A585 Windy Harbour to Skippool Improvement Scheme

TR010035

6.8.5 ES Appendix 8.5: Bat Technical Appendix

APFP Regulation 5(2)(a)

Planning Act 2008

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Infrastructure Planning

Planning Act 2008

The Infrastructure Planning
(Applications: Prescribed Forms and
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A585 Windy Harbour to Skippool Improvement Scheme

Development Consent Order 201[ ]

ES APPENDIX 8.5: BAT TECHNICAL APPENDIX

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1 INTRODUCTION

1.1 Aims and Objectives

1.1.1 This report provides the findings of bat surveys undertaken in support of Highways England's proposed development of the A585 between Windy Harbour and Skippool (hereafter referred to as 'the Scheme').

1.1.2 The aims and objectives of this study were to:

- Identify: the assemblage of bat species using the study area; the relative frequency with which the study area is used by the different species; and the spatial and temporal distribution of bat activity
- Determine the nature of activity for different bat species (i.e. foraging, commuting and/or roosting)
- Ascertain the existence of any bat roosts within the site
- Advise of any implications that presence would have on the Scheme

1.1.3 The need for mitigation or compensation, and the identification of potential opportunities to enhance the existing ecological baseline, are not included within this report, but are discussed in full in Chapter 8: Biodiversity (document reference TR010035/APP/6.8).

1.2 Report Structure

1.2.1 This report has been subdivided into the following sections:

- Section 1 and 2: provide the aims and objectives and methodologies adopted
- Section 3: presents the findings of the desk study and bat surveys
- Section 4: summarises the results and provides the conclusions of the surveys with regards to bats
- Section 5: references
- Annex A: Root assessments
- Annex B: Emergence and re-entry surveys
- Annex C: Transect survey details
- Annex D: Static survey details
- Annex E: Sonichiro methodology
- Annex F: Drawings

2 METHODOLOGY

2.1 Introduction and Guidelines

2.1.1 Survey methodologies were devised with reference to the:

- Bat Workers Manual (Mitchell-Jones and McLeish, 2004)
- Bat Mitigation Guidelines (Mitchell-Jones 2004)
- Bat Surveys: Good Practice Guidelines 3rd Edition (Collins, 2016)
- Design Manual for Roads and Bridges Volume 10 (Highways Agency 2001)

2.1.2 Bat surveys focus on identifying features used by bats for roosting, foraging and commuting.

2.2 Desk Study

2.2.1 The Study Area was determined during the options phase, at which time multiple Scheme options were under consideration. The desk study area and subsequent survey area were determined to encompass all potential Scheme options. This report therefore, in some instances, contains information outside of the various study and survey areas discussed herein.

2.2.2 The following approximate radii around the Draft Order Limits were used in the desk study (See Figure 8.5.1 at Annex F):

- 0.5km for potential roost features and habitats
- 5km for bat records
- 30km for Special Areas of Conservation (SACs) designated for bats (Highways Agency, 2009)

2.2.3 Aerial imagery and the results of the Extended Phase 1 Habitat Survey (see Appendix 6.8.1 Phase 1 Habitat Report) were reviewed to initially identify buildings, trees and other potential roost features within, and close to, the Draft Order Limits.

2.2.4 Table 2-1 summarises the sources of information utilised during the desk study and the information that was obtained.

Table 2-1: Sources of Information

Source	Information obtained
Multi-Agency Geographic Information for the Countryside (MAGIC) – magic.defra.gov.uk	The location of international/national nature conservation designated sites notified for bats; and registered European Protected Species Licence applications.

Source	Information obtained
Ordnance Survey mapping and online aerial imagery	Habitats present and their context within, and connectivity to the wider area. Potential roost features and habitats Ecological features potentially not evident on the ground during field surveys. Potential barriers to animal movements (such as road networks, built development and major watercourses).
Lancashire Environment Record Network (LERN) (http://www.lancashire.gov.uk/lern.aspx; last accessed 11/10/2016)	Bat records.

2.3 Defining the Survey Area

2.3.1 The area in which detailed roost assessments and activity surveys (roost activity, transects and static monitoring) would be undertaken (the 'Survey Area') was determined using the following contextual information:

- Existing information on bat species distribution, population size and known roosts
- Statutory and non-statutory designated sites
- Habitat composition within the footprint of the Scheme and the context of this habitat composition in the wider landscape

2.3.2 Using the contextual information generated from the sources described above, it was determined that the Survey Area would comprise the Draft Order Limits and adjacent suitable habitats within a 100m radius (Figure 8.5.2 at Annex F). This would enable robust baseline information to be generated, against which an assessment of potential impacts could be undertaken.

2.4 Qualifications and Experience

2.4.1 All bat survey work was conducted by suitably experienced persons. All work with potential to result in disturbance of bats or their roosts was led by holders of an appropriate Natural England licence.

2.5 Roost Assessment

2.5.1 Structures and trees within the Survey Area were assessed from ground-level for their suitability to support roosting bats. In line with Bat Conservation Trust (BCT) Guidance, structures and trees were assigned a level of roost suitability as set out in Table 2-2. Roost assessments were undertaken in May 2017.

Table 2-2: Guidelines for Assessing Bat Roost Suitability

Suitability	Habitat description
Negligible	Negligible habitat features on site likely to be used by roosting bats.
Low	A structure with one or more potential roost sites that could

Suitability	Habitat description
	be used by individual bats opportunistically. However, these potential roost sites do not provide enough space, shelter, protection, appropriate conditions and/or suitable surrounding habitat to be used on a regular basis or by larger numbers of bats (i.e. unlikely to be suitable for maternity or hibernation). A tree of sufficient size and age to contain potential roost features but with none seen from the ground or features seen with only very limited roosting potential.
Moderate	A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status (with respect to roost type only – the assessments in this table are made irrespective of species conservation status, which is established after presence is confirmed).
High	A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.

2.5.2 All structures within the Survey Area were inspected in detail externally and, where possible, internally to compile information on: potential and actual bat entry / exit points; potential and actual bat roosting locations; evidence of bats; and, the number of surveyors required for any subsequent surveys.

2.5.3 All trees within the Survey Area were inspected in detail from ground-level to look for features that bats could use for roosting (Potential Roosting Features; hereafter referred to as PRFs).

2.5.4 The assessment involved a detailed inspection of the tree from ground-level to compile information about the tree, PRFs (or lack of), and evidence of bats. The assessment was undertaken during daylight hours aided by binoculars and a bright torch. Due to the large number of trees within the Survey Area, only trees with greater than negligible suitability were recorded.

2.5.5 PRFs with Moderate–High roost suitability and structures with Low–High roost suitability were subject to Roost Activity Surveys, in line with the survey effort detailed in Table 2-3.

2.5.6 Trees that could not be adequately assessed from ground-level, were subject to climbed PRF inspections, where safe and appropriate

2.5.7 Climbed PRF Inspections involved accessing PRFs using a harness and ropes to carry out a detailed internal inspection. Torches, mirrors and endoscopes were used to verify PRF suitability, compile information on the dimensions and protection from the elements and to search for evidence of bats. The PRF inspection surveys were undertaken during daylight hours and in dry and calm weather for safety reasons.

2.6 Emergence or Re-entry Surveys – Structures and Trees

2.6.1 Following the bat roost assessments, further emergence / re-entry surveys were undertaken on structures and trees within the Survey Area, in line with Collins (2016), as per Table 2-3.

2.6.2 A dusk emergence survey immediately followed by a pre-dawn re-entry survey would only represent a single survey visit; therefore, when a feature was subject to multiple surveys, these were separated by a minimum of 24 hours.

2.6.3 Dusk emergence surveys were undertaken between May and September, in appropriate weather conditions for bats (Annex B, has a full breakdown of the survey conditions). Emergence surveys started a minimum of 0.25 hours before sunset and lasted at least 1.5 hours. Dawn re-entry surveys started 2 hours before sunrise and finished at approximately sunrise.

2.6.4 Surveyors were positioned to provide full coverage of all potential roost access points on each feature subject to survey.

2.6.5 During each survey, a record of the number of bat passes of each species, together with additional information such as direction of flight, emergence/re-entry point and behaviour, was recorded, where possible. Surveyors used time-expansion echolocation detectors connected to a digital recording device. Recordings were analysed using BatSound.

Table 2-3: Roost Activity Survey Effort

Suitability	Survey effort and timing	
	Tree	Structure
Negligible	No further survey required	No further survey required
Low	No further survey required	1 survey: dusk emergence or dawn re-entry
Moderate	2 surveys: 1 dusk emergence and 1 dawn re-entry	
High	3 surveys: 1 dusk emergence, 1 dawn re-entry and 1 dusk or dawn survey with at least 1 survey May–August	

2.7 Habitat Assessment

2.7.1 To inform the required level of survey effort for transect and static monitoring surveys, habitats within the Survey Area were assessed against the criteria in Table 2-4.

Table 2-4: Guidelines for Assessing Bat Habitat Suitability

Suitability	Habitat description
Negligible	Negligible habitat features on site likely to be used by commuting or foraging bats.
Low	Habitat that could be used by small numbers of commuting bats such as a “gappy” hedgerow or unvegetated stream, but isolated, i.e. not very well connected to the surrounding landscape by other habitat.
Moderate	Suitable, but isolated habitat that could be used by small numbers of foraging bats such as a lone tree (not in a parkland

Suitability	Habitat description
	situation) or a patch of scrub.
High	Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens.

2.7.2 Habitats within the Survey Area were assessed as being of moderate suitability for bats. A commensurate level of survey effort was therefore employed for Transect and Static Monitoring Surveys as detailed in Section 2.8 Transect survey and Section 2.9 Static monitoring.

2.8 Transect Survey

2.8.1 Three transect routes (see Figure 8.5.2 at Annex F) were surveyed, in appropriate weather conditions, at approximately monthly intervals from April–October 2017. In line with BCT Guidance, 1 of the 7 surveys for each transect route comprised a combined dusk and pre-dawn survey within one 24-hour period. Survey dates, times and weather conditions are provided in Annex C, Table 8 1.

2.8.2 Transect routes were designed with reference to the habitat composition of the Survey Area, the footprint of the Scheme and accessibility – including health and safety considerations. Transects incorporated features which may act as bat flight lines (such as hedgerows and watercourses) that could be severed or adversely affected during construction or operation of the Scheme.

2.8.3 A description of each transect is provided below:

- Transect 1 was located in the western section of the Scheme. The transect encompassed Carrs Wood, Main Dyke and 2 waterbodies
- Transect 2 traversed predominantly improved grassland and a network of hedgerows, in addition to 3 waterbodies
- Transect 3 encompassed improved grassland and a network of hedgerows, at the furthest point east of the Scheme

2.8.4 Surveys commenced at sunset and continued for approximately 2 hours. Surveyors recorded bat calls using a Batlogger M with internal recording and Global Positioning System (GPS) facility. Observed bat activity was described to aid the distinction between bat foraging activity and bat commuting activity.

2.9 Static Monitoring

2.9.1 Four static monitoring locations were selected for each transect route. Static monitoring was undertaken using Songmeter SM4Bat detectors. The detectors were deployed for a minimum of 5 consecutive nights each month from April–October 2017 (See Figure 8.5.2 at Annex F for locations). As per Collins (2016), this equates to the survey effort for high suitability bat habitat, contradicting the assessment within paragraph 2.7.2. Due to the size of the Scheme, additional static detectors were considered necessary to provide adequate sampling coverage across a large area of moderate habitat suitability, rather than to reflect survey guidance for habitats of high suitability.

2.9.2 Detectors were set to record from 0.5 hours before sunset until 0.5 hours after sunrise. Monitoring locations were kept consistent between surveys. Habitat descriptions at each monitoring location are provided in Annex D, Table 10-3.

2.9.3 Each night of monitoring comprised two separate dates – as surveys commence on 1 evening and continue until the morning of the following day. To aid with interpretation of data, survey nights are discussed with reference to the night on which recording started.

2.9.4 To differentiate between monitoring locations between different surveys, each location is also identified with a unique Location ID denoting the year and month in which the survey was undertaken and the monitoring location, the latter of which was consistent between surveys. For example, 17-04-01 refers to a survey undertaken in 2017, in April, at Monitoring Location 1.

2.10 Call Analysis

2.10.1 Data generated during bat activity surveys, particularly transect and static monitoring are discussed as the number of bat passes. The definition of a bat pass is defined in each subsequent section, where relevant, but generally 'bat passes' refer to the number of acoustic files recorded and does not necessarily reflect the number of bats recorded.

Emergence / Re-entry Survey – Structures and Trees

2.10.2 Surveys were undertaken with the use of Pettersson bat detectors and roland audio recorders. Recordings were analysed using BatSound © Pettersson Elektronic AB real-time spectrogram. The analysis was undertaken manually by competent professionals with the assistance of British Bat Calls: A Guide to Species Identification (Russ, 2012).

Transect Survey

2.10.3 Recordings were analysed using BatExplorer © Elekon AG. The analysis was undertaken manually by competent professionals with the assistance of British Bat Calls: A Guide to Species Identification (Russ, 2012).

2.10.4 The data was collated to determine the number of bat passes throughout the transects. A bat pass, for the purpose of this study, was an individual GPS-tagged call.

Static Monitoring

2.10.5 Echolocation data generated during static monitoring surveys was analysed using the auto-identification software SonoChiro.

2.10.6 SonoChiro uses an extensive library of echolocation call parameters to inform the identification process. The identification process involves 3 stages:

1. Identification to species
2. Identification to species group
3. Assignment of Overall Identification

2.10.7 A confidence level ((lowest) 1–10 (highest)) is assigned at each of the first 2 identification stages. The Overall Identification is assigned, by SonoChiro, based on the confidence levels assigned at stages 1 and 2. Results of the Overall Identification

are reported herein.

2.10.8 Checks for Type I and Type II errors (full explanations are provided in Annex E – SonoChiro methodology) are undertaken by manual verification of 5% of the bat calls attributable to each species, genus or species group, for 1 of the 7 surveys (Survey 3, June), determined during the auto-identification.

2.10.9 Additional verifications are also undertaken when considered necessary, such as if a taxon is well outside of its known range and cannot reasonably be attributed to another taxon.

2.10.10 Full details of the SonoChiro analysis method are provided in Annex E. The complete list of taxa which SonoChiro may apply to calls recorded in the UK is provided in Annex E Table 11-1.

2.11 Data Analysis

2.11.1 The duration of each period of Static Monitoring: the number of sampling nights or the duration between sunset and sunrise, may vary between surveys. To provide a standard sampling unit, a bat activity index (BAI) in the form of the mean numbers of bat identifications per night was generated for each taxon for each night of survey at each unique Location ID. The mean BAI was then calculated for each monitoring location per survey to provide a mean BAI for each Location ID.

2.12 Limitations and Assumptions

Roost Assessments

2.12.1 As a precautionary measure, if access restrictions prevented structures roost suitability from being adequately assessed, a level of survey effort commensurate with a high suitability feature was employed. This was implemented on B2 and B4.

2.12.2 An historic ice house (B6) was identified within a block of woodland (Figure 8.5.3 at Annex F). An internal inspection was undertaken: B6 was a bunker and was flooded at the time of the survey. The flooding presented a health and safety risk which could not be reasonably mitigated. For this reason, surveyors were unable to comprehensively assess the roost suitability of the bunker. The underground aspect of the bunker gives it potential hibernation value and is unlikely to be utilised for maternity roosts due to the low temperatures that are anticipated within the bunker. Therefore, emergence surveys were not undertaken, and the absence of data is unlikely to qualitatively affect the evaluation of bats and bat habitats within the Draft Order Limits.

Climbed Inspections

2.12.3 The majority of trees identified as having PRFs were climbed. However, 4 trees (T26, T31, T32 and T37) were considered unsafe to climb and emergence and re-entry surveys were undertaken to identify any roosting bats.

Emergence and Return Surveys

2.12.4 Due to access restrictions, emergence and re-entry surveys at B4 were only undertaken in September 2017; outside the optimum survey window. The survey identified the structure to be a confirmed roost; however, an assessment on the type of roost could not be confirmed.

2.12.5 Rainfall occurred early within the first dusk emergence survey and the dawn re-entry survey at B3. The dusk emergence survey recorded light rain but is not seen as a constraint to the survey, due to minimal amount of time during which it was raining. During the dawn re-entry survey, the rain was still intermittent, but heavier, than the dusk emergence survey. Surveyors remained in positions (due to cover being available at each location) and continued to observe the roosting locations. Rainfall ceased over an hour before sunrise; therefore, the survey continued. Bats were recorded foraging post-rainfall, suggesting that bats had possibly not returned to roost locations or had remerged after the rainfall had ceased. Although the weather conditions were sub-optimal during the return surveys, as bat activity was recorded during the survey, the weather conditions are considered to have had a minimal effect on the suitability of the survey.

2.12.6 Slight rainfall hindered the final survey at B4 in September for approximately 25 minutes at the start of the survey with the remainder of the survey dry. Bats were recorded after the rainfall; the weather was therefore considered to be a minor limitation to the survey.

2.12.7 The dawn re-entry survey at B2 was also subject to light rainfall throughout, with heavy rainfall for a 10-minute spell 55 minutes before sunrise. The survey, undertaken in September, was the last of 3 surveys at B2. The first 2 surveys undertaken in July and August were successful and the loss of survey data from this survey will not influence the overall evaluation of the structure.

Transect Surveys

2.12.8 On 5 occasions during transect surveys the end temperature dropped just below 10°C. On each occasion most of each survey was completed during optimal conditions. Additionally, the remaining transect surveys were undertaken wholly within optimal conditions. Any limitation relating to the 5 surveys undertaken partially during sub-optimal conditions is considered minor, and, in combination with the volume of data collected during the full suite of transect surveys, is highly unlikely to qualitatively affect any conclusions drawn in this report.

Call Analysis

2.12.9 There is much overlap between the call parameters of some bat species. Additionally, all bat species vary their calls according to the habitat in which they are flying. Definite identification to species level from acoustic data alone is therefore difficult and often not possible. A proportionate effort to identify bat calls to species level was made based on the volume of data collected and the necessity to ascertain whether as species (particularly those which are rare in the area) is present. The following considerations were made:

- *Myotis* bats (*Myotis* sp) – Although there are 7 species of Myotis bats in the UK, only 4 are known to occur in Lancashire: Daubenton's bat *Myotis daubentonii*, Natterer's bat *M. nattereri*, Brandt's bat *M. brandtii* and whiskered bat *M. mystacinus*. Bats of the *Myotis* genus exhibit a large degree of overlap in call characteristics. Although in some instances *Myotis* species can be distinguished from one another, this of often with a low level of confidence; therefore, for the purpose of this study, *Myotis* bats were grouped together and identified as *Myotis* sp

- 'Big bats' – This group includes noctule *Nyctalus noctula*, Leisler's *Nyctalus leisleri* and serotine *Eptesicus serotinus* bats. Noctule bats are common and widespread in England. Leisler's bats are mainly restricted to southern and eastern England. Serotine bats are rather uncommon in the UK, with a distribution mainly confined to southern England, and the closest known records are from north Wales. Where it was not feasible to identify calls to species level, they were either identified to genus level (i.e. *Nyctalus* sp.) or grouped as 'big bat' *Eptesicus/Nyctalus/Vespertilio* sp.)
- Pipistrelle bats *Pipistrellus* sp. – Both common pipistrelles *Pipistrellus pipistrellus* and soprano pipistrelles *P. pygmaeus* are common and widespread in the UK. Nathusius' pipistrelles *P. nathusii* have been recorded in Lancashire but are rare. Common pipistrelle calls exhibit a level of overlap in call characteristic with soprano pipistrelle and Nathusius' pipistrelle at the upper and lower end, respectively, of their echolocation range. In these instances, calls were identified as common / soprano pipistrelle or Nathusius' / common pipistrelle

3 RESULTS

3.1 Desk Study

3.1.1 A summary of the bat records identified during the desk study and their approximate location in relation to the Scheme is provided in Table 3-1.

Table 3-1: Summary of Bat Records

Species	No. of Records	Year	Conservation status	Distance (m) and direction of nearest record from the Scheme
Daubenton's Bat	19	2009–2011	European Protected Species	180 SW
Common Pipistrelle	14	2005–2011	European Protected Species	155 S
Noctule	2	2002	European Protected Species	155 S
Soprano Pipistrelle	12	1998–2012	European Protected Species	155 S
Pipistrelle species	4	2002–2009	European Protected Species	50 W
Chiroptera	12	2004–2011	European Protected Species	180 SW

3.1.2 Four records of bat roosts were identified where European protected species licences have been issued. The closest of these was a common pipistrelle roost approximately 1.2km north east of the Scheme. The remaining issued licences were for common pipistrelle, soprano pipistrelle and brown long-eared bat.

3.2 Roost Assessment

Structures

3.2.1 The roost assessment identified 6 structures. Table 3-2 summarises the results of the bat roost assessment surveys of structures. Refer to Annex A for detailed results and see Figure 8.5.3 at Annex F for their locations.

Table 3-2: Preliminary Roost Assessment Summary Results of Structures

Suitability	ID
Negligible	B5
Low	B1
Moderate	B4
High	B2, B3, B6

3.2.2 B5 was assessed to be of negligible suitability to support bat roosts and was not surveyed further. The remaining buildings, excluding B6 (as detailed in Section 2.12) were subject to emergence/re-entry surveys.

3.2.3 No roosts were confirmed during the roost assessments.

Trees

3.2.4 Following the preliminary ground-level roost assessment, 25 trees were assessed as having greater than negligible bat roost suitability. Climbed PRF inspection surveys were undertaken at 7 of these trees (refer to Annex A for detailed results and Figure 8.5.3 for locations at Annex F). Table 3-3 summarises the results of the roost assessment, following the PRF inspection survey.

Table 3-3: Tree Roost Assessment Summary Results

Suitability	Tree ID
Low	T6, T7, T8, T9, T10, T11, T12, T13, T14, T15, T16, T21, T22, T23, T24, T25, T28, T29, T30, T33, T34
Moderate	T26, T31, T32, T37

3.2.5 There were 21 trees assessed to be of low suitability to support bat roosts and 4 trees of moderate suitability.

3.2.6 No trees with high suitability or confirmed roosts were identified during the survey.

3.3 Emergence / Re-entry Surveys – Structures and Trees

3.3.1 The emergence/re-entry surveys found bat roosts at 3 structures within the Survey Area (Table 3-4). Detailed results are presented in Annex B Table 8-1.

Table 3-4: Summary of Bat Roosts Found During Emergence / Re-entry Surveys

Structure ID	Location of roost	Peak count of bats recorded	Species
B2	On the western aspect gable end of main bungalow above conservatory. There was a slight gap in the bargeboard and tile.	6	Common pipistrelle
B3	On western facing gable of garage	2	Common pipistrelle
B4	On south eastern gable of main house	4	Common pipistrelle

3.3.2 No bats were recorded emerging from any of the trees surveyed.

3.3.3 Additional species identified in flight during the surveys (i.e. not emerging from roosts) were common pipistrelle, soprano pipistrelle, *Myotis* sp and noctule.

3.4 Transect Survey

3.4.1 A summary of the transect survey results is provided below in Table 3-5. Detailed survey results are presented in Annex C and Figure 8.5.4 at Annex F.

3.4.2 Eight species were identified during the transect surveys. Although analysis of echolocation calls was undertaken in BatExplorer, for consistency, species or species group labels produced by SonoChiro (Annex 3, Table 11-1) were used for the transect data.

Table 3-5: Taxa Recorded During Transect Surveys

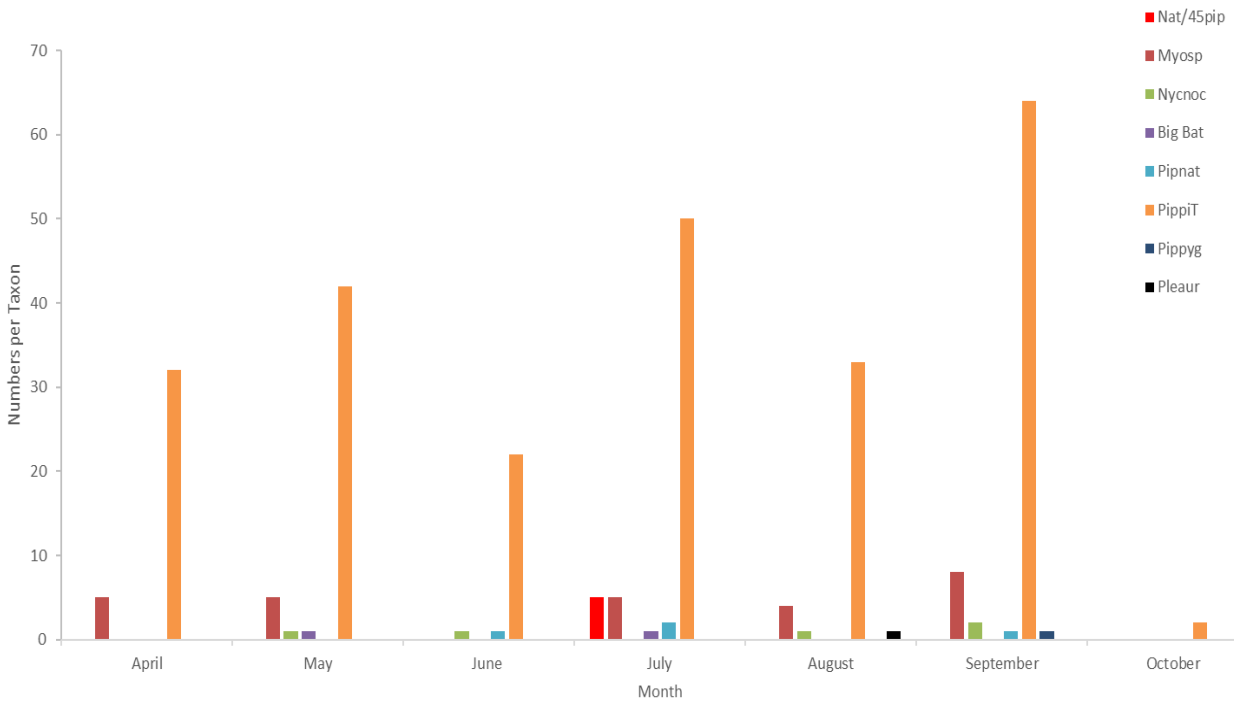
Label	Species or species group (taxon)
Nycnoc	Noctule
ENVsp	*Eptesicus/Nyctalus/Vespertilio* sp. ('big bat')
Pipnat	Nathusius' pipistrelle
PippiT	Common pipistrelle
Pippyg	Soprano pipistrelle
Myosp	Myotis sp
Pleaur	Brown long-eared bat *Plecotus auritus*
Nat/45pip	Nathusius pipistrelle/common pipistrelle

3.4.3 The vast majority of identifications were of common pipistrelle (84.5%) with *Myotis* sp the second most frequently recorded (9.3%). The remaining taxa were recorded much less frequently. Bat activity was the highest during July and September with the lowest bat activity recorded in October and June (Insert 3-1). Bat activity was widely dispersed throughout the Survey Area; nevertheless, the majority of bat activity was recorded at 2 locations:

- The hedgerow and tree line boundaries of the residential properties to the north of the A585
- The copse adjacent east of the B2560

3.4.4 The remaining recordings were associated with linear features such as hedgerows and trees lines with minimal activity recorded within the agricultural fields between the A585 and A586.

Insert 3-1: Total Numbers Per Taxon Per Month During Transect Activity Surveys



3.5 Static Monitoring

3.5.1 Twelve taxa were identified from the static monitoring data (Table 3-6)

Table 3-6: Taxa Recorded During Static Surveys

Label	Species or species group (taxon)
Rhisp	Horseshoe species *Rhinolophus* sp
Rhifer	Greater horseshoe *Rhinolophus ferrumequinum*
Nycnoc	Noctule
ENVsp	*Eptesicus/Nyctalus/Vespertilio* sp. ('big bat')
Pip35	Kuhl's/Nathusius'/Savi's pipistrelle
Pipnat	Nathusius' pipistrelle
PippiT	Common pipistrelle
Pippyg	Soprano pipistrelle
Myosp	Myotis sp
Pleaur	Brown long-eared bat
Chiro sp.	Unidentified species
Parasi	SonoChiro has not identified a bat call, but cannot entirely rule out the potential for a bat call to be present

3.5.2 Taxa identified by Sonochiro were refined, manually, using contextual information:

- Due to the high level of uncertainty associated with Parasi and Chiro sp. identification, these taxa were excluded from further analysis
- The Scheme is situated well outside of the known greater horseshoe bat

species' range. Constant high frequency background noise can mimic the call parameters of horseshoe bats. All of the Rhifer and Rhisp calls were manually verified, and all were found to be either constant high-frequency background noise calls or bat social calls

- Due to the limitations in distinguishing between species of the Myotis genus (as detailed in paragraph 2.12.9) calls identified as Myosp and Myonat were all grouped as *Myotis* sp
- The Scheme is on the periphery of the known range for serotine and within the ranges of Leisler's bat and noctule. Of these 3 species, noctule was the only one identified to species level; however, most of the recordings potentially attributable to these species were identified as ENVsp. Calls identified as ENVsp and Nycnoc were therefore grouped as ENVsp
- Khul's and Savi's pipistrelle are vagrant species for which records in the UK are restricted to south-east England. Calls identified as Pip35 were therefore considered to be Nathusius' pipistrelle

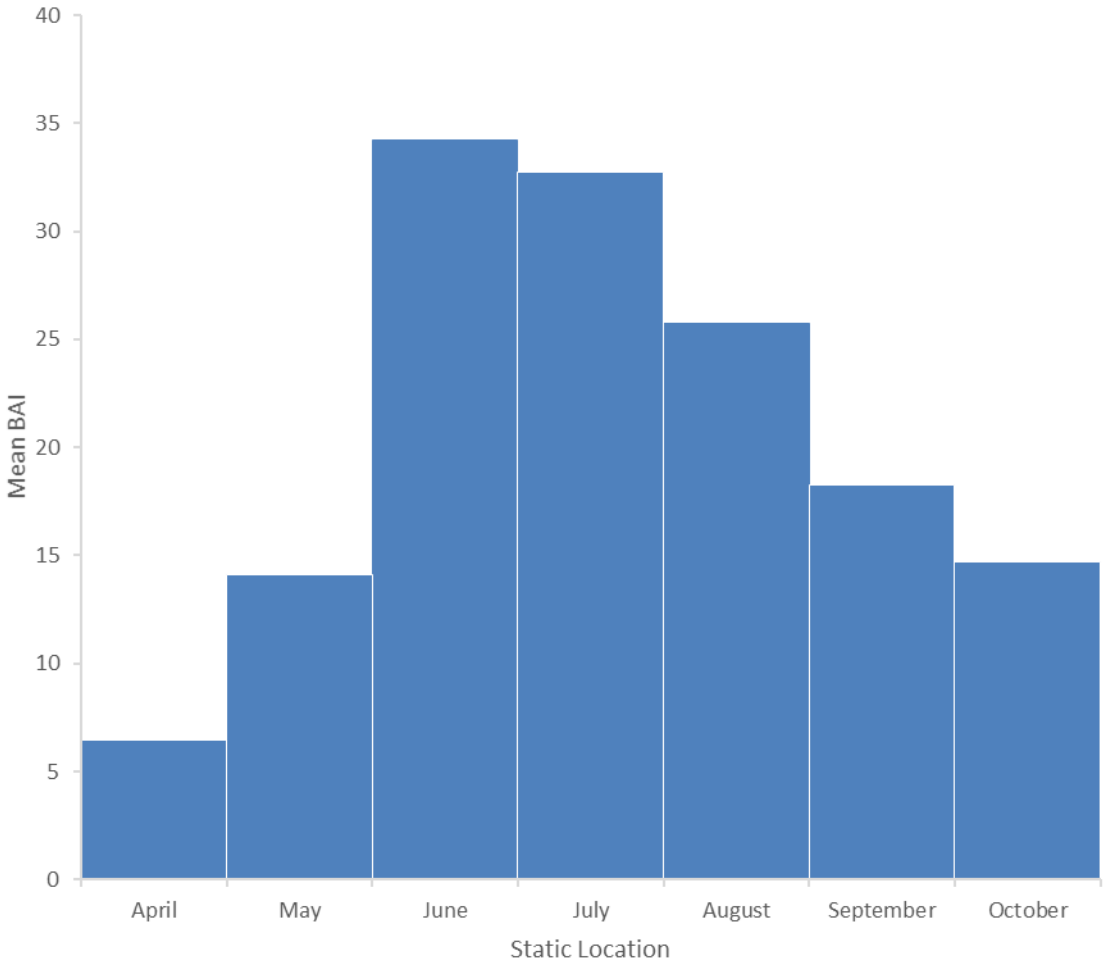
3.5.3 The number of passes per taxon were recorded at each static monitoring location, the raw data and refined data is presented In Annex D. Data is discussed with reference to the refined data hereafter.

3.5.4 The overwhelming majority of recorded activity (c. 92%) was attributable to common pipistrelle. Calls attributable to *Myotis* sp were second most frequently recorded (c. 5%). The remaining taxa were recorded at low intensities; spatial and temporal patterns of activity could therefore not be discerned, in isolation, due to the small sample sizes generated.

3.5.5 Mean BAI per month was also calculated for all combined bat activity to investigate temporal patterns of activity across the survey period (Insert 3-2).

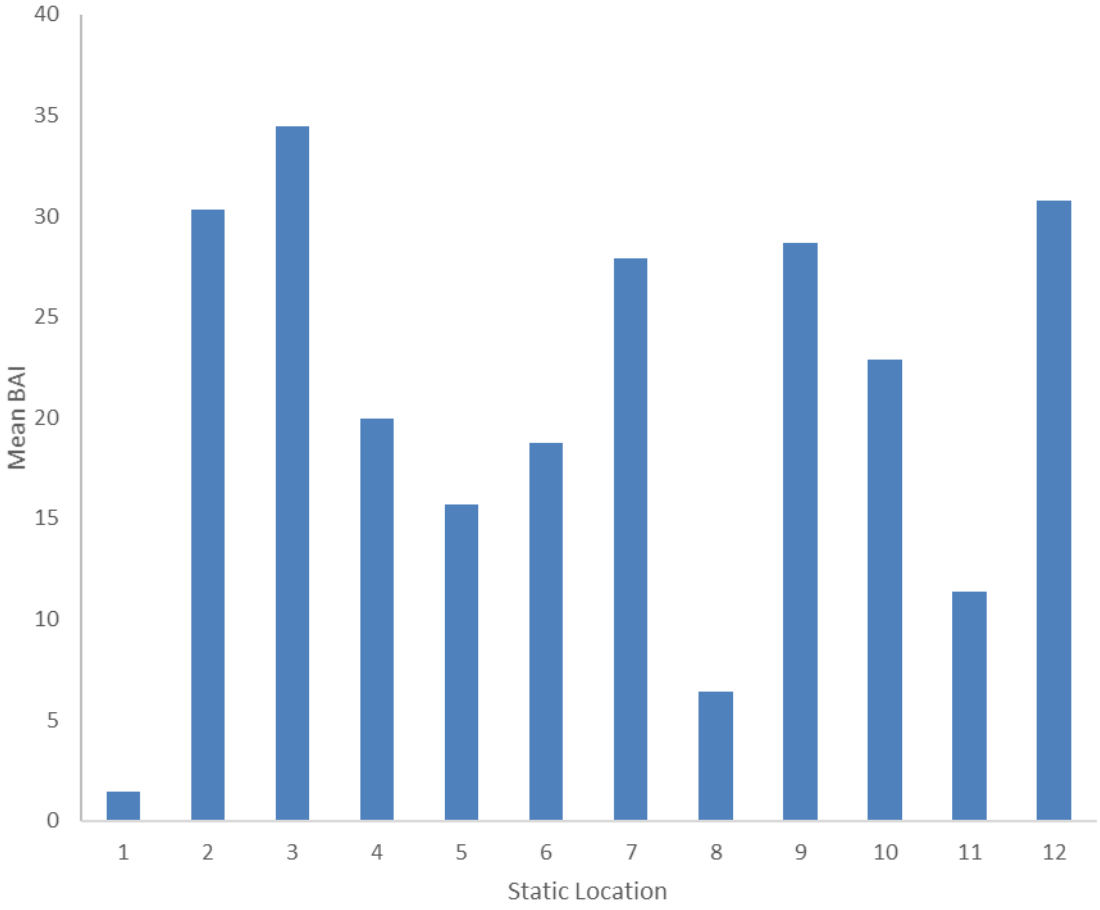
3.5.6 Activity levels increased gradually from April until June. The highest intensity of bat activity was recorded in June and remained relatively stable through to August before decreasing in September (Insert 3-2).

Insert 3-2: Mean BAI for all Bat Taxa and Locations Combined Per Survey



3.5.7 Overall the highest intensity of bat activity was recorded at Static Locations 2, 3 and 12. Locations 1, 8 and 11 recorded markedly lower data in comparison to the remaining statics within the Survey Area (Insert 3-3).

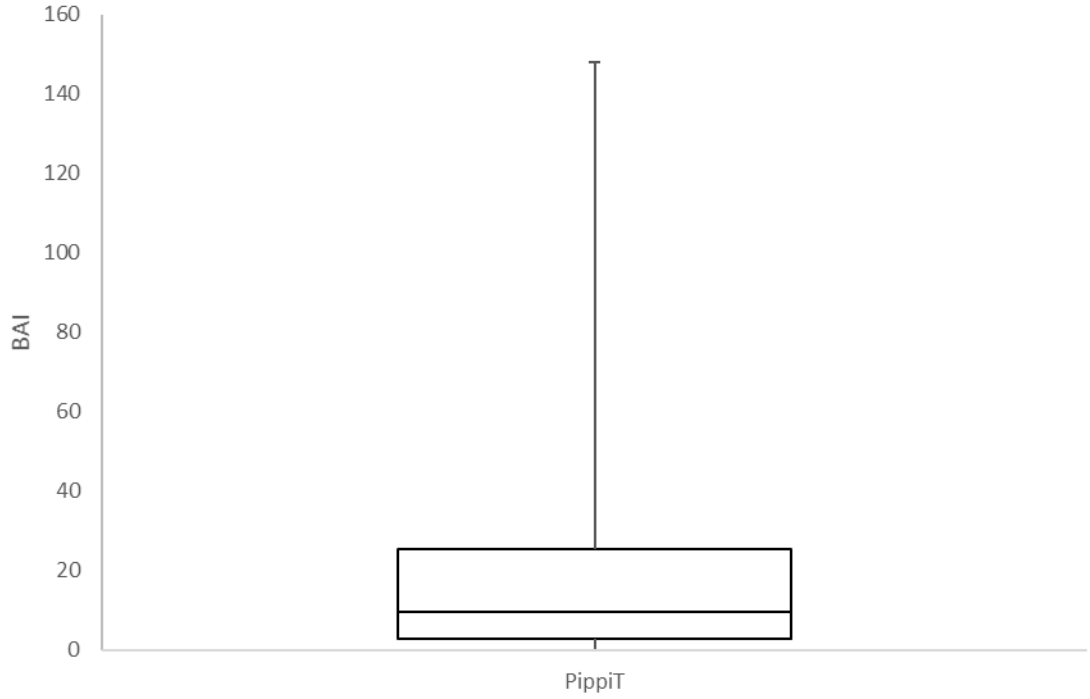
Insert 3-3: Mean BAI Per Location of all Taxa and Months Combined



3.5.8 Activity from noctule, Nathusius pipistrelle, soprano pipistrelle and brown long-eared bat was recorded infrequently; collectively BAI ranged from 0.00–5.82 for these taxa. These infrequently recorded taxa were, however, reasonably widespread within the Survey Area, with activity from most of these taxa recorded at all Static Locations.

3.5.9 Although frequently recorded, activity from common pipistrelle was recorded predominately at relatively low levels of intensity with infrequent periods of higher activity – as evidenced by the box and whisker plot (Insert 3-4) produced for common pipistrelle.

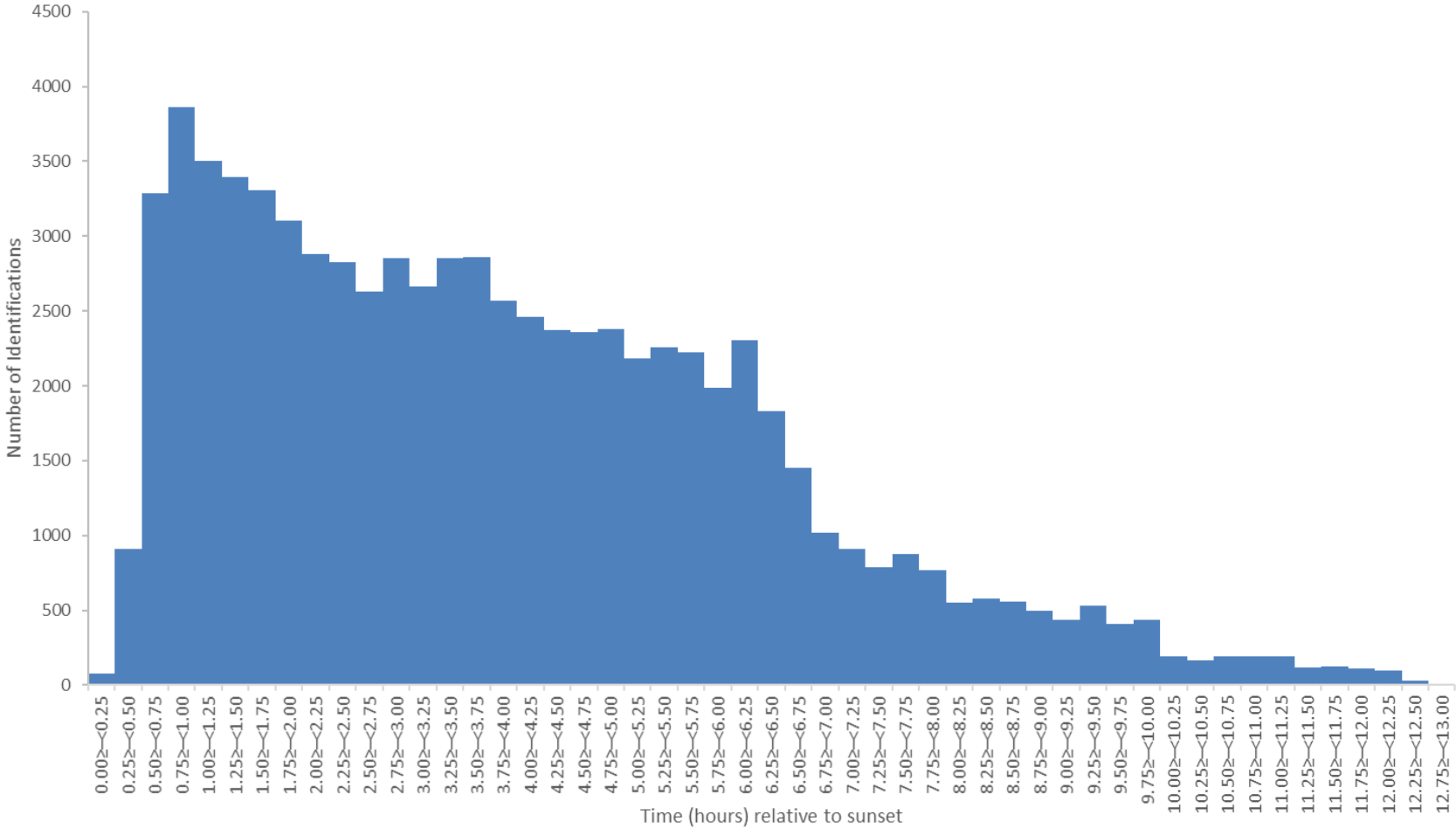
Insert 3-4: Box and Whisker Plot of BAI



3.5.10 The time of each bat identification relative to sunset was calculated to investigate temporal patterns of activity (Insert 3-5).

3.5.11 The analysis identified a peak in activity within approximately 1 hour of sunset with a gradual decline, but reasonably consistent high levels of activity. The decrease in activity 8–13 hours after sunset is likely attributable to nights lasting 8–10 hours only occurring at either end of the bat survey (April–October), rather than indicating of a pattern of activity.

Insert 3-5: Static Monitoring Bat Activity (all species and surveys combined) Relative to Sunset



4 CONCLUSION

4.1 Bat Roosts

4.1.1 Common pipistrelle day roosts or satellite roosts were identified in 3 buildings. Day roosts are used by individual bats, or small groups of males, to rest or shelter in the day. Satellite roosts are alternative roosts found near a main maternity colony, that can be used by a few individual breeding females to small groups of breeding females throughout the breeding season.

4.1.2 Twenty-five trees within the Survey Area, although not confirmed as bat roosts, had bat roosting suitability. The removal of these features would result in the destruction of a potentially suitable roost.

4.2 Commuting and Foraging Habitats

4.2.1 A common bat species assemblage, typical of the region, was identified in the Survey Area, with common pipistrelle by far the most frequently recorded species. Nathusius' pipistrelle, a rare species within the region, was recorded, but only infrequently and sparsely distributed throughout the Scheme footprint.

4.2.2 Key foraging and commuting areas were associated with a woodland to the east of the B5260 and residential gardens surrounding the A585. The woodland comprised mature trees that created a sheltered area and was close to a network of hedgerows that provided habitat connectivity beyond the Scheme boundary. Residential garden boundaries, particularly garden boundaries to the north of the A585, along the Scheme boundary were utilised by bats.

4.2.3 Low levels of bat activity were recorded through the Scheme boundary between the A585 and A586; which is an area of agricultural land close to Main Dyke. Open and exposed arable habitats are typically low value to bats; a general assumption which is supported by the survey results.

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6 ABBREVIATIONS

Term	Meaning/Definition
BAI	Bat Activity Index
BCT	Bat Conservation Trust
GPS	Global Positioning System
LERN	Lancashire Environment Record Network
MAGIC	Multi-Agency Geographic Information for the Countryside
PRF	Potential Roosting Features
SAC	Special Area of Conservation

ANNEX A – ROOST ASSESSMENTS

Table A-1: Bat Roost Inspection Survey Results – Structures

Structure ID	Grid reference	Internal inspection undertaken (Yes/No)	Description	Roost suitability
B1	SD 35876 40469	Yes	Stone and brick-built structure with no roof. Potentially an old barn or storage unit located within an improved grassland, adjacent to the A585. The building presented a number of crevices; however, the features were exposed to the elements.	Low
B2	SD 35804 40564	No	Brick-built with rendered finish bungalow with a number of extensions. The rendered finish covered any potential damage to the brickwork. All of the roofs were slate with wooden soffit boards, fasciae and bargeboards. A number of crevices were identified beneath these features.	High
B3	SD 35837 40566	Yes	Brick-built 2-storey house with a rendered finish. Slate tiled roof with wooden soffits, fasciae and gable ends. Single-storey garage adjoining building. Loft was underfelt lined within main house and asbestos boards over lining within the garage. Crevices were identified on external features.	High
B4	SD 35807 40486	No	Brick-built 2-storey house with a rendered finish. Slate tiled roof with wooden soffits, fasciae and gable ends. Thorough inspection could not be undertaken due to access issues.	High
B5	SD 35738 40555	Yes	Bridge over Main Dyke, for the A585. Bridge did not present any crevices.	Negligible
B6	SD 37933 39181	Yes	Brick-built bunker located within a woodland. The bunker was open to the interior with no door in place. The interior	High

Structure ID	Grid reference	Internal inspection undertaken (Yes/No)	Description	Roost suitability
			was flooded, limiting the internal survey. There were wooden panels on the interior walls that appeared to provide bat suitability, however, these could not be inspected.	

Table A-2: Bat Roost Assessment Results – Trees

Structure ID	Grid reference	Tree species	Description of feature	Position in landscape	Roost suitability: Ground-level survey	Climbed PRF inspection undertaken (Yes/No)	Roost suitability: Climbed PRF inspection
T6	SD 37674 39173	Sycamore *Acer pseudoplatanus*	Trunk cavity	Field boundary in a small copse	Low	No	N/A
T7	SD 37673 39166	Sycamore	Trunk cavity	Field boundary in a small copse	Low	No	N/A
T8	SD 35896 40449	Willow *Salix* sp.	Trunk cavity	Field boundary in a small copse	Moderate	Yes	Low
T9	SD 35895 40408	Ash *Fraxinus excelsior*	Branch cavity	Field boundary in a small copse	Low	No	N/A
T10	SD 36466 40178	Silver Birch Betula pendula	Pruning wound / rot hole	In amenity grassland adjacent to the A585	Low	No	N/A
T11	SD 36810 39407	Sycamore	Pruning wound / rot hole	Roadside verge of	Low	No	N/A

Structure ID	Grid reference	Tree species	Description of feature	Position in landscape	Roost suitability: Ground-level survey	Climbed PRF inspection undertaken (Yes/No)	Roost suitability: Climbed PRF inspection
				planted trees along A586			
T12	SD 36664 39377	Elm *Ulmaceae* sp.	Pruning wound / rot hole	Roadside verge of planted trees along A586	Low	No	N/A
T13	SD 36753 39387	Sycamore	Pruning wound / rot hole	Roadside verge of planted trees along A586	Low	No	N/A
T14	SD 36772 39398	Sycamore	Pruning wound / rot hole	Roadside verge of planted trees along A586	Low	No	N/A
T15	SD 36897 39407	Sycamore	Pruning wound / rot hole	Roadside verge of planted trees along A586	Low	No	N/A
T16	SD 36952 39412	Sycamore	Pruning wound / rot hole	Roadside verge of planted trees along A586	Low	No	N/A
T19	SD 37677 39171	Beech *Fagus sylvatica*	Trunk cavity / butt rot Pruning wound / rot hole and	Field boundary in a small copse	Moderate	Yes	Low

Structure ID	Grid reference	Tree species	Description of feature	Position in landscape	Roost suitability: Ground-level survey	Climbed PRF inspection undertaken (Yes/No)	Roost suitability: Climbed PRF inspection
			loose bark				
T20	SD 37694 39187	Sycamore	2 x Pruning wound / rot hole	Field boundary in a small copse	Moderate	Yes	Negligible
T21	SD 37825 39228	Beech	Pruning wound / rot hole and woodpecker hole	Field boundary in a small copse	Moderate	Yes	Low
T22	SD 37902 39252	Sycamore	Loose bark and dead wood in one branch	Field boundary in a small copse	Low	No	N/A
T23	SD 37898 39250	Sycamore	2 x Pruning wound / rot hole	Field boundary in a small copse	Moderate	Yes	Low
T24	SD 37837 39230	Sycamore	3 x Trunk cavity / butt rot	Field boundary in a small copse	Moderate	Yes	Low
T25	SD 37924 39258	Sycamore	Pruning wound / rot hole	Field boundary in a small copse	Low	No	N/A
T26	SD 37928 39251	Sycamore	2 x Pruning wound / rot hole	Field boundary in a small copse	Moderate	No	N/A
T28	SD 38862 39492	Alder *Alnus glutinosa*	Pruning wound / rot hole	Field boundary in a small	Low	No	N/A

Structure ID	Grid reference	Tree species	Description of feature	Position in landscape	Roost suitability: Ground-level survey	Climbed PRF inspection undertaken (Yes/No)	Roost suitability: Climbed PRF inspection
				copse			
T29	SD 38871 39512	Sycamore	Pruning wound / rot hole	Roadside verge of planted trees along A585	Low	No	N/A
T30	SD 38759 39497	Willow	Pruning wound / rot hole	Roadside verge of planted trees along A585	Low	No	N/A
T31	SD 38740 39492	Ash	Pruning wound / rot hole	Roadside verge of planted trees along A585	Moderate	No	N/A
T32	SD 38709 39486	Ash	Pruning wound / rot hole	Roadside verge of planted trees along A585	Moderate	No	N/A
T33	SD 38437 39442	Sycamore	Pruning wound / rot hole	Roadside verge of planted trees along A585	Low	No	N/A
T34	SD 38467 39456	Ash	Pruning wound / rot hole	Roadside verge of planted trees along A585	Low	No	N/A
T37	SD 33793	Sycamore	Deadwood	Field boundary	Moderate	No	N/A

Structure ID	Grid reference	Tree species	Description of feature	Position in landscape	Roost suitability: Ground-level survey	Climbed PRF inspection undertaken (Yes/No)	Roost suitability: Climbed PRF inspection
	43918		and woodpecker hole	in a small copse			

ANNEX B – EMERGENCE AND RE-ENTRY SURVEYS

Table B-1: Dusk Emergence and Dawn Re-entry Survey Results

Structure ID	Date	Visit No.	Dusk or dawn	Start time	End time	Sunset / sunrise time	Weather at start				Weather at end				Bat emergence/re-entry recorded
							Temperature (°C)	Rainfall*	Cloud cover (Oktas)	Wind speed (Beaufort)	Temperature (°C)	Rainfall*	Cloud cover (Oktas)	Wind speed (Beaufort)	
B1	23/05/17	1	Dusk	21:00	22:50	21:20	18	0	3	0	15	0	3	0	No
B2	25/07/17	1	Dusk	21:10	23:00	21:28	19	0	2	0	16	0	2	0	5 common pipistrelles
	10/08/17	2	Dusk	20:30	22:30	20:51	15	0	1	1	14	0	1	1	6 common pipistrelles
	8/09/17	3	Dawn	05:00	06:30	06:30	13	2	8	1	13	2	8	1	No
B3	26/06/17	1	Dusk	21:30	23:15	21:47	15	1	7	1	14	0	7	1	No
	18/07/17	2	Dusk	21:10	23:00	21:28	21	0	7	3	18	0	5	3	No
	1/08/17	3	Dawn	03:25	05:30	05:25	16	1	2	0	14	0	5	0	2 common pipistrelles
B4	20/09/17	1	Dusk	19:00	21:00	19:17	16	0	8	3	12	0	8	3	4 common pipistrelles
	25/09/17	2	Dusk	18:50	20:05	19:05	16	0	7	0	15	0	7	0	2 common pipistrelles
	29/09/17	3	Dawn	05:10	07:15	07:10	14	2	7	3	14	0	8	3	No
T26	13/06/17	1	Dusk	21:22	23:10	21:42	16.5	0	4	0	14	0	4	0	No
	28/06/17	2	Dawn	02:45	04:57	04:42	12	0	7	4	12	0	7	4	No
T31	24/05/17	1	Dusk	20:50	22:45	21:20	18	0	0	0	17	0	0	0	No

Structure ID	Date	Visit No.	Dusk or dawn	Start time	End time	Sunset / sunrise time	Weather at start				Weather at end				Bat emergence/re-entry recorded
							Temperature (°C)	Rainfall*	Cloud cover (Oktas)	Wind speed (Beaufort)	Temperature (°C)	Rainfall*	Cloud cover (Oktas)	Wind speed (Beaufort)	
	7/06/17	2	Dawn	03:00	04:45	04:43	12	0	7	6	11	0	7	6	No
T32	24/05/17	1	Dusk	20:50	22:45	21:20	18	0	0	0	17	0	0	0	No
	7/06/17	2	Dawn	03:00	04:45	04:43	12	0	7	6	11	0	7	6	No
T37	13/06/17	1	Dusk	21:22	23:10	21:42	16.5	0	4	0	14	0	4	0	No
	28/06/17	2	Dawn	02:45	04:57	04:42	12	0	7	4	12	0	7	4	No
* 0 = none; 1 = drizzle / mist; 2 = light showers; 3 = heavy showers; 4 = heavy rain.															

ANNEX C – TRANSECT SURVEY DETAILS

Table C-1: Transect Survey Results

Transect number	Date	Visit No.	Dusk or dawn	Start time	End time	Sunset / sunrise time	Weather at start				Weather at end				Taxon and number of passes							
							Temperature (°C)	Rainfall*	Cloud Cover (Oktas)	Wind Speed (Beaufort)	Temperature (°C)	Rainfall*	Cloud Cover (Oktas)	Wind Speed (Beaufort)	Nycnoc	ENVsp	PippiT	Pippyg	Pipnat	Myosp	Plesp	Nat/45pip
1	18/04/17	1	Dusk	20:19	22:39	20:19	11	0	8	3	10	0	8	3	-	-	32	-	-	-	-	-
2	19/04/17	1	Dawn	04:03	05:51	06:03	8	0	1	2	8	0	1	2	-	-	-	-	-	-	-	-
3	24/04/17	1	Dusk	20:30	22:30	20:30	8	0	2	6	7	0	2	6	-	-	-	-	-	5	-	-
1	3/05/17	2	Dusk	20:45	22:50	20:46	15	0	5	3	10	0	5	3	-	1	18	-	-	1	-	-
2	8/05/17	2	Dusk	20:55	22:55	20:55	10	0	0	1	8	0	0	1	-	-	13	-	-	1	-	-
3	9/05/17	2	Dusk	20:57	22:59	20:57	10	0	0	0	8	0	0	0	1	-	11	-	-	3	-	-
1	8/06/17	3	Dusk	21:40	23:31	21:40	17	0	1	3	15	0	1	2	-	-	7	-	1	-	-	-
2	5/06/17	3	Dusk	21:38	23:36	21:38	13	0	8	9	12	0	8	8	-	-	2	-	-	-	-	-
3	8/06/17	3	Dusk	21:40	23:40	21:40	15	0	4	2	12	0	4	2	1	-	13	-	-	-	-	-
1	5/07/17	4	Dusk	21:38	23:40	21:38	17	0	4	1	18	0	4	1	-	-	17	-	2	1	-	1
2	5/07/17	4	Dusk	21:38	23:40	21:38	17	0	5	0	17	0	5	0	-	1	7	-	-	1	-	3
3	10/07/17	4	Dusk	21:41	23:50	21:40	16	0	6	2	14	0	6	2	-	-	26	-	-	3	-	1
1	2/08/17	5	Dusk	21:10	23:10	21:08	18	0	6	2	16	0	6	2	-	-	17	-	-	4	-	-
3	5/08/17	5	Dusk	20:59	22:59	20:59	17	0	2	1	14	0	2	1	1	-	15	-	-	3	-	-
2	2/08/17	5	Dusk	21:07	23:10	21:08	18	0	3	1	15	0	3	1	-	-	10	-	-	-	-	-

Transect number	Date	Visit No.	Dusk or dawn	Start time	End time	Sunset / sunrise time	Weather at start				Weather at end				Taxon and number of passes							
							Temperature (°C)	Rainfall*	Cloud Cover (Oktas)	Wind Speed (Beaufort)	Temperature (°C)	Rainfall*	Cloud Cover (Oktas)	Wind Speed (Beaufort)	Nycnoc	ENVsp	PippiT	Pippyg	Pipnat	Myosp	Plesp	Nat/45pip
1	31/08/17	6	Dusk	20:06	22:06	20:06	17	0	1	2	14	0	1	2	-	-	17	-	-	4	-	-
1	1/09/17	6	Dawn	04:20	06:16	06:20	8	0	1	1	9	0	1	1	-	-	1	-	-	2	-	-
2	31/08/17	6	Dusk	20:06	22:06	20:06	20	0	1	1	14	0	1	1	2	-	23	-	1	-	-	-
2	1/09/17	6	Dawn	04:20	06:20	06:20	8	0	1	1	10	0	1	1	-	-	1	-	-	-	-	-
3	5/09/17	6	Dusk	19:54	21:56	19:54	16	0	4	5	16	0	4	5	-	-	12	-	2	-	-	-
3	6/09/17	6	Dawn	04:29	06:29	06:29	16	0	3	4	15	0	3	4	-	-	10	-	-	-	-	-
1	2/10/17	7	Dusk	18:47	20:15	18:47	13	0	6	5	15	0	6	5	-	-	1	-	-	-	-	-
2	2/10/17	7	Dusk	18:42	20:30	18:47	13	0	6	5	13	0	6	5	-	-	1	-	-	-	-	-
3	5/10/17	7	Dusk	19:40	21:25	19:40	13	0	2	4	12	0	2	4	-	-	-	-	-	-	-	-
* 0 = none; 1 = drizzle / mist; 2 = light showers; 3 = heavy showers; 4 = heavy rain.																						

ANNEX D – STATIC SURVEY DETAILS

Table D-1: Number of Identifications per Taxon (raw data)

Location ID	Rhifer	Rhisp	Myonat	Myosp	Nycnoc	ENVsp	PippiT	Pippyg	Pipnat	Pip50	Pip35	Pipkuh	Plesp	ChiroSp	parasi	Total
17-04-1	0	0	0	0	0	0	72	0	0	0	0	0	0	5	7	84
17-04-2	0	0	0	0	0	0	352	0	0	2	0	0	0	25	2	381
17-04-3	0	0	0	0	0	0	1,117	1	0	16	1	0	0	55	9	1,199
17-04-4	0	0	0	1	0	0	20	0	0	0	0	0	0	3	22	46
17-04-5	0	0	0	1	0	0	58	0	0	0	0	0	0	10	4	73
17-04-6	0	0	0	1	0	0	128	0	0	4	0	0	0	56	0	189
17-04-7	0	0	0	1	0	0	43	0	0	0	0	0	0	8	11	63
17-04-8	1	0	0	1	0	0	73	0	0	1	0	0	0	11	5	92
17-04-9	0	0	0	7	0	0	443	0	1	5	0	0	2	29	2	489
17-04-10	0	0	0	7	0	0	696	0	0	88	0	0	1	27	4	823
17-04-11	0	0	0	6	0	0	90	0	0	0	0	0	0	17	18	131
17-04-12	0	0	0	5	0	0	405	1	0	3	0	0	0	23	3	440
17-05-1	0	0	0	4	0	0	31	0	0	0	0	0	1	3	1	40
17-05-2	0	0	0	37	0	0	500	0	0	14	0	0	0	299	5	855
17-05-3	0	0	0	785	0	0	1146	0	0	17	2	0	0	345	10	2,305
17-05-4	0	0	0	0	0	0	88	0	1	0	0	0	0	4	25	118
17-05-5	0	0	0	22	0	0	173	0	0	0	0	0	0	26	3	224
17-05-6	0	0	0	4	0	0	363	0	6	4	2	0	2	83	5	469
17-05-7	0	0	0	4	0	0	874	0	0	10	0	0	0	82	6	976
17-05-8	0	0	0	17	0	0	411	0	0	1	0	0	0	39	14	482
17-05-9	0	0	0	28	0	1	1039	0	0	2	0	0	0	104	4	1,178

Location ID	Rhifer	Rhisp	Myonat	Myosp	Nycnoc	ENVsp	PippiT	Pippyg	Pipnat	Pip50	Pip35	Pipkuh	Plesp	ChiroSp	parasi	Total
17-05-10	0	0	0	11	0	0	84	0	0	2	0	0	0	19	4	120
17-05-11	0	0	0	102	0	0	429	0	1	4	1	0	0	176	24	737
17-05-12	0	0	0	2	0	0	1,083	0	1	3	1	0	0	72	8	1,170
17-06-1	0	0	0	1	0	0	43	0	0	1	1	0	0	11	7	64
17-06-2	0	0	0	50	0	0	1,237	0	0	104	3	0	0	402	3	1,799
17-06-3	0	0	0	31	0	0	2,450	1	1	64	2	0	0	305	30	2,884
17-06-4	0	0	0	1	0	0	1,720	0	0	1	1	0	0	40	9	1,772
17-06-5	0	0	0	23	0	0	180	0	0	1	2	0	7	46	2	261
17-06-6	0	0	0	15	0	0	755	0	1	5	2	0	0	86	2	866
17-06-7	1	0	0	135	0	0	3,175	0	0	45	0	0	0	620	10	3,986
17-06-8	0	0	0	2	0	0	97	0	0	1	0	0	0	48	1	149
17-06-9	0	0	1	21	0	0	492	0	4	7	17	0	4	194	21	761
17-06-10	1	1	0	96	0	0	1,031	0	0	36	2	0	0	215	0	1,382
17-06-11	1	0	0	47	0	0	248	0	0	0	2	0	1	197	1	497
17-06-12	0	0	0	5	0	0	2,167	0	0	2	2	0	0	284	7	2,467
17-07-2	0	0	0	121	0	0	2,388	0	0	29	0	0	0	1,130	1	3,669
17-07-3	0	0	0	69	0	1	1,068	0	1	16	1	0	5	216	4	1,381
17-07-4	0	0	0	8	0	0	1,831	0	1	5	1	0	1	118	19	1,984
17-07-5	0	0	0	25	0	0	1,104	0	0	1	2	0	2	469	8	1,611
17-07-6	0	0	0	44	0	0	1,343	0	8	20	5	0	0	177	5	1,602
17-07-7	0	0	0	23	0	0	463	0	0	1	0	0	6	112	8	613
17-07-8	0	0	0	18	0	0	406	0	0	4	0	0	4	106	5	543
17-07-9	0	0	0	147	0	4	1,191	0	2	10	4	0	8	397	3	1,766
17-07-10	0	0	0	394	0	0	1,306	0	0	24	1	0	0	265	7	1,997

Location ID	Rhifer	Rhisp	Myonat	Myosp	Nycnoc	ENVsp	PippiT	Pippyg	Pipnat	Pip50	Pip35	Pipkuh	Plesp	ChiroSp	parasi	Total
17-07-11	0	0	0	9	0	0	267	0	3	1	0	0	1	117	0	398
17-07-12	0	0	0	2	1	0	457	0	1	1	10	3	0	275	10	760
17-08-1	0	0	0	0	0	0	77	0	0	4	0	0	0	13	0	94
17-08-2	0	0	0	288	0	0	1,414	0	0	26	0	0	1	1,414	15	3,158
17-08-3	0	0	0	61	0	1	1,770	0	0	30	3	0	0	191	9	2,065
17-08-4	0	0	0	0	0	0	525	0	0	3	0	0	0	22	3	553
17-08-5	0	0	0	11	0	0	938	0	0	10	3	1	4	168	10	1,145
17-08-6	4	0	0	2	0	0	1,462	0	0	15	0	0	0	64	4	1,551
17-08-7	0	0	0	9	0	0	846	0	0	9	0	0	1	104	5	974
17-08-8	0	0	0	2	0	0	631	0	0	9	0	0	0	42	12	696
17-08-9	0	0	0	14	0	9	1,860	2	2	29	2	0	10	437	30	2,395
17-08-10	0	0	0	43	0	1	1,695	0	0	72	0	0	0	471	10	2,292
17-08-11	0	0	1	6	1	0	1,760	1	1	25	4	0	1	153	12	1,965
17-08-12	0	0	0	4	0	0	1,937	0	1	5	3	0	1	338	148	2,437
17-09-1	0	0	0	1	0	1	81	1	0	0	0	0	0	21	1	106
17-09-2	0	0	0	113	0	0	2,061	0	0	48	0	0	0	639	4	2,865
17-09-3	0	0	0	755	0	1	432	1	0	15	1	1	2	889	12	2,109
17-09-4	0	0	0	3	1	0	1,068	1	1	5	3	0	0	44	8	1,134
17-09-5	0	0	0	26	0	0	1,061	0	1	3	1	0	2	90	4	1,188
17-09-6	0	0	0	1	0	0	888	0	0	17	0	0	0	136	6	1,048
17-09-7	0	0	0	6	1	0	673	1	0	7	0	0	0	198	1	887
17-09-8	0	0	0	3	0	0	153	0	0	7	0	0	0	88	23	274
17-09-9	0	0	0	33	0	0	421	53	1	17	1	0	3	249	11	789
17-09-10	0	0	0	44	0	0	611	0	0	29	0	0	1	82	5	772

Location ID	Rhifer	Rhisp	Myonat	Myosp	Nycnoc	ENVsp	PippiT	Pippyg	Pipnat	Pip50	Pip35	Pipkuh	Plesp	ChiroSp	parasi	Total
17-09-11	0	0	0	2	1	0	297	1	1	0	1	1	2	53	9	368
17-09-12	0	0	0	6	0	1	2,254	1	3	4	4	0	0	221	6	2,500
17-10-1	2	0	0	4	0	0	109	0	0	4	0	0	0	36	18	173
17-10-2	0	0	0	101	0	0	199	2	0	8	0	0	0	104	6	420
17-10-3	0	0	0	0	0	0	483	0	0	10	2	0	0	194	35	724
17-10-4	0	0	0	21	0	0	193	0	0	0	0	0	0	67	5	286
17-10-5	0	0	0	6	0	0	1,241	0	1	8	1	0	0	170	5	1,432
17-10-6	0	0	0	0	0	0	597	0	0	11	0	0	0	54	0	662
17-10-7	0	0	0	93	0	0	1,500	0	0	9	0	0	0	258	10	1870
17-10-8	0	0	0	1	0	0	158	0	0	5	1	0	0	71	19	255
17-10-9	0	0	0	30	0	0	4,356	0	2	22	14	0	1	106	10	4,541
17-10-10	0	0	1	54	0	0	842	0	1	11	0	0	4	124	13	1,050
17-10-11	0	0	0	0	0	1	329	0	2	1	2	0	1	70	1	407
17-10-12	0	0	0	0	0	0	1,821	0	0	10	1	0	0	100	23	1,955

Table D-2: Number of Identifications per Taxon (refined data)

Location ID	Myosp	Nycnoc	PippiT	Pippyg	Pipnat	Plesp	Noise	ChiroSp	parasi	Total
17-04-1	0	0	72	0	0	0	0	5	7	84
17-04-2	0	0	354	0	0	0	0	25	2	381
17-04-3	0	0	1,133	1	1	0	0	55	9	1,199
17-04-4	1	0	20	0	0	0	0	3	22	46
17-04-5	1	0	58	0	0	0	0	10	4	73
17-04-6	1	0	132	0	0	0	0	56	0	189
17-04-7	1	0	43	0	0	0	0	8	11	63
17-04-8	1	0	74	0	0	0	1	11	5	92
17-04-9	7	0	448	0	1	2	0	29	2	489
17-04-10	7	0	784	0	0	1	0	27	4	823
17-04-11	6	0	90	0	0	0	0	17	18	131
17-04-12	5	0	408	1	0	0	0	23	3	440
17-05-1	4	0	31	0	0	1	0	3	1	40
17-05-2	37	0	514	0	0	0	0	299	5	855
17-05-3	785	0	1,163	0	2	0	0	345	10	2,305
17-05-4	0	0	88	0	1	0	0	4	25	118
17-05-5	22	0	173	0	0	0	0	26	3	224
17-05-6	4	0	367	0	8	2	0	83	5	469
17-05-7	4	0	884	0	0	0	0	82	6	976
17-05-8	17	0	412	0	0	0	0	39	14	482
17-05-9	28	1	1,041	0	0	0	0	104	4	1,178
17-05-10	11	0	86	0	0	0	0	19	4	120
17-05-11	102	0	433	0	2	0	0	176	24	737
17-05-12	2	0	1,086	0	2	0	0	72	8	1,170
17-06-1	1	0	44	0	1	0	0	11	7	64
17-06-2	50	0	1,341	0	3	0	0	402	3	1,799

Location ID	Myosp	Nycnoc	PippiT	Pippyg	Pipnat	Plesp	Noise	ChiroSp	parasi	Total
17-06-3	31	0	2,514	1	3	0	0	305	30	2,884
17-06-4	1	0	1,721	0	1	0	0	40	9	1,772
17-06-5	23	0	181	0	2	7	0	46	2	261
17-06-6	15	0	760	0	3	0	0	86	2	866
17-06-7	135	0	3,220	0	0	0	1	620	10	3,986
17-06-8	2	0	98	0	0	0	0	48	1	149
17-06-9	22	0	499	0	21	4	0	194	21	761
17-06-10	96	0	1,067	0	2	0	2	215	0	1,382
17-06-11	47	0	248	0	2	1	1	197	1	497
17-06-12	5	0	2,169	0	2	0	0	284	7	2,467
17-07-2	121	0	2,417	0	0	0	0	1,130	1	3,669
17-07-3	69	1	1,084	0	2	5	0	216	4	1,381
17-07-4	8	0	1,836	0	2	1	0	118	19	1,984
17-07-5	25	0	1,105	0	2	2	0	469	8	1,611
17-07-6	44	0	1,363	0	13	0	0	177	5	1,602
17-07-7	23	0	464	0	0	6	0	112	8	613
17-07-8	18	0	410	0	0	4	0	106	5	543
17-07-9	147	4	1,201	0	6	8	0	397	3	1,766
17-07-10	394	0	1,330	0	1	0	0	265	7	1,997
17-07-11	9	0	268	0	3	1	0	117	0	398
17-07-12	2	1	458	0	14	0	0	275	10	760
17-08-1	0	0	81	0	0	0	0	13	0	94
17-08-2	288	0	1,440	0	0	1	0	1,414	15	3,158
17-08-3	61	1	1,800	0	3	0	0	191	9	2,065
17-08-4	0	0	528	0	0	0	0	22	3	553
17-08-5	11	0	948	0	4	4	0	168	10	1,145
17-08-6	2	0	1,477	0	0	0	4	64	4	1,551
17-08-7	9	0	855	0	0	1	0	104	5	974

Location ID	Myosp	Nycnoc	PippiT	Pippyg	Pipnat	Plesp	Noise	ChiroSp	parasi	Total
17-08-8	2	0	640	0	0	0	0	42	12	696
17-08-9	14	9	1,889	2	4	10	0	437	30	2,395
17-08-10	43	1	1,767	0	0	0	0	471	10	2,292
17-08-11	7	1	1,785	1	5	1	0	153	12	1,965
17-08-12	4	0	1,942	0	4	1	0	338	148	2,437
17-09-1	1	1	81	1	0	0	0	21	1	106
17-09-2	113	0	2,109	0	0	0	0	639	4	2,865
17-09-3	755	1	447	1	2	2	0	889	12	2,109
17-09-4	3	1	1,073	1	4	0	0	44	8	1,134
17-09-5	26	0	1,064	0	2	2	0	90	4	1,188
17-09-6	1	0	905	0	0	0	0	136	6	1,048
17-09-7	6	1	680	1	0	0	0	198	1	887
17-09-8	3	0	160	0	0	0	0	88	23	274
17-09-9	33	0	438	53	2	3	0	249	11	789
17-09-10	44	0	640	0	0	1	0	82	5	772
17-09-11	2	1	297	1	3	2	0	53	9	368
17-09-12	6	1	2,258	1	7	0	0	221	6	2,500
17-10-1	4	0	113	0	0	0	2	36	18	173
17-10-2	101	0	207	2	0	0	0	104	6	420
17-10-3	0	0	493	0	2	0	0	194	35	724
17-10-4	21	0	193	0	0	0	0	67	5	286
17-10-5	6	0	1,249	0	2	0	0	170	5	1,432
17-10-6	0	0	608	0	0	0	0	54	0	662
17-10-7	93	0	1,509	0	0	0	0	258	10	1,870
17-10-8	1	0	163	0	1	0	0	71	19	255
17-10-9	30	0	4,378	0	16	1	0	106	10	4,541
17-10-10	55	0	853	0	1	4	0	124	13	1,050
17-10-11	0	1	330	0	4	1	0	70	1	407

Location ID	Myosp	Nycnoc	PippiT	Pippyg	Pipnat	Plesp	Noise	ChiroSp	parasi	Total
17-10-12	0	0	1,831	0	1	0	0	100	23	1,955

Table D-3: Static monitoring locations and habitat descriptions

Static detector location	Grid reference	Habitat description
1	SD 35468 40615	located within a semi-improved grassland, on the boundary of an avenue of mature trees adjacent to a tributary of Skippool Creek.
2	SD 35764 40569	located on the boundary of Main Dyke within the riparian habitat.
3	SD 36099 40524	located on the boundary of residential properties with connectivity to hedgerows and improved grassland.
4	SD 36049 40091	located along the boundary of improved grassland and provides connectivity to hedgerows.
5	SD 36304 39861	located within a hedgerow that provides connectivity to Carr Wood to the north and Main Dyke to the south.
6	SD 36829 39409	adjacent to the A586 within the avenue of trees bounding the road providing connectivity to hedgerows.
7	SD 37090 39246	located within a hedgerow that provides connectivity to several hedgerows bounding improved grassland.
8	SD 37661 39129	located within a small deciduous copse bounded by improved grassland.
9	SD 37909 39208	located within a woodland bounded by improved grassland that provides connectivity to larger sections of woodland.
10	SD 38175 39324	located on the boundary of a small woodland copse and arable field, connected to the wider landscape by hedgerows and other small sections of woodland.
11	SD 38394 39391	located on a hedgerow separating an improved grassland and arable field. The hedgerow provides connectivity to woodlands to the north and south.
12	SD 38880 39470	located on a hedgerow with a wet ditch beneath it. The hedgerow provided connectivity to improved grasslands and small copses.

Table D-4: Static Monitoring Survey Dates

Survey number	Deployment dates	No. survey nights
1	13/04/2017–18/04/2017	5
2	03/05/2017–09/05/2017	5
3	01/06/2017–05/06/2017	5

Survey number	Deployment dates	No. survey nights
4	12/07/2017–16/07/2017	5
5	08/08/2017–13/08/2017	6
6	01/09/2017–05/09/2017	5
7	03/10/2017–09/10/2017	6

ANNEX E – SONOCHIRO METHODOLOGY

At the time of these analyses, SonoChiro was capable of identifying all known British bat species (including vagrants) to Species or Species Group level. A full list of the classifications used by SonoChiro is provided in Table 11-1.

Table E-1: SonoChiro

SonoChiro classification	Species or species group
Barbar	Barbastelle *Barbastella barbastellus*
Eptnil	Northern bat *Eptesicus nilssonii*
Eptser	Serotine *Eptesicus serotinus*
Myobec	Bechstein's bat *Myotis bechsteinii*
Myonat	Natterer's bat *Myotis nattereri*
Nyclei	Leisler's bat *Nyctalus leisleri*
Nycnoc	Noctule *Nyctalus noctula*
Pipkuh	Kuhl's pipistrelle *Pipistrellus kuhlii*
Pipnat	Nathusius' pipistrelle *Pipistrellus nathusii*
PippiT	Common pipistrelle *Pipistrellus pipistrellus*
Pippyg	Soprano pipistrelle *Pipistrellus pygmaeus*
Pleaur	Brown long-eared bat *Plecotus auritus*
Pleaus	Grey long-eared bat *Plecotus austricasus*
Rhifer	Greater horseshoe *Rhinolophus ferrumequinum*
Rhihip	Lesser horseshoe *Rhinolophus hipposideros*
ENVsp	*Eptesicus/Nyctalus/Vespertilio* sp. ('big bat')
Myosp	*Myotis* sp.
Pip35	Kuhl's/Nathusius'/Savi's pipistrelle *Hypsugo savii*
Pip50	Common/soprano pipistrelle
Plesp	Long-eared Bat *Plecotus* sp.
Rhisp	Greater/lesser horseshoe bat *Rhinolophus* sp.
Chiro sp.	Bat sp.
Parasi	SonoChiro has not identified a bat call, but cannot entirely rule out the potential for a bat call to be present

SonoChiro provides bat call identifications through a 2-stage process, with an initial detection stage and a secondary classification stage. The initial detection stage locates all recordings with the potential to contain bat calls; the programme has been devised to be highly sensitive at this stage to ensure maximum detection of bat calls. This can result in a large number of recordings not containing bat calls being considered as potential bat calls (Type I error). However, such calls are filtered out during the second, classification stage.

At each classification stage, SonoChiro bases its identifications on an extensive library of pre-identified bat calls and related parameters, which are applied to an unknown bat call (or sequence of calls) to determine its identification. Classification initially identifies whether there is more than one species present within a recording. SonoChiro is capable of identifying up to 3 different bat species on a recording.

SonoChiro provides identification results, for each call sequence, on 3 levels:

1. Species
2. Species Group
3. Overall Identification

At the first 2 levels, confidence in the accuracy of the identification is assigned a score on a scale of 1–10, with one indicating the lowest level of confidence and ten indicating the highest.

A threshold value (5) is used at the species and group levels in determining the Overall Identification. If Species-level identification is assigned a confidence level above the threshold, then the Species-level identification is used as the Overall Identification. If Species-level confidence is ≤5 and Species Group-level confidence is above 5, then Species Group-level identification is used as the Overall Identification. If neither Species or Species Group level has a confidence above the threshold, then an Overall Identification of 'Chiro sp.' is assigned. 'Chiro sp.' denotes sufficient confidence that a bat call (or calls) are present, but do not contain sufficient information on which to base an identification to Species, or Species Group.

Additionally, if a call sequence lacks sufficient information on which to assign a classification with a confidence level ≥1 at Species or Species Group level, but the presence of a bat cannot confidently be ruled out, then the call is identified as Parasi.

SonoChiro outputs provide details of the 3 levels of identification (Species, Species Group and Overall) and related confidence indices, as well as descriptive metadata: time and date of the recording, number of calls on which the identification has been based, and a range of call parameter values.

Auto-identification Process

Analysis was undertaken using SonoChiro version 3.3.3. SonoChiro was set to:

- Auto-identify calls from bat species occurring within the British Isles
- Identify calls recorded at a time-expansion setting of 1 and which occurred for a minimum of 0.5ms
- Sensitivity level of 7 (the advised default)
- Retain files identified as containing no bat calls (i.e. Noise) – used for later manual verification, as required

Manual Verification of SonoChiro Outputs

To test for Type I and Type II errors in SonoChiro's identifications, manual verifications were undertaken.

For manual verification to be effective a sufficiently large sample size is required and, preferably, the full range of species considered likely to occur within a study area would be represented. June was therefore preselected as the month in which these 2 criteria were most likely to be met by the data generated.

The dataset generated during the June survey was sufficiently large as to produce appropriately sized sub-sample of calls (more details below) for each Species or Species Group; additionally, as confirmed upon completion of the identification of data from July–October, the full range of Species, excluding Pleaur, or Species

Groups recorded throughout the study were identified within the June data; Pleaur was however represented at Species Group level by Plesp within the June dataset and due to the low number of Pleaur identifications within the April-October data, additional manual verification of this species was not required. Therefore, the June dataset was considered appropriate for the manual verification and no additional verification from other survey months was required.

A 5% sample from each call classification as per the Overall Identification for the June 2017 data only, was collated using random number tables to select individual calls for manual identification. Noise files were also included in the manual verification to investigate whether recordings labelled as Noise by SonoChiro readily contained calls which could reasonably be identified to Species or Species Group level (Table 11-2).

Table E-2: Summary of Manual Verification of June 2017 SonoChiro Outputs

Category	Total No. calls	No. calls verified (5%)	No. calls verified agreed with SonoChiro	Overall Identification % match
Pip35	34	2	2	100
Pipnat	6	6	6	100
PippiT	13,595	680	679	99.9
Pip50	267	14	14	100
Pippyg	1	1	1	100
Myosp	427	22	22	100
Myonat	1	1	1	100
Plesp	12	1	0	0
Rhisp	3	3	0	0
Rhifer	1	1	0	0
Chiro sp	2,448	122	120	98.46
Parasi	93	5	0	0%
Noise	22,137	1,107	650	58.7

Manual verification of PippiT, Pip35, Pipnat, Pip50, Pippyg, Myosp and Myonat matched the classifications assigned by SonoChiro.

Manual verification matched only a proportion of the identifications for PippiT (99.85%), Plesp (0%), Rhisp (0%), Rhifer (0%), Chiro sp (98.36%), Parasi (0%) and Noise (58.72%). In each case, the disparity was because calls could be confidently classified as either a bat (Chiro sp – for Noise identifications), or to Species Group level (applicable to Chiro sp, Parasi and Noise identifications), i.e. SonoChiro displayed Type II errors when compared to manual identification.

The non-identification to Species or Group level of low quality recordings (i.e. containing little data) helps to prevent false positives, such as could occur with quiet or borderline bat calls.

Due to the large volume of data generated, the exclusion of recordings (Type II errors) containing bat calls is unlikely to qualitatively affect conclusions drawn based on the dataset generated.

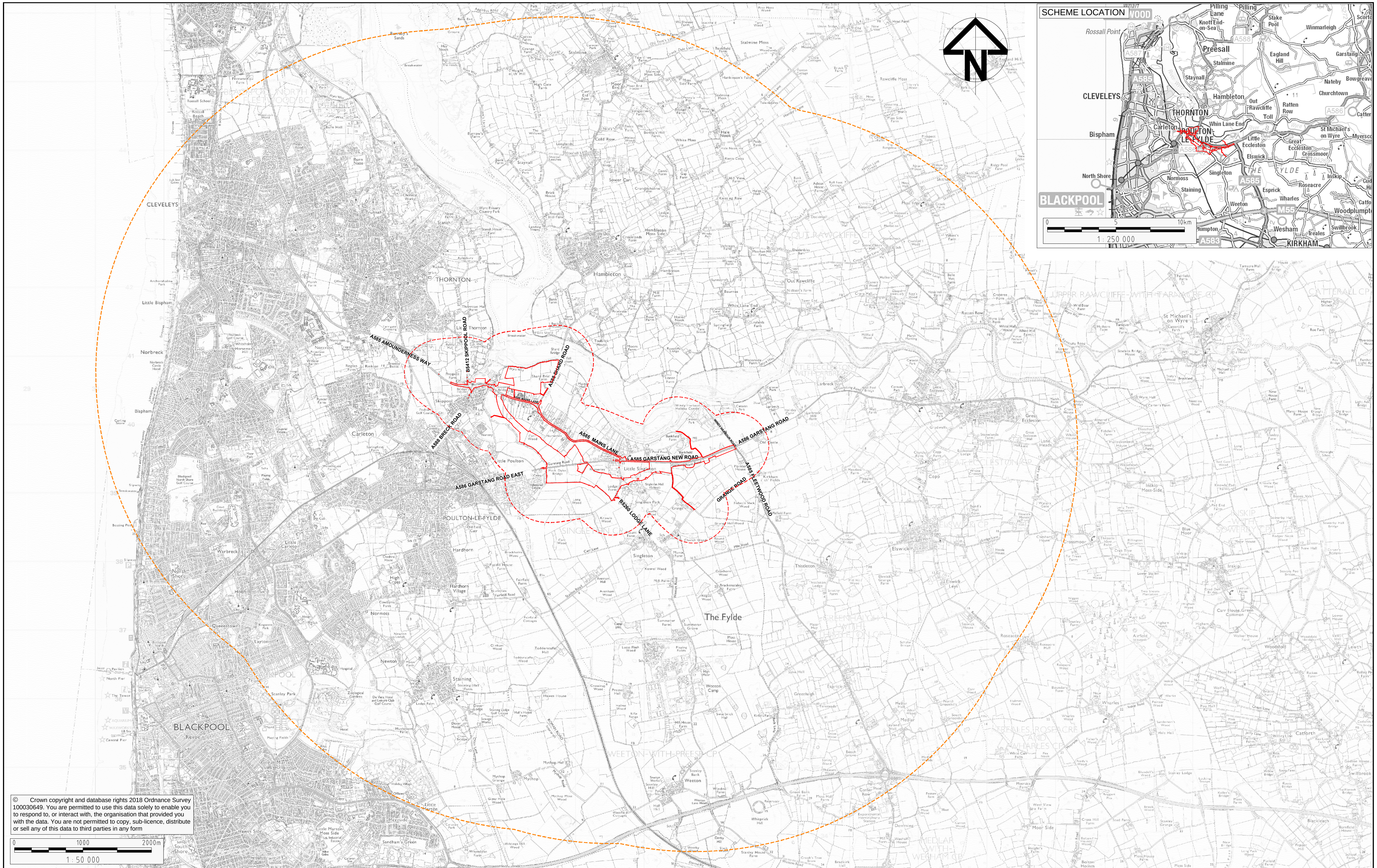
The Plesp classified by SonoChiro, was manually classified as Myosp, with the

Rhifer and Rhisp classified as unspecificed social calls or noise. These low numbers of Type I errors, when compared to manual identification, are extremely unlikely to affect conclusions drawn.

Conclusion

Manual identification of the dataset would likely result in a higher number of bat calls being identified to Species or Species Group, thereby providing a finer level of detail on the recorded bat assemblage, which may be considered as a benefit to the study. However, the level of confidence assigned to a call sequence identified manually cannot be quantified and a human analyst is subject to cognitive biases. Additionally, intra-observer and inter-observer variation is removed through the use of auto-identification. Considering each of these factors, amongst others, and via the systematic manual verifications undertaken, the use of SonoChiro is considered to be acceptable for the identification of bat call data in this study.

ANNEX F – DRAWINGS



0 1000 2000m

1 : 50 000

KEY:

- Draft Order Limits
- 500m Study Area
- 5km Desk Study Area

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P00	S8	OCT18	S8 - DCO SUBMISSION	JN	KB	NH

Client: highways england

Project: A585 WINDY HARBOUR TO SKIPPOOL IMPROVEMENT SCHEME

Drawing Title: ENVIRONMENTAL STATEMENT REGULATION 5(2)(a) BAT REPORT: BAT STUDY AREA

Status: S8 - DCO SUBMISSION

Revision: 0

Scale: 1:50 000 @ A3

Date: OCT 2018

Drawn By: J.NORMAN

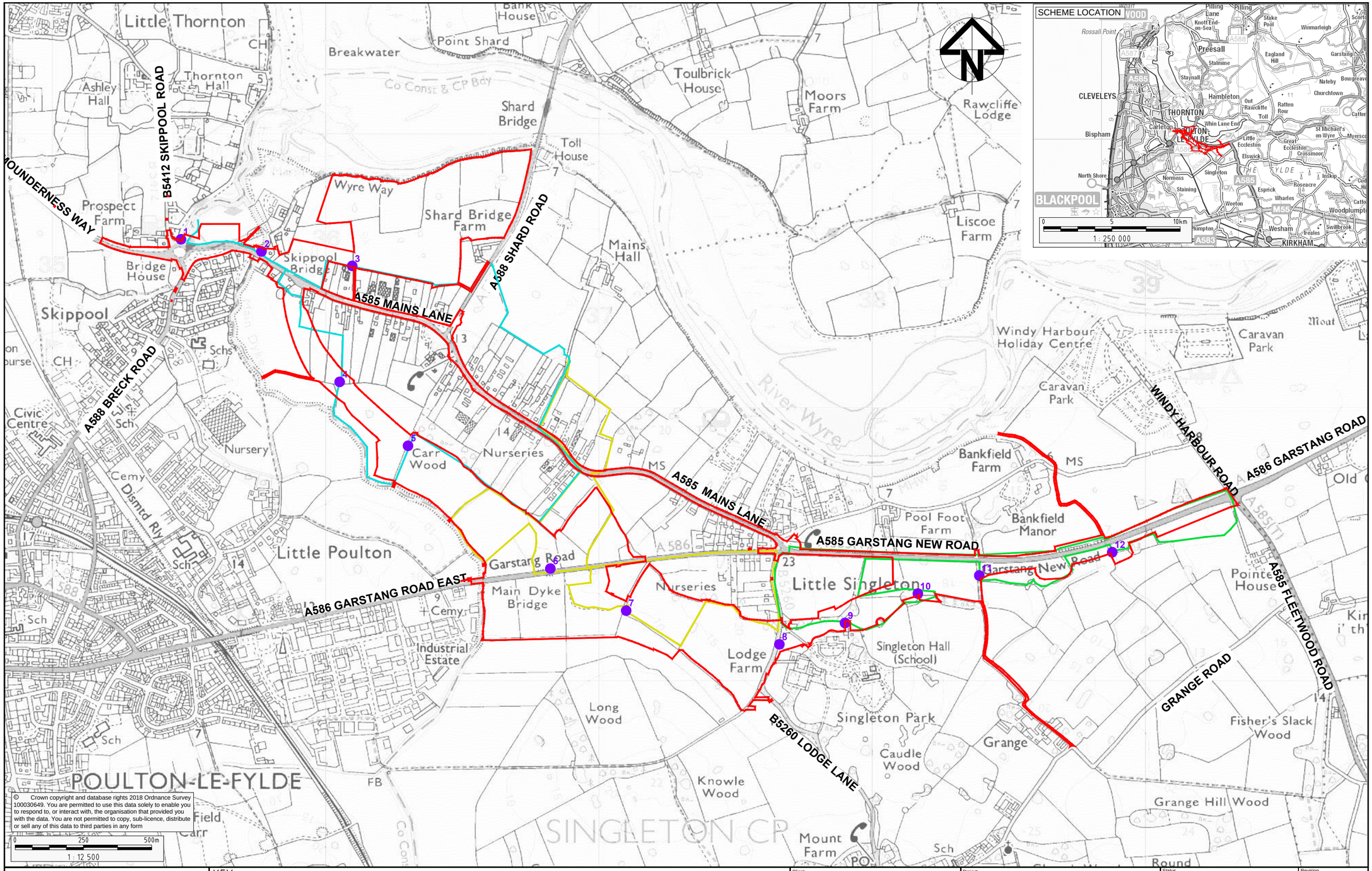
Checked By: K.BURROWS

Approved By: N.HENDERSON

PINS No.: TR010035

FIGURE 8.5.1

Drawing number: HE548643-A585-EAC-SZ_GN000-DR-L-3043



0 250 500m
1 : 12 500

KEY:

- Draft Order Limits
- Static Locations
- 100m Survey Area
- Transect Route 1
- Transect Route 2
- Transect Route 3

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
0	S8	OCT18	S8 - DCO SUBMISSION	JN	KB	NH

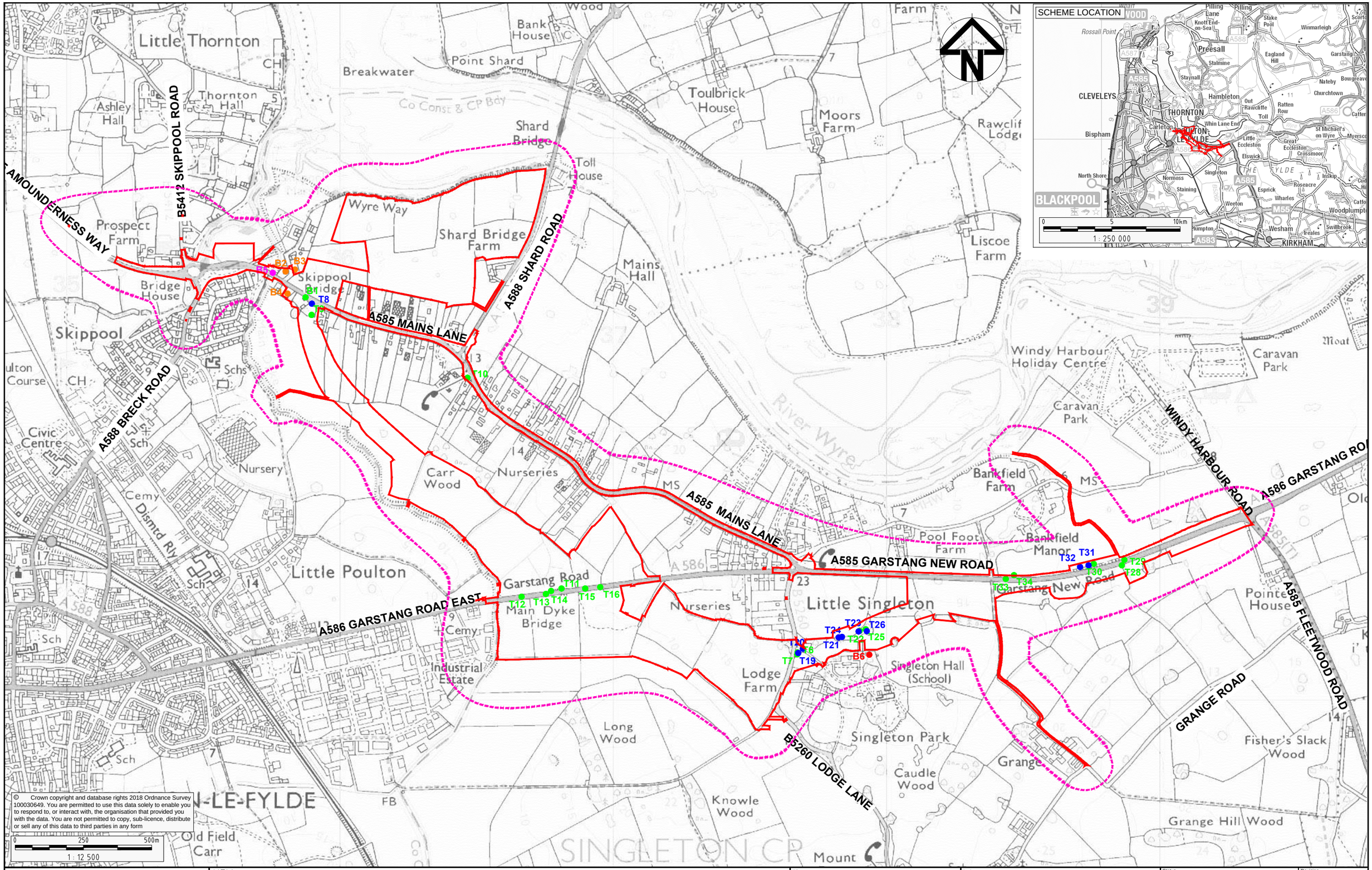
Client: highways england

Project: A585 WINDY HARBOUR TO SKIPPOOL IMPROVEMENT SCHEME

Drawing Title: ENVIRONMENTAL STATEMENT REGULATION 5(2)(a) BAT REPORT: BAT STUDY AREA

Status	S8 - DCO SUBMISSION	Revision	0
Scale	1:12 5000 @ A3	Date	OCT 2018
Drawn By	J.NORMAN		
Checked By	K.BURROWS		
Approved By	N.HENDERSON		
PINS No.	TR010035		FIGURE A8.5.2

Drawing number (HE PIN | Originator | Volume | Location | Type | Role | Number): HE548643-A585-EAC-SZ_GN000-DR-L-3044



KEY:

- Draft Order Limits
- 100m Survey Area
- Confirmed Roost
- Negligible Suitability
- Low Roost Suitabilty
- Moderate Roost Suitability
- High Roost Suitability

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
P00	S8	OCT18	FINAL	JN	KB	NH

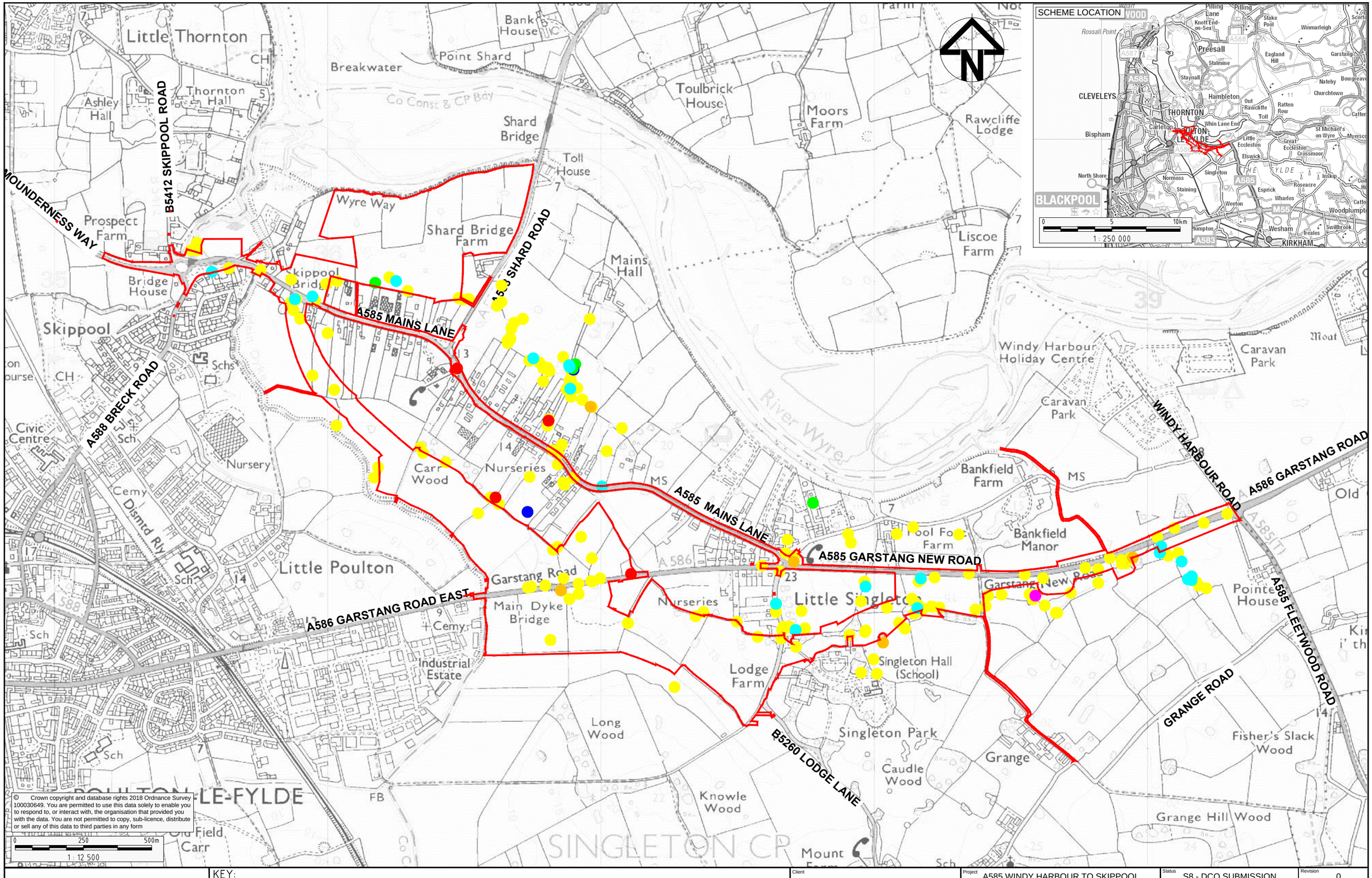
Client: highways england

Project: A585 WINDY HARBOUR TO SKIPPOOL IMPROVEMENT SCHEME

Drawing Title: ENVIRONMENTAL STATEMENT REGULATION 5(2)(a) BAT REPORT: ROOST ASSESSMENT RESULTS

Status	S8 - DCO SUBMISSION	Revision	0
Scale	1:12 500 @ A3	Date	OCT 2018
Drawn By	J.NORMAN		
Checked By	K.BURROWS		
Approved By	N.HENDERSON		
PINS No.	TR010035		FIGURE 8.5.3

Drawing number: HE548643-A585-EAC-SZ_GN000-DR-L-3045



KEY:

- Draft Order Limits
- Big Bat
- Myosp
- Nat/45 pip
- Nycnoc
- PippiT
- Pleaur
- Pipnat

Rev	Status	Rev. Date	Purpose of revision	Drawn	Chck'd	Apprv'd
0	S8	OCT18	S8 - DCO SUBMISSION	JN	KB	NH

Client: highways england

Project: A585 WINDY HARBOUR TO SKIPPOOL IMPROVEMENT SCHEME

Drawing Title: ENVIRONMENTAL STATEMENT REGULATION 5(2)(a) BAT REPORT: TRANSECT SURVEY RESULTS

Status	S8 - DCO SUBMISSION	Revision	0
Scale	1:12 500 @ A3	Date	OCT 2018
Drawn By	J.NORMAN		
Checked By	K.BURROWS		
Approved By	N.HENDERSON		
PINS No.	TR010035		FIGURE 8.5.4

Drawing number (HE PIN | Originator | Volume | Location | Type | Role | Number): HE548643-A585-EAC-SZ_GN000-DR-L-3046

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