously unrecorded hibernacula in the area. The study area comprises a wide variety of habitat types including coniferous forest, rivers and lakes, marsh, bog, fen and scrub but the predominant habitats are improved agricultural grassland and wet grassland. The mosaic of natural and manmade habitats along the corridor provides potential foraging habitats, commuting corridors, roosting and perhaps minor hibernating sites. Agriculture is the primary use of land within the study area, and there are numerous used and disused farm buildings and houses. These provide minor roosting opportunities for bats. Mature hedgerows and tree lines surround some of these buildings. In addition, there are a number of bridges over the rivers and streams in the study area. Some of these bridges, particularly the older ones, provide summer roosting locations for bats. There are a number of mature trees along the route and these would also provide some potential winter roosting habitat for bats.

1.3 Bat Ecology

1.3.1 Introduction

Bats are the only mammals able to sustain powered flight. Their wings are modified arms covered in a membrane of soft elastic skin, which is supported by four fingers and a thumb. The ability to fly has enabled them to exploit aerial prey and avoid terrestrial predators and has probably been responsible for the great diversity in their feeding habits as well as shaping aspects of their reproduction, roosting and social behaviour (Kunz, 1982). These mammals are classified into the Order Chiroptera, which is further divided into two categories: the Microchiroptera (little bats) and the Megachiroptera (large bats). The sub-order Microchiroptera, which occur in Ireland are primarily insectivores, while the second group of bats is fruit-eaters. Worldwide, there are about 970 species of bat, 33 of which are in Europe, 14 in Britain and 9 in Ireland. Bats contribute to one quarter of all mammals and are widely distributed in both Northern and Southern latitudes, absent only from the sub-Artic and Antarctic. Next to rodents, they are the most successful mammalian orders and also show the most diversity in diet and range of habitat. They have colonised most islands and in some may be the only native mammal.

1.3.2 Foraging and prey

Microchiropteran bats have evolved a sophisticated echolocation system, which helps them detect prey and navigate through their surroundings. The bat produces high-frequency sounds that are emitted as short pulses from the mouth or in the case of the lesser horseshoe bat, through the nose leaf. The echoes of objects detected as sound bounces back from buildings, trees, the ground, insects and anything else in the area helping bats build a 'sound picture' of their surroundings. Using echolocation allows bats to forage successfully at night and enables them to exploit night-flying insects, a food reserve for which is there is no competition during the hours of darkness. It is possible to hear these echolocation sounds using a 'bat detector', which is a device which electronically lowers the frequencies to within human hearing range. In addition, Microchiropteran bats species have evolved different echolocation frequencies and wing morphology, allowing exploitation of different habitats, therefore avoiding intra-specific competition. This technique allows efficient capture of insects where e.g. the Pipistrelle can consume up to 3,500 insects every night (O'Sullivan, 1994).

1.3.3 Roosting behaviour

Bats originally utilised caves and trees for dwellings, but many now find buildings just as suitable for their needs (Richardson, 1985). Bats are social animals and most species congregate in large colonies during summer. These colonies consist mostly of females of every reproductive class, with some juvenile males from the previous year. Male bats normally roost individually or in small groups meeting up with the females in the late Autumn-early winter, when it is time to mate. In summer, bats seek warm dry buildings in which they can give birth and suckle their young. In winter, they seek out places with a constant low temperature and high humidity where they can become torpid and hibernate during adverse weather conditions. However, bats do not hibernate continuously during winter and will awake and hunt during mild nights when there are insects available and it is energetically advantageous to forage.

1.3.4 Metabolism and hibernation

Bats in flight have a high metabolic rate and thus must consume large amounts of food in proportion to their size. When insects are abundant this poses no problem. However, maintaining a high body temperature is extremely costly and needs abundant food; so when food is scarce bats save energy by lowering their body temperature. They even do this when in their day-time roosts during their active season in summer. When they return from hunting, their temperature remains relatively high until they have completed digestion of their food, and then it may drop from almost 35°C to about I5°C. In this state the bats are described as torpid, feel slightly cool and do not move about. They increase their body temperature to almost 40°C just prior to leaving the roost at dusk to hunt (Hayden & Harrington, 2000).

Bats hibernate during winter, usually, depending on the weather, from mid-November to the end of March. In autumn they may increase their weight by about 30% in preparation for winter hibernation. During hibernation they remain torpid by day and for most of the night and their body temperature may fall as low as about 5°C. Bats must wake up at intervals during winter to excrete metabolic wastes by urination or to avoid freezing if the temperature of the roost falls close to zero. Since hibernating bats require substantial amounts of energy to assume a normal body temperature, they are vulnerable to disturbance in their winter roosts. If

they are disturbed to such an extent that they have to wake up unnecessarily, their fat reserves will be seriously depleted and they may not have sufficient reserves to survive until spring. For example, causing a bat to wake up inappropriately from hibernation may use up as much energy as it would otherwise use in a month (Hayden & Harrington, 2000).

1.3.5 **Longevity and Breeding**

The maximum recorded age of all British Isles bat species ranges from 7-30 years, with an average maximum of about 20 years. During this time females produce just one young each year, sometimes reproducing every second year. The survival of young bats is totally dependent on weather conditions and their ability to forage as soon as possible therefore gaining enough weight and body fat to survive hibernation in cold weather.

1.4 Bat species in Ireland

Nine species of bats have been recorded in Ireland. Eight of these belong to the Family Vespterilionidae and are characterised by long ears with a growth from the inner margin of the ear called the tragus. They are Daubenton's (*Myotis daubentoni)*, whiskered (*Myotis mystacinus)*, Natterer's (*Myotis natterei)*, Leisler's (*Nyctalus leisleri)*, common pipistrelle (*Pipistrellus pipistrellus)*, soprano pipistrelle (*Pipistrellus pygmaeus)*, Nathusius pipistrelle (*Pipistrellus nathusii)*, brown long-eared bat (*Plecotus auritus)* and the lesser horseshoe bat (*Rhinolophus hipposideros)*. All these species, except the lesser horseshoe, are distributed widely across the country. However, Natterer's and whiskered bats are rare and little is known of their ecology (Whilde, 1993). Until recently the rare Nathusius pipistrelle was thought to occur only in Northern Ireland but there have been recent reports of the species in the Republic. A total of six bat species have been recorded, or are expected to occur, in the study area. In Table 1 the call frequencies of these bat species are described.

Table 1 List of bat species likely to be present in, or near, the study area along with their call characteristics (adapted from Jones & Walsh, 2001).

Species	Peak Frequency Range (kHz)	Call Frequency Range (kHz)	Call Duration Range (msec)
Common Pipistrelle	46.3 (41.7-51.8)	40.8-83.3	6.3 (3.8-12.0)
Soprano Pipistrelle	55.5 (48.8-61.6)	47.3-90.4	3.7 (2.7-10.7)
Natterer's	49 (28-66 kHz)	20-101	4 (3-8)
Daubenton's	47.8 (39.5-56.7)	32.0-87.5	6.2 (3.9-8.3)
Brown long-eared	39.8 (31.7-45.0)	28.1-92.5	1.7 (0.6-2.7)
Leisler's	26.9 (21.1-36.6)	20.6-61.0	10.9 (10.6-27.1)

The dependence of Irish bat species on insect prey has left them vulnerable to habitat destruction, land drainage, agricultural intensification and increase use of pesticides. Also, their reliance on buildings as roosting sites has made them particularly vulnerable to renovation works and the use of timber chemical treatment. Bats are considered sensitive indicators of the health of the wider environment and their population trends will reflect changes in climate, water quality and agricultural practices. They account for ten of Ireland's terrestrial mammal species, approximately one quarter of the species of the Irish land mass.

1.5 Bat legislation

1.5.1 **Irish Legislation**

All bat species are protected under the Wildlife Act 1976, Wildlife (Amendment) Act 2000, the European Habitats Directive (92/43/EEC) and the Bern and Bonn Conventions. Ireland is also a signatory of the European Bat Agreement. All Irish bat species are listed in Annex IV of the Habitats Directive while the Lesser Horseshoe Bat is listed under Annex II of the Habitats Directive as a species of community interest whose conservation requires the designation of Special Areas of Conservation (European Commission, 1992). The Wildlife Act protects all bats and their roosts and it is an offence to kill, disturb, handle, sell or offer any bat whether alive or dead, without an appropriate license. The Wildlife Amendment Act 2000 improves the conservation status of bat species and their habitats and gives statutory protection to National Heritage Areas (NHAs).

1.5.2 **European Legislation**

In Ireland, the most important legislation for the protection and conservation of natural habitats, flora and fauna is the EC Habitats Directive 1992 (EEC 92/43), transposed as the EC (Birds and Natural Habitats) Regulations (2011). The Lesser horseshoe bat, a species which does not occur within the study area, is listed as an Annex II species; while all other bat species are listed on Annex IV under the Habitats Directive (1992).

1.5.3 **International Legislation**

Ireland has ratified two international wildlife laws pertaining to bats as follows:-

- *The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention, 1982).* This legislation ensures that governments take into account the conservation needs of species during the formulation of planning and development policies. It also seeks the protection of endangered species and in relation to bats, it stipulates that all bat species and their habitats are conserved.
- *The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983).* This item of legislation seeks to harmonize laws across national boundaries to protect migratory species.

1.6 Bats and roads

Bats frequently use quiet roads to commute and forage, particularly where they are flanked by hedgerows. Large, busy roads are used for forage by some species, as nocturnal insects are attracted by the lighting. However, some bat species are sensitive to light or noise, and are unable to feed at illuminated roadsides. Bats may be killed by vehicles where they commute along busy roads, and low flying species, pregnant females and juveniles are most at risk (Outen, 2002). New roads may interrupt movement from roosts to foraging sites, causing population decline. Habitat destruction for road construction may reduce food availability for bats, and buildings and mature trees close to the route are often removed, potentially resulting in the destruction of bat roosts.

The interactions between bats and roads has been summarised by NRA (2005b) '*Guidelines for the Treatment of Bats during the Construction of National Road Schemes*' as follows:-

- They avail of minor roads and country lanes as feeding sites and as commuting routes between roosts and feeding areas (such as woodlands or waterways). Such roads typically are flanked by well-developed hedgerows. Roads with hedgerows on either side that form a closed canopy are particularly favoured. The absence of lighting on such roads allows light intolerant bats to feed there. All species of Irish bat have been noted to feed along minor roads and lanes.
- The construction of a road sometimes destroys vegetation cover that previously was used by bats as they moved between roosts and feeding areas. Since the new road acts as a barrier preventing movement across a road, a bat population may be prevented from accessing a formerly used habitat potentially resulting in population decline. Also, vehicles may kill bats when they commute along the new road to move from one roosting or feeding area to another.
- Roosts lying within the land-take are generally removed to allow access for construction equipment and to construct the road itself. Trees immediately adjacent to roads are often removed as a safety measure. In some circumstances, there may be scope to retain trees or other structures if they are known to have good bat roost potential, provided they do not interfere with the construction or operation of the road.
- The necessity to remove substantial lengths of hedgerow and treeline and the loss of mature trees, draining of wet areas and rendering of some areas as unsuitable for feeding (e.g. due to light and noise pollution) all affect the availability of invertebrate prey and feeding sites for bats. Noise from traffic may render some sites unsuitable for bats, such as the brown long-eared bat that depends more on passive hearing (i.e. listening to sounds produced by prey) than on echolocation to capture prey.
- As bats orient their flight using vertical landscape elements, their movements are reasonably simple to steer and it is relatively easy to find solutions for bottlenecks threatening their flight paths. The consideration of bat flight paths, feeding areas and roosts during the planning phase, followed by the incorporation of appropriate mitigation measures into the road design, will reduce the severity of significant impacts on bat populations.

1.7 Bat detecting

1.7.1 **Bat detectors**

Bat detectors are electronic instruments that can translate the high-pitched sounds that bats use to fly in the dark and feed into sounds within our range of hearing. Two types of detectors were used during the current assessment; 'heterodyne' and 'frequency division'.

Heterodynes allow the operator to ‘tune into’ a bat call in a similar fashion to tuning an analogue radio set where you turn a dial to select a particular radio station. The user selects the range by rotating the frequency dial, which usually covers from about 20 Hz to 120 kHz. These detectors allow differentiation between many different species by identifying the peak frequency and the tonal characteristics of the calls (i.e. 'slaps' versus 'ticks'). Heterodyne detectors work by mixing the incoming bat frequency picked up by an ultrasonic microphone with a local tuneable oscillator. The signal output from the mixer will be a combination of (a) the original ultrasonic frequency, the local oscillator frequency, the frequency that is the sum of the local oscillator and original frequencies, and (b) the frequency that is the difference between the original and local oscillator frequencies. This signal is fed to a low pass filter that only allows through the difference frequency, which is amplified and then fed to a loudspeaker or earphones. Frequency division detectors listen in to the whole range of frequencies that the bats produce. The frequency of the ultrasound is divided by a constant factor e.g. 10, meaning that a frequency of 60 kHz will be converted to 5 kHz. For Frequency Division the call is fed to a zero crossing detector which outputs a digital signal into a binary counter. Usually the output from the counter is divided by 32. To make sure that amplitude information is passed on the call is demodulated and the resulting signal used to remodulate the counter's output.

2 METHODOLOGY

2.1 Desk study and field survey

In preparing this report, all tasks were carried out with reference to:

- *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes'* (NRA, 2005a);
- '*Guidelines for the Treatment of Bats during the Construction of National Road Schemes*' (NRA, 2005b);
- '*Guidelines for the Assessment of Ecological Impacts of National Road Schemes – Revision 2*' (NRA 2009);
- '*Ecological surveying techniques for protected flora and fauna during the planning of National Road Schemes – Version 2*' (NRA 2008a);
- '*Environmental Impact Assessment of National Road Schemes – A practical guide*' (NRA 2008b);
- '*Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes*' (NRA 2008c).
- '*Bat Mitigation Guidelines for Ireland*' (Kelleher & Marnell, 2006).

The overall purpose of the 2005-2006 survey was to examine bat activity over a four season period. This ensured that a full understanding of the seasonal distribution and activity of bat populations in the study area was attained. Spring, summer and autumn surveying was within a corridor extending to 0.5 km or more either side of the proposed N4 Collooney to Castlebaldwin Realignment. All activity surveys were undertaken during dry conditions, with the summer and autumn surveys focussed on relatively mild days. The current assessment therefore draws significantly on the following reports:

- Ecofact (2005a) N4 Collooney to Castlebaldwin Road Scheme. Assessment of the Impact of the Proposed Development on Bats. Seasonal Report 1. November 2005.
- Ecofact (2006a) N4 Collooney to Castlebaldwin Road Scheme. Assessment of the Impact of the Proposed Development on Bats. Seasonal Report 2. February 2006.
- Ecofact (2006b) N4 Collooney to Castlebaldwin Road Scheme. Assessment of the Impact of the Proposed Development on Bats. Seasonal Report 3. April 2006.
- Ecofact (2006c) N4 Collooney to Castlebaldwin Road Scheme. Assessment of the Impact of the Proposed Development on Bats. Seasonal Report 4. July 2005.

The activity surveys during 2010 (2 nights) were considered to provide optimal weather conditions for the assessments completed. Extensive daytime visual surveys (over 7 days) were again undertaken during 2012 with night-time activity surveys including emergence watches and car-based monitoring carried out during July 2013.

The main purpose of the 2012 and 2013 validation surveys was to look at roost sites, and other bat habitats and assess if any changes had occurred since the year-long 2005-06 intensive survey. Targeted walkover activity surveys and car based monitoring was also undertaken during the 2010 survey. This approach allowed a validation update of the previous more detailed survey, and was considered to be a sensible approach. The survey during 2013 included daytime visual inspections of bat habitats and roost sites throughout the entire study area. The information on bat roosts, bat habitats, bat foraging and commuting routes, species present and their abundance and utilisation of the study area is more than adequate to make the current assessment of the implications of the proposed road realignment on bats.

Overall, the importance of the study area for bats and bat habitats and roosting sites were considered to remain largely the same / or be slightly less favourable for bats due to a general increase in agricultural management in the intervening period, in addition to an extended period of cold winters and wet, cool summers which affected insect production. Where changes were recorded (i.e. removal of hedgerows etc.) the extent and significance of this change was considered. Therefore the authors of the current report are satisfied that the use of the 2005/2006 validated data in making the current assessment will be expected slightly overestimate rather than underestimate the importance of bat populations in the study area. This approach is therefore consistent with taking the precautionary approach, as is required under the Habitats Directive.

Bats regularly use mature trees for roosting. Bats are known to move from tree to tree from night to night, and even during a single night. It is therefore important to note that all mature trees in the study area are considered to be 'potential' bat roosts and all mature trees will need to be surveyed again ~~in~~ immediately advance of felling at the site preparation phase. Likewise all buildings and sheds along the route must also all be considered to have bat roost potential. The NRA's *'Guidelines for the Treatment of Bats during the Construction of National Road Schemes*' (NRA 2005b) will need to be followed during the site preparation phase.

The surveys were collectively undertaken by ecologists Dr. William O'Connor, PhD, MSc, BSc, CBiol, MIBiol, CEnv, MCIEEM, (2005-2012); Gerard Hayes BSc., MCIEEM (2005-2013); Daireann McDonnell MSc, BSc, MCIEEM, (2010-2012); Noreen McLoughlin MSc, BSc.; Joyce Novak, MSc.; and Mieke Muyllaert MSc, MIEEM (2005-2006).

2.2 Assessment of bat species present

2.2.1 **Desk study**

A desk study of bat records from the study area was undertaken. Sources accessed included The Bat Conservation Trust's report '*Distribution atlas of bats in Britain and Ireland 1980-1999'* (Richardson, 2000), the book '*Exploring Irish Mammals'* by Hayden & Harrington (2000), and the heritage Council publication '*Bridge Usage By Bats In County Leitrim And County Sligo'* by Shiel (1999). The online database hosted by the Irish National Biodiversity Data Centre (NBDC) (www.biodiversityireland.ie) was also utilised to find previous records of bats in the study area and to generate a bat habitat suitability index (after Lundy *et al.,* 2011).

2.2.2 **Habitat survey**

A desk study of the aerial photographs along the proposed route was undertaken to locate areas that appeared to be physically suitable for bats. Areas highlighted as being potentially suitable were then visited during the field study. The survey corridor was then walked in daylight to assess the potential for bat activity and bat roosts. Much of the survey corridor comprises habitats which are not ideally suitable for bats. These areas include agricultural and wet grassland habitats. The main bat habitats on the site are the areas of woodland and hedgerows and along river corridors. The 5 point scale bat habitat suitability index on the Irish National Biodiversity Data Centre (NBDC) website was also utilised to assess the importance of the study area for bats.

2.2.3 **Roost survey**

A desk study of the aerial photographs along the proposed route was undertaken to locate areas that appeared to be suitable for roosting bats. Structures and mature trees highlighted as being potentially suitable were visited during the field studies in 2006, 2010 and 2012. Access to some of the buildings could not be attained as they were locked or the owners could not be contacted. However, much information can be gained from a thorough examination of the eaves, windows, ledges etc. without entry into a building and this method was relied on in a number of cases. Cellars, caves or other underground structures were not recorded in the study area. A roost emergence survey was undertaken in the surveys completed in 2006 and 2010. At selected buildings which were considered to have potential to hold roosting bats a roost emergence survey was undertaken from one hour before dusk to one hour after. Heterodyne and Frequency Division bat detectors along with a bat counter unit were employed during this survey. In 2012 all potential roosts were visited again and inspected visually for signs of bat activity (i.e. staining, droppings, insect remains etc.).

2.2.4 **Bat detector survey**

Bat detector surveys were undertaken during the autumn, spring and summer survey periods (2005-2012). Monitoring for active bats was carried out using two bat detectors (a Stag Electronics Bat Box III Heterodyne and a Bat Box Duet Frequency Division detector). During the 2010 and 2012 surveys Anabat CF1 Frequency Division detector/ recorders were also used). Several torches were also used during the walkover surveys. Bats activity was monitored using both walkover and windshield type bat detector surveys. Walkover surveys involved walking sections of the route and entering potential roost buildings and a walkover detector survey of the entire route corridor was also undertaken during the summer survey. The night time surveys for bats also included a car based survey along the road corridors surrounding the site following the methodology employed in '*The car-based bat monitoring Scheme for Ireland*' (Roche & Aughney, 2008), where the surveyors

drove at 15mph. During each survey continuous digital recordings from the frequency division bat detector made (2005-2006) with later surveys employing an Anbat CF unit. The environs of derelict buildings and sheds along the corridor were also surveyed for bat activity.

Monitoring for active bats was carried out using bat detectors (Bat Box III, Box Duets, and Anabat devices). Frequency division sounds from the Bat Box Duet were recorded continuously on a Sony NET-MD digital recorder. Digital recordings were downloaded for subsequent sound analyses. Likewise in the later surveys data recorded on the Anabats were assessed using Analook software. At selected buildings which were considered to have potential to hold roosting bats; roost emergence surveys were undertaken from one hour before dusk to one hour after.

Bat activity varies according to season and ambient temperatures which influence the abundance of bat prey. A total of four surveys were carried out between Autumn 2005 and Summer 2006, and detailed validation surveys were also completed during 2010 and 2012. With the extent of surveying (habitats, roosts and activity) coupled with the temporal variation of surveying, it is assumed that all bat species present in the study area have been documented. Information on the foraging patterns / densities of bats at the edge of the study area is not likely to be as comprehensive as areas which would be directly affected by the new road. The level of impact on these peripheral areas however would not be as significant as those associated with the new road corridor.

3 EXISTING ENVIRONMENT

3.1 Species recorded

In general, a relatively low diversity and abundance of bats was recorded in the study area. In Figures 1-4 the results of the 2005-2010 studies are presented graphically. It is noted that the majority of the survey work was undertaken during an extensive 2005-2006 year-long survey. It is considered that the results of this study are still fully valid as follow up surveys, which included both visual assessment of landscapes, bat foraging and commuting habitats, and roosts were conducted along with targeted bat activity surveys. The same team of ecologists were involved in all the surveys and are satisfied that the surveys still provide a full account of bat species diversity and abundance, and bat habitats and utilisation, within the study area.

The dominant species recorded was Soprano Pipistrelle. This species is the dominant bat species in this area of County Sligo. It is a common, widespread and adaptable bat species, which is often associated with woodland, hedgerows and lakes/rivers. The habitats in the areas surveyed are, in many cases, quite suitable for this species. Previous bat surveys have noted the dominance of this species over its close relative, the Common Pipistrelle, in the North West (Roche *et al.*, 2005).

Common Pipistrelle was also recorded occasionally during the surveys completed. This species is also a common widespread and adaptable bat species. Two *Myotis* sp. bat species (Daubenton's and Natterer's) were also recorded; however these bats were restricted in their distribution and were located away from the corridor of the proposed N4 realignment.

The bat surveys have confirmed that the corridor of the proposed N4 Collooney to Castlebaldwin Realignment is not a particularly important area for bats. This is mainly due to the absence of high quality bat habitats within this area of County Sligo. The study area is generally open and wet, and there is general absence of broad leaved woodland, mature trees and good roosting sites. This affects the diversity and abundance of bat populations in the study area.

In Table 2 a Habitat Suitability Index (HSI) for bats at selected points along the proposed N4 Collooney to Castlebaldwin Realignment is presented. This Index ranges from 0 to 100 with 0 being least favourable and 100 most favourable for bats. In the study area the HSI for bats ranges from 18 at Castlebaldwin (southern end of the proposed road development) to 33 at Doorly (northern end of the proposed road development). The HSI rating for the study area was obtained from the online database hosted by the Irish National Biodiversity Data Centre (NBDC).

Table 2 Habitat Suitability Index for bats at selected points along the proposed N4 Collooney to Castlebaldwin Realignment. Index ranges from 0 to 100 with 0 being least favourable and 100 most favourable for bats. Obtained from the online database hosted by the Irish National Biodiversity Data Centre (NBDC).

Species	Doorly	Cloonlurg	Ardloy	Castlebaldwin	Records from study area
All bats	33	23	30	18	
Soprano pipistrelle	46	37	42	28	Yes
Brown long eared	43	28	39	25	
Common pipistrelle	42	32	39	25	Yes
Lesser horseshoe	2	1	3	3	
Leisler's	45	36	44	31	Yes
Whiskered bat	20	9	19	8	
Daubenton's	42	27	37	17	Yes
Nathusius' pipistrelle	10	6	7	5	
Natterer's	47	28	40	22	Yes

The HSI for the Annex II listed Lesser horseshoe bat ranged from 1-3 in the study area, indicating that it is highly unlikely that this species occurs in the study area. This was borne out by the extensive surveys undertaken, where this species was not recorded. The highest HSI ratings in the study area was for the Soprano pipistrelle and Common pipistelle, and the surveys confirmed that these bats were also common in the study area. The HSI for Natterer's bat was high at the Northern end of the study area, and also near Ardloy. The Northern end of the study area is near the Unshin River corridor and it is known that this area is important for this species, which roosts in some of the bridges along this river corridor. However this area is outside of the study area for the current development and this species was not recorded at the northern end of the study area. Natterer's bats were recorded roosting in the existing N4 Bridge at Drumfin and were recorded in car transects near Ardloy Bridge.

Leisler's bat was also recorded regularly in the study area, and this it is also indicated that habitats are suitable for this species based on the HSI values from some areas of the study area. Daubenton's bats are associated with river corridors and were recorded on the Drumfin River, downstream of the study area. Brown long eared bats were not recorded during the current surveys and the general absence of woodland habitats makes the study area sub-optimal for this species. It is noted that they can be difficult to pick up on detectors however.

The HSI ratings for this species were relatively high at the northern end of the study area (43), but this is thought to reflect the presence of more suitable nearby habitats associated with the Unshin River corridor. The low HSI scores for Nathusius' pipistrelle indicates that unsuitability of the study area for this species, and this bat was not recorded during the current bat surveys. The following species have been recorded in the study area:-

- Common pipistrelle (*Pipistrellus pipistrellus*): This is an abundant and widely distributed species known to forage along hedgerows, woodland edges, gardens and urban areas near streetlamps.
- Soprano pipistrelle (*P. pygamaeus*): This pipistrelle is also abundant and widespread in Ireland and has similar habitat requirements. This species favours woodland and hedges along the edges of water bodies.
- Natterer's bat (*Myotis nattereri*): This is a rare species and likes woodland and mature hedgerow habitats. This species has been previously recorded roosting in Behy Bridge on the Drumfin River.
- Brown long-eared bat (*Plecotus auritus*): This is a woodland species and the general lack of deciduous woodland in the study area makes it unsuitable for use by this species. This species was not recorded but may occur in the study area.
- Daubenton's bat (*Myotis daubentonii*): This bat has been recorded previously along the Unshin River and has been found roosting in bridges along the Drumfin River. It is likely to use the river corridors and lakes in the study area for foraging
- Leisler's Bat (*Nyctalus leisleri*): This bat species is known to forage over open deciduous and coniferous woodland and in areas of scrub. They are also known to forage in parkland and suburban areas. Some suitable, albeit sub-optimal, habitat for this species occurs along the route corridor. Leisler's bat populations in Ireland are of international importance.

An account of the bat species recorded / expected to occur along the proposed road alignment is provided below.

3.1.1 **Common and Soprano pipistrelle**

Ireland's two smallest bat species, and also the commonest, the Common Pipistrelle (*Pipistrellus pipistrellus*) and Soprano Pipistrelle (*Pipistrellus pygmaeus*) are the bats most likely to be seen flying around soon after dusk in both urban and rural areas. Both have a rapid, twisting flight as they pursue tiny prey of midges, mosquitoes and small moths. A single Pipistrelle (weighing no more than 5-6g, a 1 euro piece) may consume as many as 3,500 of these insects in one night. The two are called Common and Soprano because the latter echolocates at a higher frequency peaking at 55kHz, compared with the former which echolocates at a peak frequency of 45kHz. The Soprano Pipistrelle tends to form nursery roosts with larger numbers of individuals (up to 1,500) compared with the common pipistrelle which would typically have a much smaller nursery size.

Pipistrelles are frequently found roosting in houses, although they also roost in other locations such as tree holes. In houses they prefer to occupy confined spaces such as behind hanging tiles and soffit boards or between roofing felt and roof tiles, rather than the main attic space. In winter, common pipistrelles of both sexes hibernate together in small groups in cavities or recesses in buildings or in hollow trees. Entry to hibernation by common pipistrelles depends somewhat on weather and may occur any time from November to the end of March, but common pipistrelles do not enter deep continuous hibernation and may even

become active in winter when conditions allow. This allows excretion of metabolic wastes. Soprano pipistrelles have similar roosting and breeding habits to common pipistrelles except that soprano pipistrelles appear to be more dependent on water than the common pipistrelle.

3.1.2 Leisler's bat (*Nyctalus leisleri*)

This is the biggest Irish bat and it is often found roosting in buildings. The Leisler's bat has distinctive level flight at greater heights than the other Irish species, from which it dives down after dung flies and beetles. It can be seen soon after sunset flying over open spaces such as parks and fields. Because it is one of the first bats to emerge in the evening and is quite large, the Leisler's may be confused with Swifts that may also be flying around. They are best told apart by the wing shape, the Swift's wings are smoothly curved and scimitar-like. Swifts also shriek, while the Leisler's bat is inaudible without a bat detector. The Leisler's bat is rare in Britain and the rest of Europe but it is relatively common here. For this reason the Irish population of Leislers' bats is considered of International Importance.

In winter Leisler's bats probably hibernate in hollow trees or cavities and recesses in buildings, but relatively little is known about winter roosts in Ireland. There is often a characteristic sweet pungent smell associated with winter roosts of male Leisler's bats. It has been suggested that there may be a migration to cooler parts of the country in winter where more suitable roost temperatures may be found.

3.1.3 Daubenton's bat (*Myotis daubentonii*)

Often called the 'water bat', this species is easily recognised in flight by its low, level flight a few centimetres above the surface of lakes, slow-moving rivers and canals. It skims like a hovercraft above the water in search of caddisflies, mayflies and midges, and may even scoop prey from the water surface using its big feet. Many other bats feed over lakes and rivers, but none has such a close association with water as the Daubenton's. These bats can even swim if they make a mistake and end up in the water. Daubentons' bats roost under stone bridges, in ruins, canal tunnels and damp caves. They are usually solitary but numbers in certain winter roosts may increase during the winter.

3.1.4 Natterer's bat (*Myotis nattererii*)

One of the rarer Irish bat species, the Natterer's bat likes woodland and mature hedgerow habitats. The Natterer's bat has broad wings so can fly with great manoeuvrability among trees. It sometimes gleans insects or even spiders from foliage and may eat larger prey at a feeding perch. Its usual roost sites are in tree holes, old stone buildings such as churches and barns, and under bridges. This species has a fringe of stiff bristles along the trailing edge of its tail membrane, which may help to hold or trap its prey. *Myotis nattererii* has been previously recorded roosting in Behy Bridge on the Drumfin River. In winter, it hibernates in cavities or recesses in caves or buildings.

3.1.5 Brown Long-eared bat (*Plecotus auritus*)

The huge ears of this bat are its most distinctive feature – they are almost as long as the body. Although they are probably quite common in Ireland, it is difficult to see Long-eared Bats in flight because they prefer to forage in woodland flying amongst the foliage, picking moths and other insects off leaves. These bats emit their quiet echolocation sounds through their nose. Larger prey items such as noctuid moths are taken to a feeding perch, often in a porch or outhouse. These perches are recognisable by the piles of insect remains, such as moth wings, which collect under them. The Long-eared bat roosts in buildings such as houses with large attic spaces, churches, outbuildings and in tree holes. In winter, brown long-eared bats may disperse and hibernate singly or in small groups in cavities or recesses in buildings or in hollow trees. They are quite tolerant of cold and can survive temperatures as low as 4°C. Hibernation occurs, depending somewhat on the weather, from about mid-November to early March.

3.2 Bat Habitats Present

3.2.1 Foraging and commuting habitats

The proposed route corridor for the N4 Collooney to Castlebaldwin realignment crosses over and is adjacent to a wide variety of habitat types. The dominant habitat types encountered were improved agricultural grassland (GA1) and wet grassland (GS4). Other habitats recorded from within the study area included marsh (GM1), bog (PB), fen (PF), rivers and lakes (FL), coniferous forest (WD4) and scrub (WS1). A hedgerow network (WL1)

consisting primarily of native trees and shrubs occurs over significant proportion of the study area. In addition to these natural features, a number of used and disused farm buildings and houses are present along the route. Bats are also using the roofs of occupied buildings in the study area, including houses in Drumfin village. However, no buildings identified as being used to any significant degree by bat species lies within the CPO of the proposed alignment. This mosaic of natural and manmade habitats along the corridor provides foraging habitats, commuting corridors, roosting and perhaps minor hibernating sites. The most important area for bats near the proposed development is considered to be the Unshin River Valley cSAC, which includes parts of the Markree Estate. This estate and designated area would however not be directly affected by the proposed development.

The majority of habitats described above, with the exception of the improved agricultural grassland, provide foraging habitat for bats. The insects associated with wetlands, rivers and lakes are abundant during the late spring and summer evenings. Samples of the macro-invertebrates from sites on the rivers and streams in the area revealed that insects were well represented amongst the fauna. These habitats provide suitable foraging for species such as the common and soprano pipistrelle and Leisler's bats. Over significant areas of the study area, there is a network of mature hedgerows characterised by a mix of native and introduced species. They provide commuting channels for bats as they travel from their roosts to the foraging areas around the rivers, lakes, bogs and fens. However, in many areas this network is fragmented to some degree. During the course of the current study some hedgerow removal by local landowners was also recorded; grazing and poaching has affected hedgerows in other areas. Many of the best hedgerows in the study area are not located in the CPO area.

The majority of habitats, with the exception of the improved agricultural grassland, were deemed to provide some foraging potential for bats. The insects associated with bogs, fens, wet grasslands, marsh, rivers and lakes would be abundant during the late spring and summer evenings. Subsequently, it was confirmed that these habitats do indeed provide suitable foraging for species such as the common and soprano pipistrelle, which travel widely from their roosting sites to forage for food. The diet of the pipistrelles is primarily composed of small moths and other small insects, such as midges. These insects would be abundant in the bogs, fens and wet grasslands of the study area at certain times. Other areas identified as important foraging areas for Pipistrelles, *Myotis* bats and Leisler's bats were the riparian zones of rivers and streams in the study area. Again, a number of these habitats are present within the study area and many sections of these have well developed and relatively undisturbed riparian zones. Samples of the macro-invertebrates from a selection of sites on the rivers and streams revealed that insects were well represented amongst the fauna. Mayflies, caddis flies and blackflies were recorded at all the aquatic sites investigated. The results of bat activity levels along the proposed road corridor are given in figures 12.3.1 to 12.3.8 contained within volume 3 of this EIS.

Throughout the study area, there is a network of hedgerows. These hedgerows are dominated by native species such as hawthorn *Crategus monogyna*, blackthorn *Prunus spinosa*, elder *Sambucus nigra*, ash *Fraxinus excelsior* and gorse *Ulex europaeus*. These hedgerows, in particular those which are thick with few gaps, provide good commuting channels for bats as they travel from their roosts to the foraging areas around the rivers, lakes, bogs and fens.

3.2.2 **Roosting and hibernating habitats**

Agriculture is the primary use of land within the study area, and there are numerous used and disused farm buildings and houses. These provide minor roosting opportunities for bats, especially pipistrelles. Mature hedgerows and tree lines surround some of these buildings.

There are a number of bridges over the rivers and streams in the study area. Some of these bridges, particularly the older ones, provide summer roosting locations for bats. Bats have occasionally been recorded hibernating in bridges in Ireland. Daubenton's Bat and Natterer's Bat were recorded roosting in Behy Bridge. No bats were found in hibernation in bridges during this study. No bridges are directly affected by the proposed development. Old and new buildings are present in the immediate vicinity of the proposed road corridor. No potential hibernacula were observed in any of the buildings along the road corridor. Droppings indicated that bats use, in small numbers, some of the older building and sheds in the study area. Other potential roosts (but not hibernacula) were located in farm buildings at Cloonlurg, and Cloonymeenaghan, and some of the houses at Drumfin village are used by bats, However these building would not be directly affected by the proposed realignment.

There are a number of mature trees along the route and these would also provide some potential winter roosting habitat for bats. No confirmed tree roosts were found during the current survey, but all the mature trees in the study area would be considered to have some bat roosting potential. Caves and underground features can be used as hibernacula by bats. There is no indication that any such features occur within the study area.

Agriculture is the primary use of land within the study area and there are numerous used and disused farm buildings and houses. These have the potential to contain bats, especially the pipistrelles. Mature hedgerows and tree lines surround many of these buildings and these would provide links to commuting corridors for the bats using these roosts. In addition, there are a number of bridges over the rivers and streams in the study area. Some of these bridges, particularly the older ones, provide summer roosting locations for bats.

Table 3 Species associations with roost types (adapted from Mitchell-Jones, 2004).

Species	Trees		Buildings		Underground	
	Maternity	Hibernation	Maternity	Hibernation	Maternity	Hibernation
Daubenton's bat	**	*	**	*	**	***
Natterer's bat	**	**	***	*	*	***
Common pipistrelle	**	**	***	***		*
Soprano pipistrelle	**	**	***	***		*
Leisler's bat	**	**	***	*		
Brown long-eared bat	***	***	***	***		**

* *- low dependence; unusual, but has been recorded*

** *- some usage recorded, though perhaps not the most important type of site*

*** *- the most frequently recorded type of site for this species/activity*

Table 4 Identification of key ecological receptors within the zone of influence; based on '*Guidelines for the Assessment of Ecological Impacts of National Road Schemes – Revision 2*' (NRA 2009).

Ecological receptors	Summary description of the ecological receptors	Evaluation of the ecological receptors	Selection as key ecological receptors
Designated sites	Unshin River Valley cSAC, which includes parts of the Markree Estate	Internationally Important. Individual features described in geographical context, extent, significance; structure and function of ecosystems	None identified (not directly affected by the proposed development)
Habitats	Study area dominated by improved agricultural grassland and wet grassland. Other habitats include fen, coniferous forest, rivers and lakes, Scrub, hedgerow, buildings and treelines	Ranging from local to national importance; some of which are of local importance (higher value) as they support bats. Habitats within the study area are typical of Co. Sligo	Habitats of importance to bats include coniferous forest, rivers and lakes, scrub and a good hedgerow network. Old buildings and trees also identified as being important.
Flora	Hedgerows, trees and wet grassland which support insect production	Local Importance (higher value). Flora in the study area is representative of the general Sligo area	Wet grassland and hedgerows important for insect production. Trees and building potentially used for roosts
Watercourses	The Drumfin River would be crossed by the proposed new road. The Unshin River is located east of the proposed new road	Bat use the Drumfin corridor for foraging so is rated Nationally important. Important for the production of insects	Natterer's bat previously recorded roosting in the existing N4 bridge over the Drumfin River
Fauna	Bats: Soprano and Common Pipistrelle, Daubenton's, Brown long-eared, Natterer's and Leisler's	All protected under Irish and European legislation and distributed widely around the country	Bats: Soprano and Common Pipistrelle, Daubenton's, Natterer's and Leisler's bats recorded

3.2.3 **Foraging and commuting habitats**

These habitats are indicated in the activity and habitat maps provided in figures 12.3.1-12.3.8 in volume 3 of this EIS. Overall it has to be considered that all mature hedgerows along with the river corridors are used as foraging / commuting routes for bats to one degree or another. However, no particular areas were highlighted of being of particular individual importance. There are a significant number of farm buildings along the route and they can also be considered to be used to some degree or another for summer roosting. Although very small numbers (and often only individual bats) were recorded in these features. All bridges in the study area also are important to some degree to bats. The bridges in the study area could provide roosting locations for bats but are likely to be more important as summer roosts. No bridges are directly affected by the proposed development. It is also noteworthy that many of the occupied private houses are also used as bat roosts (with examples recorded at Drumfin village). No hibernacula were confirmed during the current study. There are also a number of mature trees along the route and these would also provide some potential winter roosting habitat for bats.

The most important area for bats near the proposed development is likely to be the Drumfin River corridor and the Unshin River Valley cSAC, and the proposed realignment has been designed to be further away from this designated site than the existing N4.

The areas in the immediate vicinity of the proposed road corridor area itself contains a significant number of old buildings including abandoned farmhouses, sheds and the derelict castle at Castlebaldwin. There are also a

number of areas containing stands of mature trees, which could be used by roosting bats. Bats can also roost in new/occupied houses and this was taken into account in the survey. All the buildings present along the proposed road corridor (to 1 km away from the proposed road) were viewed as part of the current survey.

The Unshin River cSAC runs generally parallel to the east of the proposed road realignment. The National Parks and Wildlife (NPWS) site synopsis describes it as "*a notable as an example of a pristine river corridor that has not been drained and retains natural habitats along its margins*". This river corridor provides important habitats for bats; especially in areas with riparian woodland. The Unshin River is closest to the proposed road in the stretch from Collooney to Drumfin. However, the proposed road is however further away from the river corridor than the existing N4 in this area. The distance from the road to the river ranges from approximately 300 m at Doorly to over 2 km at Ardloy. The proposed road also crosses two tributaries of the Unshin River - the Drumfin River and the Turnalaydan Stream, which is the outflow of Lough Corran.

There is a small area of coniferous plantation and scrub surrounded by some mature hedgerows located approximately 800m to the west of the proposed realignment, at Doorly. The Turnalaydan Stream, which flows into Lough Corran from the north, also borders this forestry plantation.

Corran and Boathole Loughs are two small lakes located approximately 100m to the west of the proposed road corridor. An area of coniferous forestry is also present here. The Turnalaydan Stream outflow from Lough Corran connects into the Unshin River. The bat habitats here are sub-optimal but the area in general is of some importance to bats.

There is an area of coniferous forestry area at Cloonlurg which lies on the route of the proposed road. The Drumfin River corridor and associated wet willow woodland lies to the south of this. This area provides some reasonable foraging habitats for bats along hedgerows, around the forestry and along the river. This is the largest area of forestry in the study area, but the absence of mature broad leaved trees reduces the importance of this area for bats. As with most of the study area roosting habitat in limited here; however, both Pipistrelles and Leisler's bats were recorded in this area.

This is an area of extensive mature hedgerows near Cams Bridge; on the upper reaches of the Drumfin River (Kilmorgan and Knockmoynagh townlands). This area provides some reasonable foraging habitat for pipistrelle bats. However, as it is located over 1 km away from the proposed road realignment.

The proposed road corridor runs near the Aghalenane / Ardloy Loughs. Areas surrounding the lakes have a high floral diversity, and some hedgerows and scrub are present to the south of the loughs. This area is used to some extent as a foraging area for bats, and occasional Soprano pipistrelles and Leisler's were recorded here during the surveys. A *Myotis* sp. bat (thought to be Natterer's) was also recorded in this area during the car-based surveys.

Lough Meenaghan is a small lake adjoining the existing N4 at Cloonymeenaghan. The proposed realignment would be located further away from the existing N4 and would run approximately 400 m away from the lake. The Tawnagh Stream drains from the northern end of the lake and flows to the north east into the 'Swallow Hole' complex.

Hedgerow habitats in the Coolskeagh area provides some suitable foraging habitats for bats. This area is located over 1 km away from the proposed route corridor. The proposed road is located further away from this area than the existing N4.

Cleavry Lough and its surrounding hedgerows may be used to some extent as a foraging area for bats. This lough is located approximately 1 km from the proposed road corridor. The proposed road is located further away from this area than the existing N4.

3.2.4 **Buildings within the study area**

The buildings and features discussed below are indicated in the activity and habitat maps provided in figures 12.3.1-12.3.8 in volume 3 of this EIS. There are seven dwellings and abandoned buildings at the northern end of the proposed road development which will be acquired, within the stretch between Cloonamahan and Collooney. These buildings have been examined externally and no evidence of bat usage was recorded. Bats can potentially easily gain access to these building and both the attic spaces and the interior of disused buildings provide potential opportunities for roosting bats. However no evidence of bats was apparent from the external examination. The majority of the sheds within the study area are poorly insulated and of limited

value to bats also. A single Soprano pipistrelle bat were recorded emerging from the unhabitated dwelling to the east of the N4 corridor at Mullaghnabreena.

There are three buildings at Cloonlurg that have some potential for use by bats. All buildings were examined externally only due to poor access and safety concerns. These are currently being used by farm animals and for storage. The largest of these structures is a stone roofed barn with an old wind vane. These buildings are set in potentially good bat habitat, and are quite old, therefore increasing their potential importance. This complex of buildings was confirmed to be a Soprano pipistrelle roost (likely maternity roost). However it is located a significant distance from the realignment (>500m) and would not be significantly affected.

An old 2 storey farmhouse and sheds at Drumfin were examined externally. The sheds were examined internally but the house could not be entered as it was locked up and boarded. The windows on the upper level of the farmhouse were missing / open. These openings could allow bats to enter the house and bats could possibly use this building as a roost.

There are old run down farm buildings at Cloonymeenaghan to the immediate east of the proposed realignment. These buildings would not be directly affected by the proposed road development and are used for roosting by small numbers of soprano pipstrelles.

There is a small abandoned farmhouse at Drumderry to the immediate west of the proposed road corridor. This was examined externally and no signs of bat usage were found. Mr. Clarke who is leasing the land was met and he reported that he had never seen bats in the area. The house was secured and could not be entered. Mr Clarke also did not have access to the house.

There is an old house and barn near Castlebaldwin that is a minor roost for Soprano pipistrelles. The house is well secured and could not be entered. There are broken/open windows upstairs that could allow access for bats and the roof is also damaged in places.

The ruins of Castlebaldwin Manor house, a small two-storey semi-fortified L-shaped manor house which was built around 1650, lie to the southeast of Castlebaldwin village. It was constructed when the purely defensive nature of castles was being made obsolete by the advances in artillery. The function of the house was to provide a comfortable residence that could be defended against a small-scale attack. It was reported to have been burned by the Williamites around 1690 and has lain in ruins since. It is considered highly unlikely that this provides any roosting opportunities for bats as it is too exposed and provides little shelter.

There are a number of bridges in the study area. Bats have occasionally been recorded hibernating in bridges in Ireland. Daubenton's Bat and Natterer's Bat were recorded roosting in Behy Bridge during the summertime (Shiel, 1999).

There are no caves or similar underground features in the study area that could be used by bats.

3.2.5 Conclusions

In general, a low level of activity was recorded along the road corridor, with a number of exceptions. The farmhouses to the north of Aghalenane/Ardloy loughs would be lost as a result of the proposed development, along with a number of mature trees. Activity recorded in this area was moderate (15-20 bats). Foraging activity was concentrated around the mature trees and hedgerows at this location, as well as along the tertiary road in this area.

The proposed N4 road will, to some degree, form a linear barrier for bats undertaking local migrations. However the existing N4 also forms a barrier and the proposed road runs on-line or in parallel with the existing road. The new road itself will, to some degree, provide an opportunity to create new habitats and important commuting routes for bats. Landscaping and tree planting along the new road will provide corridors where bats can forage and connectivity between important habitats can be established.

By and large, the proposed route does not pass through areas that are physically ideal for bats. Most of the proposed development is located in areas currently occupied by agricultural and wet grassland. These areas are of low value to the bat populations present both in terms of habitat and insect prey production.

The proposed N4 Collooney to Castlebaldwin Realignment development is not a particularly important area for bats due to the absence of high quality bat habitats in this area of County Sligo. The proposed realignment, in the main, does not significantly impact on commuting, foraging or roosting sites for bats.

4 POTENTIAL IMPACTS

4.1 Introduction

The corridor of the N4 Collooney to Castlebaldwin Realignment is not a particularly important area for bats and the proposed realignment generally runs through agricultural grassland and wet grassland areas – habitats which are of low importance to bats. Consultation with the NPWS during the preparation of this report also confirmed that NPWS does not consider the affected areas to be particularly important to bats. NPWS and Bat Conservation Ireland also have no records of any roosts occurring in the areas directly affected by the proposed development.

No hibernation roosts were recorded during the current survey; however a number of old farmhouses / farm buildings will be affected by the proposed realignment. Some of these buildings are used in summer by roosting for bats and mitigation measures will be required. All mature trees in the study area could also be potentially used by bats. The development will also result in the loss of areas of semi-natural habitat. These areas, other habitats affected and their importance to bats are outlined in Table 5. Table 6 provides an assessment of the predicted habitat loss in the study area and the importance of these habitats to bats.

The current impact assessment and mitigation measures proposed were discussed and agreed with NPWS during a site meeting as being appropriate for the proposed N4 Collooney to Castlebaldwin Realignment. The impact assessment provided in this document is based on the combination of the findings of the 4 seasonal surveys and validation surveys undertaken during 2013.

Table 5 Predicted habitat loss on the proposed development site and the importance of these habitats to bats.

Habitat code	Habitat name	Occurring within the road alignment	Relevance to bats
FL1	Dystrophic Lakes	Only one small lake classified as dystrophic occurs within the study area, this lies adjacent to but not within the road alignment.	Not of significant importance to bats.
FW1 / FW2	Eroding / depositing watercourses	Both eroding and depositing sections of watercourses are crossed by the road alignment	The Drumfin River, Turnalaydan Stream, Tawnagh Stream and number of smaller watercourses would be affected. These areas are locally important (high value) as foraging areas or bats.
FW4	Drainage ditches	Drainage ditches are crossed by the road alignment.	Not of significant importance to bats.
GA1	Improved agricultural grassland	Improved agricultural grassland occurs within the road alignment	The main habitat affected by the proposed development. Not of importance to bats.
GA2	Amenity grassland	Amenity grassland occurs within the road alignment.	Not of significant importance to bats in the study area.
GS4	Wet grassland	Wet grassland occurs within the road alignment	The main habitat affected by the proposed development. Not of importance to bats
GS2	Dry meadows and grassy verges	Grassy verges along existing road corridors occur within the road alignment	Not of significant importance to bats.
GM1	Marsh	Marsh occurs within the road alignment	Not of significant importance to bats.

Habitat code	Habitat name	Occurring within the road alignment	Relevance to bats
FS1	Reed and large sedge swamp	Reed and large sedge swamp does not occur within the road alignment	Not of significant importance to bats.
PB1 / PB4	Raised bog / Cutover bog	Raised bog which has been cutover occurs within the road alignment.	Not of significant importance to bats.
PF1 / PF2	Rich fen and flush / Poor fen and flush	Rich fen and flush occurs within the road alignment, where the road corridor includes a small portion of the western boundary of Lackagh Fen and also the south western boundary of Aghalenane / Ardloy lakes.	Lackagh Fen and Ardloy & Aghanlenane Loughs are two areas with fen habitat on this route. This habitat considered to be of some importance to bats. Mitigation may be required.
PF3	Transition mire and quaking bog	Transition mire and quaking bog occurs within the road alignment where the road corridor includes a small portion of the south western boundary of Aghalenane / Ardloy lakes. This habitat also occurs within the Lackagh Fen complex but is not crossed by the route.	Not of significant importance to bats.
FP1	Calcareous springs	Calcareous springs are associated with fen habitat and do not occur within the road alignment.	Not of significant importance to bats.
WN6	Wet willow/alder/ash woodland	Wet willow/alder/ash woodland occurs within the road alignment.	Areas of this habitat along the Drumfin River affected. These areas are likely to be locally important as foraging areas or bats.
WN2	Oak/ash/hazel woodland	Oak/ash/hazel woodland occurs within the road alignment.	Margins of woodland important for bat foraging. Roosting potential in trees.
WD4	Conifer Plantation	Conifer plantation occurs within the road alignment.	Margins of coniferous forestry often important for bat foraging.
WS2	Immature woodland	Immature woodland occurs within the road alignment.	Some foraging habitat in these areas.
WS1	Scrub	Scrub occurs within the road alignment.	Some foraging habitat in these areas.
WL1 / WL2	Hedgerows / treelines	Hedgerows and treelines occur within the road alignment.	Likely to be locally important (high value) for bat foraging. Bat roosts may be present in trees. Mature hedgerows are important habitats for bats. Significant areas of this habitat will be affected.
BL1	Stone walls	Stone walls occur within the road alignment.	Not of significant importance to bats.
ED2	Spoil and bare ground	Spoil and bare ground occurs within the road alignment.	Not of significant importance to bats.
BL3	Buildings and artificial	Buildings and artificial surfaces occur	

Habitat code	Habitat name	Occurring within the road alignment	Relevance to bats
	surfaces	within the road alignment.	

Table 6 Predicted habitat loss on the proposed development site and the importance of these habitats to bats.

Receptor	Description	Evaluation	Implications for bats
Lackagh Fen Complex	Fen complex with Annex I Alkaline fen and transition mire with priority Annex I Tufa forming springs and high diversity marsh habitats.	National importance	No significant implications for bats.
Boathole Lough & Lough Corran	Mesotrophic lakes with reed swamp and cutover raised bog habitats to the southeast.	County importance	No significant implications for bats.
Ardloy & Aghalenane Loughs	Mesotrophic lakes complex with Annex I Alkaline fen and Transition mire habitats, priority Annex I Tufa forming springs and populations of Annex II *Vertigo geyeri*.	International importance	No significant implications for bats.
Cuileencroobagh Lough	Small, degraded dystrophic lake with Annex I transition mire within a complex of cutover raised bog.	County importance	No significant implications for bats.
Swallow Holes Complex	Small groundwater connected ponds including priority Annex I Turlough habitat. Reed swamp vegetation and wet grassland.	National importance	No significant implications for bats.
Marsh	Species-rich marsh	Local Importance (higher value)	No significant implications for bats.
Wet willow/alder/ash woodland	Wet willow/alder/ash woodland along the Drumfin River corridor and also occurring in isolated pockets	Local importance (higher value)	Margins are more important than closed woodland. Road construction will create margins. Impact is not significant.
Oak/ash/hazel woodland	Occurring in isolated pockets on dry and elevated ground within the study area	Local importance (higher value)	Not significant due to relatively minor extent of this habitat.
Scrub	Semi-natural hawthorn, blackthorn, gorse and hazel scrub within the context of an agricultural landscape	Local Importance (higher value)	No significant implications for bats. Some low grade foraging habitat will be lost.
Hedgerows and treelines	Well connected hedgerows and treelines with fair-good structure, providing a wildlife corridor function within the study area.	Local Importance (higher value)	This will be the main impact on bats due to loss of foraging and commuting routes. Slight negative impact in the local context.
Exposed calcareous rock at Carrownagark.	Species-poor limestone outcrop, significantly degraded.	Local Importance (higher value)	No significant implications for bats.

4.2 Construction phase impacts

4.2.1 Damage to commuting routes

The corridor of the N4 Collooney to Castlebaldwin Realignment is not a particularly important area for bats and the proposed realignment generally runs through agricultural grassland and wet grassland areas – habitats which are of low importance to bats. Moreover, the proposed road runs in parallel with the existing N4 road or online so the road would affect regional bat movements in a similar way as the existing road. The main mature hedgerow networks affected by the proposed development are those located immediately south west of the Drumfin River crossing and along the southern 3 km section of the proposed development.

Mature trees and hedgerows are also present near the farmhouses to the north of Aghalenane / Ardloy Loughs and the loss of these would disrupt local commuting routes and foraging areas. However, the bat assessment has concluded that most affected areas are only used by relatively small numbers of Soprano Pipistrelle bats. Although fully protected, this species (and the Common Pipistrelle) are common and adaptable species and the loss of hedgerow habitat used by low numbers of bats can be mitigated. The predicted impact is not evaluated as significant in the local context in the long term.

4.2.2 Change in insect fauna available to foraging bats

The loss of existing habitats during the road development could affect the invertebrate fauna and lessen the availability of insect prey for bats along the corridor. However, the proposed route of the road is generally over agricultural and wet grassland area and these areas are not of particular importance for insect production. Current agricultural practices in the area reducing diversity in this part of Sligo in general, and the impact of the proposed realignment would not be significant in relation to these "*existing and emerging trends*" of biodiversity loss.

4.2.3 Disturbance of bats during construction work

Aside from disturbance to roost sites, the daytime noise and dust generated during the construction of the road are unlikely to affect bats to any degree, as they will be inactive at this time. It is unlikely that significant works would be undertaken during the night. No significant effects are identified.

4.2.4 Loss of bat tree roosts

The removal of trees (especially mature deciduous) creates the risk of the loss of roost sites. This would be detrimental to bats in the short-term. This is potentially a long-term negative impact on the area if tree roost sites for maternity populations of bats are removed. Removal of large mature deciduous trees would not however be a component of the development and such trees will be examined for the presence of bats in advance of removal. No maternity roosts in trees were found during the current survey.

The only significant area where a line of mature trees (Ash and Sycamore) would be affected is near the farmhouse to the north of Aghalenane / Ardloy. These trees are of local importance to Soprano Pipistrelle bats. The installation of compensatory bat boxes will mitigate this impact. With appropriate mitigation measures no significant impacts on bat roosts would occur in the medium to long term.

4.2.5 Loss of bat roosts in buildings

There are a number of old sheds and buildings along the route which will be demolished as part of the proposed development. Most of these buildings are old farm installations and derelict houses.

A survey of these buildings was undertaken during the current survey and a number of these buildings are used as minor summer roosts by Pipistrelle bats. These include the seven buildings between Collooney and Cloonamahan, Clarke's farmhouse, the farmhouse to the north of Aghalenane / Ardloy Loughs, and the farmhouse to the east of Castlebaldwin village. These buildings will be surveyed again immediately prior to demolition and compensatory bat boxes will be used to compensate for the loss of roosts. With appropriate mitigation measures no impact evaluated as being significant with regard to the conservation status of bats in the local context is identified with regard to bat roosts in buildings.

4.3 Operation phase impacts

4.3.1 **Increased Lighting**

The proposed development will result in the introduction of a significant level of artificial lighting to areas currently unlit as a result of traffic lights. Effects upon Pipistrelle bats are likely to be minimal as these species are tolerant of light. Any impacts arising in this regard will be long term; however, they are not evaluated as being significant with regard to the conservation status of bats in the local context..

4.3.2 **Increased disturbance**

Although the existing N4 will be left in place, it is expected that traffic levels on this road will be much reduced thus reducing disturbance in this area. This will offset to some degree disturbance in new currently undisturbed areas. Effects upon Pipistrelle bats are likely to be minimal as these species are tolerant of disturbance and regularly feed along roads. The main areas where *Myotis* sp. bats were recorded will be further away from the new road than the existing road. Overall, increased disturbance from the new road on bats would not be significant in the long term.

4.3.3 **Habitat creation**

New hedgerow habitat and trees will be planted as part of the proposed development. This new habitat creation will be of some benefit to bats and is likely to result in a positive impact on bats in the medium to long-term; below a significant level in the local context.

4.3.4 **Increased risk of road death**

New roads traverse the established feeding areas and territories of bats. This may lead to death when bats encounter moving vehicles while attempting to access feeding sites or alternative roosts on the opposite side of the road. As a consequence, suitable roosts will be rendered inaccessible or less suitable. However, in the current development no major roosts or feeding areas are affected and the development would largely affect common and adaptable species (i.e. Pipistrelles) which currently feed along the existing N4 road. This would not give rise to significant impacts in the long term.

4.4 ‘Do nothing’ impact

The new road would interfere with a bat’s ability to utilise the landscape in the same manner as had been established prior to its construction. Links between roosts or between feeding sites and roosts could be severed, preventing access to alternative roosts. Bats undergo a localised or long-distance migration between roost sites in different seasons. The impacts will be greatest where the route severs well-developed hedgerows or causes the loss of mature trees. Any other areas where mature trees will be lost will also be areas where bat commuting activity is compromised. However these commuting corridors can be maintained through mitigation measures.

The demolition of buildings or trees suspected to contain bats without proper mitigation (timing and prior checking by a suitably qualified ecologist) could potentially result in unnecessary bat mortalities.

4.5 Assessment of the worst-case scenario

In the absence of mitigation, there would be no habitat replacement to compensate for that lost, bat roosts containing bats could be destroyed, bat mortalities due to traffic would be expected to increase with the operation of the new road, insect life on which bats depend for sustenance could be depleted and bat commuting corridors could be lost to the new road. Overall, in the worst case scenario, a significant negative impact could be realised in the event of a worst case scenario situation.

5 BAT MITIGATION MEASURES

5.1 Pre-construction bat survey

It is recommended that a pre construction bat survey be undertaken in the summer prior to the construction of the road. This survey will be designed to provide an update of the current assessment and inform the detailed design of the bat mitigation measures (i.e. location of bat boxes etc.).

5.2 Checking of mature trees for bats by an ecologist prior to felling

The felling of trees would be agreed in advance with NPWS. Tree felling should be carried out in accordance with a tree felling license issued by the Forestry Service and must be preceded by an examination of affected mature trees for the presence of bats. Should a number of bats be present at a time designated for felling, the tree will be maintained until bats have evacuated the tree. It is an offence under the Wildlife (Amendment) Act 2000 to intentionally destroy a bat roost during construction or engineering activities. Any mature trees or trees with suitable crevices or cavities offer roosting opportunity for bats and will be examined for bat presence prior to felling (e.g. trees at farmhouses to the north of Aghalenane / Ardloy Loughs). If tree felling is proposed during the bat breeding season, it is imperative to wait for the bats to leave the tree. Exclusion measures may be impracticable in the case of a tree where the roost is over a height of five to six metres. Trees shall not be cut up immediately and shall be left overnight to allow bats that may still be within the tree to exit.

5.3 Checking of buildings for bats by an ecologist prior to demolition

Any old buildings along the corridor, which need to be demolished, will be rechecked for the presence of bats prior to demolition. Should a number of bats be present at a time designated for demolition, the building will be maintained until bats have left or have been excluded under permission of NPWS. It is an offence under the Wildlife (Amendment) Act 2000 to intentionally destroy a bat roost during construction or engineering activities. A derogation licence from NPWS will be required to interfere with any roosts. The buildings shall be demolished in the period mid/ late September to late October to ensure that bats have finished breeding but have not entered hibernation. Buildings will be demolished *immediately* following a negative examination.

5.4 Restriction on lighting

Road lighting can artificially boost insect numbers because insects are attracted to the light. Certain species of bat, especially the two species of Pipistrelles found along the corridor, often forage around these lights as a result. However, other less common species may be negatively impacted by streetlights. It is therefore recommended that artificial lighting along the route is kept to the minimum required for safety (as proposed).

5.5 Habitat creation

Habitat creation, including planting of trees and hedgerows will be undertaken as part of the proposed road development. This will offset the loss of habitat, which will occur during construction. The existing N4 will be left in situ and it is expected that traffic levels on this road will be significantly reduced. This road is lined in parts by hedgerows and may be used more by bats in the future for foraging when disturbance (i.e. traffic) is less.

5.6 Cessation of construction work prior to darkness

No heavy plant should be in operation after dark (and including prior to sunrise). This will lessen the disturbance to bats and other mammals.

5.7 Provision of alternative roosts

Bat boxes will be provided should any tree roosts be lost and this will mitigate against such losses and hence no residual impacts in terms of loss of bat roosts are anticipated. The number and location of the bat boxes will be agreed in advance with NPWS. Consideration should be given to installing bat boxes even if no tree roosts are removed during felling. This would be a significant habitat enhancement for bats in the area.

Bat boxes of various designs will be used to offset the loss of minor roosts in buildings at Dooly, Clarke's farmhouse, farmhouses to the north of Aghalenane/Ardloy Loughs, and the farmhouse to the east of Castlebaldwin village. Schwegler 'woodcrete' boxes have the highest rates of occupation of all box types. The 75% wood sawdust, concrete and clay mixture allows natural respiration, stable temperature, and durability. They are extremely long lasting and rot- and predator-proof. They are hung from a tree branch near the trunk, or fixed to a tree trunk with a 'tree-friendly' aluminium nail. These boxes are readily available from Alana Ecology (www.alanaecology.com) and other suppliers.

Bat boxes must be in place before the demolition of buildings or the felling of trees. In accordance with NRA (2005b) *'Guidelines for the Treatment of Bats during the Construction of National Road Schemes*' it shall be stipulated in the Employer's Requirements that bat boxes must be monitored for their acceptance of use by bats and those boxes which remain unused after two years after the date of erection shall be relocated. Boxes should be sited in an area that will not be further subject to vegetation removal or demolition, either on a tree or building wall that will not be affected by the road construction or other operations.

It is important that prior planning of tree felling and demolition is undertaken to prevent last minute complications relating to the potential roosting places of bats. The implementation of the bat mitigation measures will be timed and scheduled so as to minimise the disturbance and the negative impacts on bats as far as is possible. Progress on the implementation of the measures for bats will be reported to NPWS. In line with NRA (2005b) *'Guidelines for the Treatment of Bats during the Construction of National Road Schemes*' post-construction monitoring of bats will be required in order to establish the effectiveness of the measures that have been put in place. Additional artificial roost sites (bat boxes) will be installed on the bridges over the Drumfin and Turnalaydan Stream bridges. The number of boxes to be installed will be agreed in advance with the NPWS.

5.8 Provision of vegetation corridors

Habitat creation is a feature of the proposed development. This will provide corridors for commuting and foraging for bats. Hedgerow and shrubs along the route would provide a screen against the lights of travelling vehicles and would also provide feeding for bats. In addition to this, once the plants have established and are growing, the row of vegetation would also serve as a channel along which bats would feed rather than crossing the road. Native species of hedgerow tree and shrub shall be used and most preferably of native stock. Ash, oak, rowan would all be beneficial as would blackthorn, hawthorn, bramble etc. Translocation of hedgerows should be considered to expedite the creation of new cover and flight lines or commuting routes for bats.

5.9 Provision of bat underpasses

All bridges and culverts over the larger watercourses and any underpasses for farm animals will be suitable for use by bats, providing adequate height for passage under the alignment. In particular crossings of the Drumfin River and Turnalaydan Stream will be passable by bats. The margins and embankments of the new road will be planted with native trees and shrubs, including the creation of linear hedgerow features to the road edge and along the road margin; this will provide feeding and shelter for commuting and feeding bats. These provide an alternative vegetation corridor for bats to replace hedgerow lines that are removed for road construction. Most species of bat commute along such corridors for feeding, wind shelter and most probably as a navigational aid. The locations of proposed underpasses are shown in figures 12.3.1 to 12.3.8 contained within volume 3 of this EIS.

6 RESIDUAL IMPACTS

6.1 Introduction

The residual impacts of the N4 Collooney to Castlebaldwin realignment are those impacts on bats that remain, after implementation of the mitigation measures described above. Though difficult to quantify, the magnitude of the predicted impacts are evaluated as being below as significant negative level with regard to impacts affecting the conservation status of bats in the local context, in both the short and long term. This is predicted based on habitats throughout the road corridor lost being replaced by similar and sometimes superior quality foraging habitat for bats. Also, there would be increased accessibility for commuting bats; provision of artificial roosting sites; a decrease in the probability of collision with vehicles and a reduction in lighting outside of the road corridor.

6.2 Feeding and commuting routes

The results of the bat survey have shown that the well developed hedgerows along fields and access roads throughout the study area and surroundings provide commuting routes primarily for soprano and common pipistrelle bats. The existing N4 road and its environs are mainly low value habitats for bats, offering little foraging capacity. With the landscaping measures proposed, the quality of bat foraging habitats would be increased in these areas, resulting in positive effects. With the exception of the forestry at Cloonlurg, impacts on bat commuting routes in other parts of the development (offline) are deemed to be not significant, as newly planted hedgerows / treelines mature and improve as landscape features for commuting bats. The felling of the woodland strip at Cloonlurg is predicted to impact bats below significant levels, when all mitigation measures are adhered to, including the installation of bat boxes and provision of a bat underpass at the Drumfin River crossing point. The existing N4 will carry reduced volumes of traffic and little / no vehicles in some locations (dead ends created by the new road), thereby resulting in a net increase in potential foraging areas for bats when combined with the new planting.

The land-take due to the proposed road will be substantial, but as already stated, these habitats are mostly low quality habitats for bats. With the planting proposed along the new road, the residual impact would not be significant. The habitat reinstatement using native tree species would represent a minor positive impact as roosting opportunities and insect diversity would be increased. Though the new road would divide sections of the coniferous plantation at Cloonlurg, with some positive effects due to the creation of increased woodland edge for foraging and native species planting would increase invertebrate prey abundances. The proposed N4 road will, to some degree, form a linear barrier for bats undertaking local migrations; taking cognisance that along the existing N4 there are no provisions for bats. However, the proposed bridge and underpass structures will be passable by bats. All road underpasses on the new road should not be illuminated (if this can be reconciled with road safety requirements). However, along most of the length of the proposed development the new road will run close to and parallel to the existing road, or online. This will ensure that the overall impact of the road in terms of forming an additional linear barrier will be reduced.

6.3 Lighting

Much of the existing N4 is currently without mature hedgerows and lights from vehicles illuminate the countryside around the road. The proposed new road will have treelines at either side and as trees mature the spreading of light will be reduced by the screening effect of trees. Indeed the effect of this 'channelling' of light will be greatest during the times when bats are most active (i.e. late spring, summer and early autumn) due to the foliage on the trees. This reduction in light would be beneficial for the rarer and light intolerant bat species in the area, namely Daubenton's and Natterer's bats. These bats could potentially be displaced by the new road but reduced lighting outside of the direct road corridor will result in the availability of these treelines as foraging and commuting routes on the field side, away from the road. The predicted impacts resulting from the proposed road and impacts from additional lighting are not evaluated as significant with regard to the conservation status of bat species in the local context.

7 MONITORING

Upon completion of the road construction, monitoring at the appropriate season should be undertaken by a specialist to determine the effectiveness of the mitigation measures employed. This can only be carried out with the permission of the landowner, where the measures in question are outside the landtake for the road. Monitoring should be continued for at least two years after construction work ceases. Deficiencies in the implemented mitigating measures should be corrected where possible (e.g. relocating bat boxes). Measures to enhance bat habitats including foraging and commuting potential include the planting of native trees / shrubs along the proposed realignment to provide vegetation corridors.

8 REINSTATEMENT

There is a requirement for measures along the corridor of the road to reinstate foraging and commuting routes for mammals in the form of mammal underpasses to ensure continuity of territories. The requirement for providing supplementary bat boxes will be discussed with NPWS during the detailed design stage. Subsequent to bat monitoring upon completion of the road development, in areas where bat boxes are found to be used by bats, additional bat boxes should be installed to provide additional roosting opportunities.

Additional measures would include the purposeful planting of linear scrub and treeline species to maintain wildlife corridors outside of the site, for example to the north of the new road in the vicinity of Corran and Ardloy Loughs. The landscaping plan for the road corridor includes provision for the reinstatement of native habitats following the botanical community descriptions in Fossitt (2000) to ensure that the benefit of such measures to wildlife are maximised.

9 GLOSSARY OF TERMS

Colony

The term colony is used to identify a genetically related or socially interactive population of bats within an area that may associate within a number of roost sites during the annual cycle. Harem: The mating and association of several adult females with one male.

Population

A population is the number of individuals of a given species occupying a certain area of land over a certain period of time.

Roost

This term has a dual application and is used to describe the structure (house, shed, bridge, tree, cave, etc.) within or on which a number of bats take shelter. Secondly, the bats within or on such a structure are also referred to as a roost of bats. 'Roost' does not infer a genetic or social association between the bats within a structure

Maternity roost

A maternity roost is the structure within which pregnant females aggregate in summer (typically from late May onwards) to give birth to the annual single young. The young are born within the period June to July. The bats may utilise the maternity roost up until the early part of September, by which time the young are independent. Maternity roosts may be evacuated periodically throughout the summer as bats avail of a number of roosts during the summer (there is rarely only one roost used for the entire summer for most species of bat).

Night roost

A night roost is a resting place availed of by a single or number of bats during the period of darkness and following emergence from a daytime roost. Night roosts play an important function as a resting place between feeding forays, refuges from predators and bad weather, sites to consume large prey that require manipulation and allow social interaction and information transfer between individuals of the same species.

Hibernaculae

Winter quarters / shelters of hibernating animals. Singular: hibernaculum. In relation to bats, a hiberbation roost is a hibernaculum.

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11 PLATES & FIGURES

Plate 1 The study area is generally open and dominated by improved agricultural grassland and wet grassland. Roosting opportunities are somewhat limited, and this all reduces the importance of the area for bats.

Plate 2 Open countryside looking north towards the Ardloy/Aghalenane complex.

Plate 3 Open countryside with agricultural grassland and fragmented hedgerows, near Castlebaldwin.

Plate 4 Drained river channel; Turnalaydan Stream (Lough Corran outflow).

Plate 5 Mixed/coniferous woodland at Carrowkeel, with wet grassland habitats in the foreground.

Plate 6 Farm building to the west of the study area near Cloonlurg - though to be maternity roost for Soprano pipistrelles. Not within CP area.

Plate 7 Castlebaldwin manor house. The southern end of the development will run near this structure as it ties in with the existing N2. This building is not used by bats.

Plate 8 The farmhouses to the north of Aghalenane/Ardloy Loughs would be lost as a result of the proposed development. These are used as a roost for Soprano pipstrelles.

Plate 9 Three species of bat (Natterer's, Daubenton's and Soprano pipistrelle) have been recorded using Drumfin Bridge on the existing N4 is used as a roost.

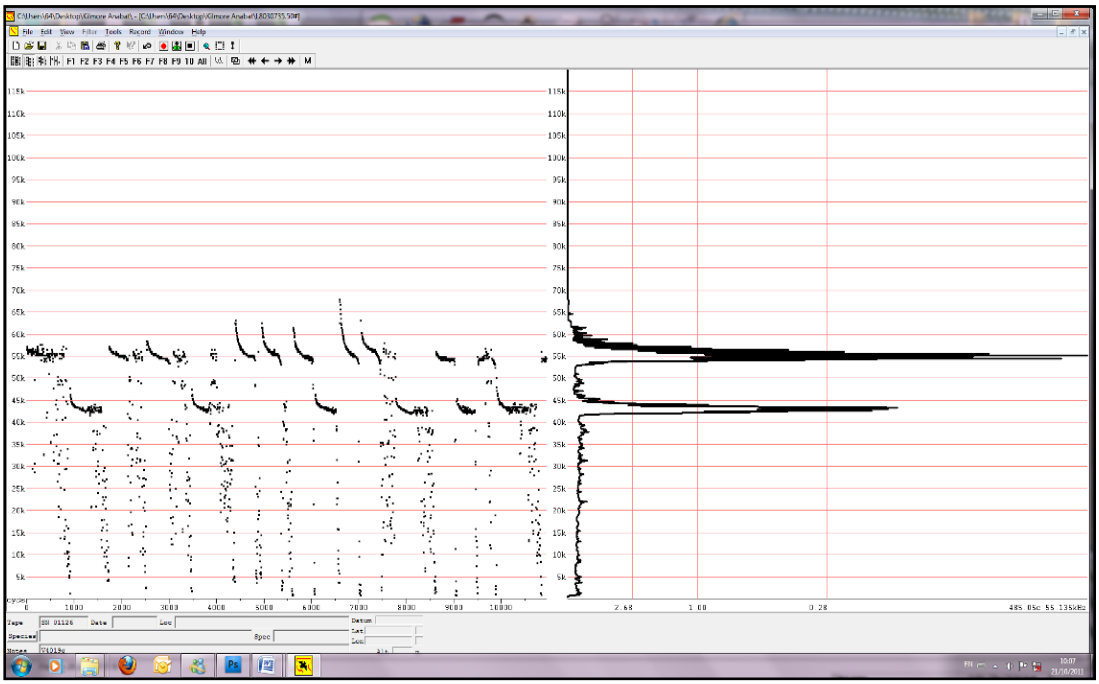

Figure 1 Anabat Sonogram of a Soprano pipistrelle bat (55.5kHz peak frequency) and Common pipistrelle (peak frequency 46.5 kHz) feeding together.

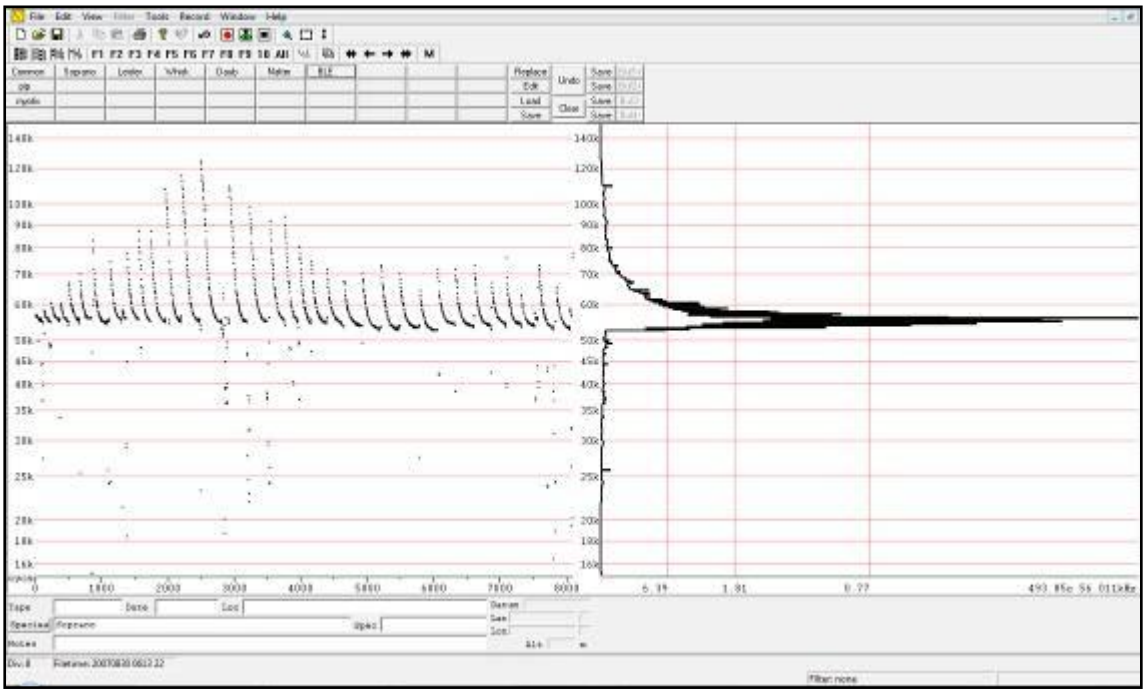

Figure 2 A good example of a soprano pipistrelle call showing the characteristic 'continuous frequency tail'. Soprano pipistrelle calls typically range from 47.3 – 90.4 kHz.

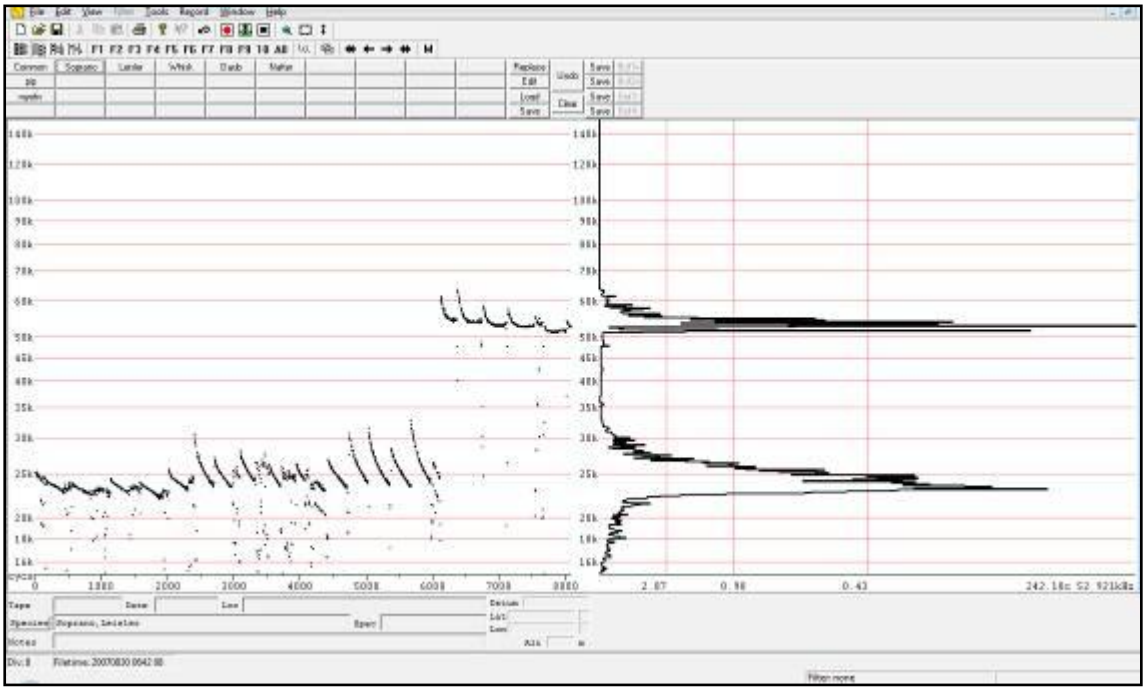

Figure 3 A soprano pipistrelle (above) and a Leisler's bat recorded together. Soprano calls peak at 55.5kHz. Leisler' bats can be identified on sonogram by the shape and especially the low frequency at which they call, 26.9kHz.

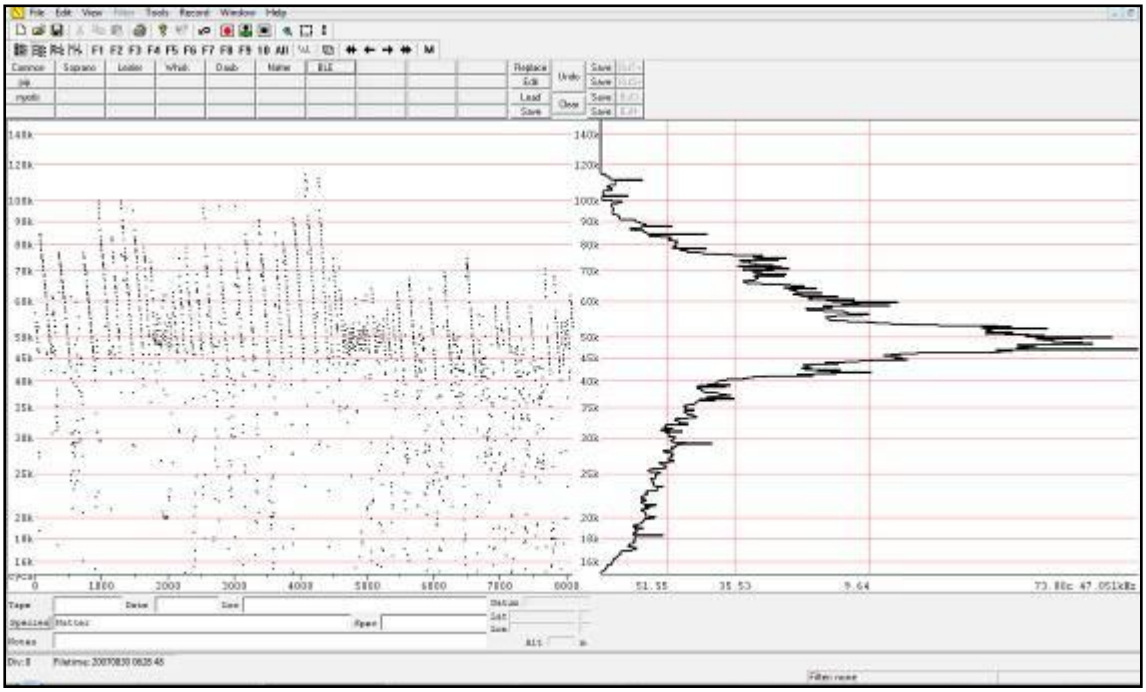

Figure 4 Natter's bats can generally be distinguished from other *Myotis* bats on a sonogram by the wider range of their calls (20 – 101 kHz). Their calls typically peak at 49 kHz.