



St John the Baptist Church, Cold Overton

Bat Management Plan

January 2020



B.A.T. Ecological | www.bat-ecological.co.uk | info@bat-ecological.co.uk | 07870 157022

Report Information:

Report title:	St John the Baptist Church, Cold Overton – Bat Management Plan
Prepared by:	Matt Cook BSc (Hons) MSc MCIEEM
Prepared for:	St John the Baptist Church, Natural England, and the Bats in Churches Heritage Lottery Fund Project
Issued on:	30 January 2020
Document reference:	B.A.T.200101

Disclosure:

This document has been prepared by B.A.T. Ecological Ltd. for the sole use of the commissioning client/s. It has been provided in accordance with the agreed scope and intended purpose and previously stated Terms and Conditions. No other warranty is made as to the professional advice included in this document. It does not purport to give legal advice.

This report should not be copied or relied upon by any third party without the express prior written agreement of B.A.T. Ecological Ltd. and the commissioning client/s.

The evidence gathered, and the opinions provided, have been prepared in accordance with the Chartered Institute of Ecology and Environmental Management Code of Professional Conduct.

Where any appraisal is based upon information provided by third parties, it is assumed that this information is relevant, correct and complete; there has been no independent verification of information obtained from third parties unless otherwise stated. Where field investigations have been carried out these have been appropriate to the agreed scope of works and carried out to a level of detail required to achieve the stated objectives.



Cover photograph by Dan Cook @ <https://danscape.co/>

Contents

Executive Summary	4
1 Introduction	5
1.1 Background.....	5
1.2 Church Location	5
1.3 Church Description	6
2 Statement of Heritage Significance	7
3 Bat Usage of the Church	9
3.1 Desk Study	9
3.2 Field Surveys	9
4 Relevant Wildlife Legislation	15
4.1 Bats	15
4.2 Nesting Birds.....	16
5 Evaluation	17
5.1 Bat Survey Effort and Expertise	17
5.2 Stakeholder Consultation.....	17
5.3 Overall Evaluation.....	18
6 Consideration of Bat Management Options	19
6.2 Option 1: Do Nothing.....	20
6.3 Option 2: Light Deterrents	21
6.4 Option 3: Acoustic Deterrents	21
6.5 Option 4: Bat Boxes	22
6.6 Option 5: Boxing In (Bat Compartments).....	23
6.7 The Preferred Bat Mitigation Strategy: Boxing-In (Bat Compartments)	24
7 Bat Management Objectives	26
7.1 Objectives	26
7.2 Achieving the Objectives.....	26
8 Prescribed Actions and Costings	29
8.1 2020.....	29
8.2 Proposed Costings - 2020	30
8.3 2021 to 2023.....	32
9 References	34
10 Appendix	36
10.1 Figure 10.1: Bat Activity and Proposed Mitigation for St John the Baptist Church	xxxvii

Executive Summary

This report presents the 2020-23 bat management plan for St John the Baptist Church, Cold Overton, Leicestershire as part of the [Bats in Churches \(BiC\) Heritage Lottery Fund \(HLF\) Project](#) led by Natural England.

St John the Baptist Church supports a maternity colony of c.250 adult female soprano pipistrelles and a maternity colony of c.20 adult female Natterer's bats, both of which predominantly roost among the roof timbers of the church nave. The management plan considers and prescribes bespoke measures intended to reduce the impacts of these bats inside the church, while ensuring that there is no harm to the bats or the favourable conservation status of the local populations to which they belong.

The strategy presented is based on the findings of a detailed suite of bat surveys of St John the Baptist Church completed by B.A.T. Ecological in 2019, a suite of bat surveys of the church undertaken by Philip Parker Associates in 2017, relevant recent research into mitigating the impacts of bats on churches, and ongoing consultation with stakeholders. The measures proposed will be implemented from 2020-23 via the Bats in Churches Class Licence (BiCCL) which is a unique Natural England licence designed to help suitably qualified bat ecologists (Registered Consultants) manage the effects of bat activity on places of worship.

Based on the information gathered to inform this report, the selected bat management option for St John the Baptist Church comprises the creation of two discreet bat compartments within the nave roof for the soprano pipistrelle colony, which is responsible for voiding most of the droppings and urine inside the church. The bespoke bat compartments have been designed to allow the soprano pipistrelles to continue to roost and breed within the fabric of the building, and use their existing access / egress features and principle roosting location, but they are sealed to prevent these bats from accessing and flying within the church interior. Recent research and usage at other churches has demonstrated the potential efficacy of this 'boxing-in' approach in reducing the impacts of voided droppings and urine from large bat colonies inside these buildings. Several generic bat boxes will also be installed at the church to provide longer-term bat roost and hibernation habitat, and the floodlighting outside the church will be managed favourably for the roosting bats.

Three key objectives have been set for the management plan at St John the Baptist Church, against which the success (or otherwise) of the proposals detailed within this report will be measured:

1. To carefully provide a range of long-term, suitable artificial alternative roosts for the bats at the church – both bespoke compartments and generic bat boxes - and monitor their occupancy;
2. To reduce the usage of the church interior by the soprano pipistrelle maternity colony to a level that is acceptable to the church users, including diminishing the depositions of droppings and urine on important wall paintings, fittings and memorials; and,
3. To monitor and maintain the status of both the soprano pipistrelle and Natterer's bat roosts within the church, and thereby ensure that the favourable conservation status of the local populations of these two species is also maintained.

The bespoke bat compartments and bat boxes will be installed at St John the Baptist Church in February or March 2020 – prior to when the female bats begin to congregate - under the direct guidance of a BiCCL Registered Consultant. Intensive monitoring of the implemented bat mitigation measures will then commence in April 2020 and continue through the summer, with further monitoring conducted until 2023. Specific targets have been set in respect of the favourable conservation status of the bats; if monitoring confirms that the local populations of Natterer's bats and soprano pipistrelles have not responded as predicted to the proposed activities, and risks to the bats have increased, an adaptive management plan will be devised and agreed with Natural England. Annual reports on the progress at St John the Baptist Church will be provided to Natural England and the various stakeholders until 2023.

1 Introduction

1.1 Background

- 1.1.1 This report presents the 2020-23 bat management plan for St John the Baptist Church, Cold Overton, Leicestershire (also referred to hereafter as 'the church') as part of the [Bats in Churches \(BiC\) Heritage Lottery Fund \(HLF\) Project](#) led by Natural England.
- 1.1.2 St John the Baptist Church supports a maternity colony of c.250 adult female soprano pipistrelles and a maternity colony of c.20 adult female Natterer's bats, both of which predominantly roost among the roof timbers of the church nave. The management plan considers and prescribes bespoke measures intended to reduce the impacts of these bats inside the church, while ensuring that there is no harm to the bats or the favourable conservation status of the local populations to which they belong.
- 1.1.3 The strategy presented is based on the findings of a detailed suite of bat surveys of St John the Baptist Church completed by B.A.T. Ecological in 2019, a suite of bat surveys of the church undertaken by Philip Parker Associates in 2017, relevant recent research into mitigating the impacts of bats on churches, and ongoing consultation with stakeholders. The measures proposed will be implemented from 2020-23 via the Bats in Churches Class Licence (BiCCL) which is a unique Natural England licence designed to help suitably qualified bat ecologists (Registered Consultants) manage the adverse effects of bat activity on places of worship.
- 1.1.4 Full details of the findings from the bat surveys undertaken at St John the Baptist Church in 2019 are provided in B.A.T. Ecological report B.A.T.191102 (November, 2019).

1.2 Church Location

- 1.2.1 The central Ordnance Survey Grid Reference (OSGR) of St John the Baptist Church is SK 81024 10152. The post code of the church is LE15 7QA and it is located here: <https://goo.gl/maps/z5Vc6aQ8poeDFYge6>. The church can be seen in photograph 1.2.1.

Photograph 1.2.1: St John the Baptist Church, Cold Overton, viewed from above facing west. Photograph taken by Peter Rycroft (Church Warden).



- 1.2.2 The church is located on Main Street in Cold Overton, which is a small rural village in the Melton district of Leicestershire, England. It is situated c.1.3 km from the western border of Rutland County and c.4.5 km to the west of the market town of Oakham. The village forms part of the civil parish of Knossington and Cold Overton.

1.3 Church Description

- 1.3.1 St John the Baptist Church is a Grade I listed building that dates back to C12, although most of what stands today comprises additions made in C13, C14 and C15. The church was restored late in C19. There are some rare C13 pre-Reformation wall paintings on two of the lime-plastered internal walls of the south aisle. These were restored and conserved in 2018. The C15 tower was also restored in 2018-19.
- 1.3.2 The church comprises a nave with a clerestory; north and south aisles; a south porch; a tower with a spire to the west of the nave, and a chancel to the east of it. There is also a small boiler room at the north-west corner of the church adjoining the tower and the north aisle. The church is predominantly constructed from coursed and squared ironstone and limestone rubble and ashlar, with ashlar dressings.
- 1.3.3 Externally, the nave and chancel roofs are covered with lead and a Swithland slate roof covers the boiler room. The octagonal church spire is constructed from stone, as is the surrounding parapet wall of the tower. The roof of the nave is finished with a crenellated parapet wall (with a chamfered band) with no rafters visible externally. The rafters of the chancel and both aisles are exposed at the eaves.
- 1.3.4 Internally, the north and south aisles have C19 roofs with arch braces resting on re-set corbels; the nave has a C19 common rafter roof with a re-set C16 chamfered span beam; the tower has a C19 principal rafter roof with restored mask corbels; and the low pitched C19 roof of the chancel comprises cambered tie beams and arch braces resting on plain corbels.
- 1.3.5 The church is surrounded by a small graveyard which supports a large yew tree *Taxus baccata* near the south porch. There is a single floodlight within the churchyard, sited near the south-east corner of it near Main Street. Beyond the graveyard are dwellings to the north, the east (beyond Main Street) and the south, and a small mature woodland is located to the west.
- 1.3.6 Several photographs of the church are provided in the preceding B.A.T. Ecological report B.A.T.191102. Further photographs and detailed information regarding the history and construction of the church can be found at: <https://www.cold-overton.co.uk/about-1> and <https://historicengland.org.uk/listing/the-list/list-entry/1075150>.

2 Statement of Heritage Significance

- 2.1.1 As part of the initial phases of the BiC Project a Statement of Significance (SoS) was prepared in respect of the heritage importance of each project church and the impact upon it from bat activity. The following comprises the executive summary from the BiC SoS for St John the Baptist Church (authored by Richard Halsey) in December 2017:

“A church has existed on this hilltop site for nearly a thousand years in close association with the adjacent Cold Overton Hall. It is a modest, essentially thirteenth century building with an expensively decorated c.1300 south nave aisle and an early fifteenth century steeple with much sculptural decoration. The roofs were well renewed in the late nineteenth century and the chancel nicely refurnished in 1926. The original wall paintings of the south aisle have suffered from damp and like other surfaces, have been affected by bats exercising and roosting in the building. The damage to walls, fittings and memorials of high significance is regrettable but not yet critical. Efforts should be made now to ensure it does not get worse”.

- 2.1.2 More specifically, the SoS (Halsey, 2017) describes the significance of the church as follows:

“This is a modest village church standing next to the Hall in the middle of the settlement, an arrangement that has existed since at least the late eleventh century. The plan and much fabric belong to a major rebuilding of c.1200. The south aisle was expensively rebuilt and decorated in the early fourteenth century to accommodate a chapel, the west steeple added about a century later with much external enrichment. The late-medieval clerestorey (now best represented by the good quality stone roof corbels inside) and porch complete the medieval church.

Little remains of the late-eighteenth century refurnishing (but it is known from sketches to be seen in the church). This and the many surviving lead hopper heads dated 1791-1804 might suggest that more was done than just reviving the rainwater disposal system. The north aisle wall is not medieval fabric. The late nineteenth century restorations, some by J. T. Micklethwaite, replaced all the roofs but to the same profiles and most likely, design. The fabric is then of high significance for its historic, architectural and archaeological value.

The remaining c.1300 wall paintings are in a sad condition, but despite misguided mid-twentieth century restoration, can be seen to be of a decent quality. With the piscina, decorated cill and fine tracery windows, this end of the south aisle is of high artistic significance. Keyser (1883) claims ‘All the other walls were also covered with subjects which have been again whitewashed over’ so it is possible that further wall paintings exist in the aisle and elsewhere under the late-nineteenth century finishing coat. The 1842 font and cover are of moderate significance but other nave furnishings are of low-moderate interest. The chancel was refurnished to a high standard in 1926 by a regionally important architect, Wilfrid Bond and can be rated as of moderate-high significance”.

- 2.1.3 Following on from this, the BiC Project SoS (Halsey, 2017) for St John the Baptist Church provides the following assessment of the impacts of bats and the priorities for bat mitigation:

“There is a scattering of faeces (and presumably urine splashes) on most of the plastered walls, which have greater significance because it is possible that further wall paintings are below the surface. Bat droppings can be seen over much of the church, with concentrations below the roosts and access points on the south side of the nave towards the west (see photos). There are only a few ledgers, those in the south aisle being of stone. The photo shows a small ledger to a child burial which has until recently been covered with carpet. The chancel seems to have fewer droppings, but the writer was told some cleaning had been done recently. The churchwarden believes the streaks on the late nineteenth century plaster to be from bat urine,

but the writer suggests these are mainly from roof and gutter leaks, some historic. The chancel roof had water dripping from a small hole at the time of the visit (above the priest's stall).

The wall paintings have some visible bat droppings on the surface but the main threat to them is the separation of the plaster from the wall behind due to damp. The organ is clearly suffering from the Natterer's access behind, but it is not of great historic significance and could perhaps be moved. It is intended to remove all the nave pews soon".

- 2.1.4 The SoS also provides a table (reproduced as Table 2.1) to show the significance of bat impacts in each area of the church in 2017, and a plan (Figure 2.1) showing the areas of high significance most affected by bats as identified in the 2016 Quinquennial Inspection Report.

Table 2.1: Significance of bat impacts in the various areas of the church in 2017.

Area/item	Significance	Impact	Total
Roof structure	2	1	2
Wall surfaces (plain)	2 (for underlying wall paintings)	3	6
Wall surfaces (painted or decorated)	5	3 (scattering)	15
Floor surfaces	1	2	2
Wall monuments	2	1	2
Floor memorials/ brasses	2	2 (but 3 for slate ledgers)	4
Altar/communion table	3	2	6
Reredos	3	2	6
Seating (chancel)	3	2	6
Rood screen	3	2	6
Pulpit	1	1	1
Lectern	1	1	1
Seating (nave and aisles)	1	3	3
Seating (other)	none		
Font	2	1	2
Organ	2	4	8
Overall impact on significance			65

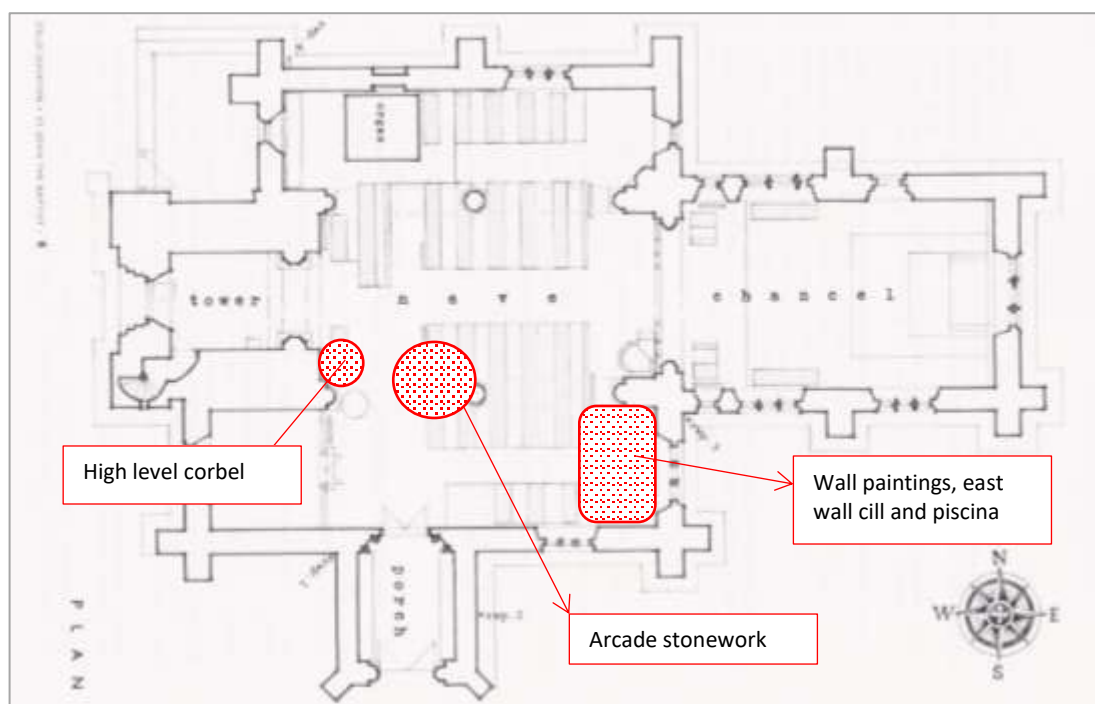


Figure 2.1: Plan from Quinquennial Inspection Report 2016 by Mark Stewart, Architect, showing areas of high significance most affected by bats in red.

3 Bat Usage of the Church

3.1 Desk Study

- 3.1.1 The desk study undertaken to inform the 2019 bat surveys found that no sites have been designated for their bat assemblage or interest within c.10 km of St John the Baptist Church. Also, no EPS bat mitigation licenses have been issued by Natural England within c.2 km of it.
- 3.1.2 There have been 14 EPS Mitigation (EPSM) licenses issued for bats within a 2-10 km radius of St John the Baptist Church. None of these relate to Natterer's bats, however five of them permit activities that impact on soprano pipistrelles including one that impacted on a breeding site - 2015-9200-EPS-MIT. This licence covers the period 2015-25 and was issued for a site which is >7 km to the south-east of the church.
- 3.1.3 It is understood that a maternity colony of soprano pipistrelles is being managed via a BiCCL at another BiC Project church, in Braunston-in-Rutland, which is c.4.5km to the south-east of Cold Overton. According to Collins (Ed.), 2016 the Core Sustainance Zone for a soprano pipistrelle colony usually comprises a radius of c.3km.
- 3.1.4 Based on the above, it is considered that the proposed actions at St John the Baptist Church are unlikely to result in cumulative impacts on the same populations of soprano pipistrelles as will be impacted under the aforementioned two licenses.

3.2 Field Surveys

- 3.2.1 In August 2017, following their bat surveys of St John the Baptist Church, Philip Parker Associates (Report ref: P2017-28 R1, paragraphs 6.10 and 6.11) concluded that it *"clearly supports a maternity roost of soprano pipistrelles [with a late summer colony size estimated to be in excess of 200 bats] with small numbers of common pipistrelles and Natterer's bats recorded. Roosting for all appears to be in the nave. The main access is into the nave and north aisle (few bats were seen to use the chancel). Pipistrelle access is mainly in the south-western corner of the nave and less in the north-west corner. Natterer's bat access was the north-west corner of the north aisle near the organ"*. Refer to this report for more information.
- 3.2.2 In the summer of 2019, the suite of detailed bat surveys undertaken by B.A.T. Ecological concluded that St John the Baptist Church continued to support a maternity colony of soprano pipistrelles, with an estimated peak colony size of c.250 adult female bats, and a maternity colony of c.20 adult female Natterer's bats.
- 3.2.3 Figure 10.1 in the Appendix provides a plan of the key findings in respect of bats in 2019. In 2019 both the soprano pipistrelles and the Natterer's bats roosted among the roof timbers of the nave, accessing and egressing their roosts via apertures alongside the span beams. The soprano pipistrelles roosted in several locations nearest the western half of the nave roof, predominantly on the southern side, whereas the Natterer's bats roosted at the eastern end of the nave roof above the chancel arch. Photograph 3.1.1 shows most of the locations where bats have accessed roosts among the nave roof timbers over many years, indicated by the characteristic wear on the span beams. The yellow arrows on this photograph show the locations of the soprano pipistrelle roosts used in 2019 (feature 1, Figure 10.1), and the red arrow shows the location of the roost used by Natterer's bats in 2019 (feature 2, Figure 10.1). Photograph 3.1.2 shows the droppings that had aggregated below one of the two main soprano pipistrelle roosts within the nave over 3-4 weeks in July 2019. Photograph 3.1.3 shows a close-up view of one of the main soprano pipistrelle roosts used in the nave in 2019

Photograph 3.1.1: The location of most of the bat roosts within the nave of the church.



Photograph 3.1.2: Soprano pipistrelle droppings on a sheet below a roost in the nave.



Photograph 3.1.3: One of the main soprano pipistrelle roost features within the roof of the nave, above a span beam. The wear caused by the bats accessing and egressing their roost is apparent.



- 3.2.4 The 2017 bat report by Philip Parker Associates (and associated drawings P2017 – 28 D1A and P2017 – 28 D2) also described the soprano pipistrelles and Natterer's bats roosting in the above locations. The significant wear on the span beams is indicative of bats accessing and egressing these roosts over many years before 2017 as well.
- 3.2.5 The suite of nocturnal surveys undertaken in 2019 identified two features used by the soprano pipistrelles to access and egress the church, both of which comprise apertures in the stonework between the parapet wall of the clerestory and the tower. One of these features, which was used by approximately two thirds of the colony is located on the southern elevation of the church (feature 3a, Figure 10.1; photographs 3.1.4 and 3.1.5) and the other feature, which was used by approximately one third of the colony, is located on the northern elevation (feature 3b, Figure 10.1; photographs 3.1.6 and 3.1.7). Almost all of the soprano pipistrelles that were recorded exiting these two features in 2019 commuted in a general westerly direction once they had emerged, towards the woodland adjacent to the churchyard.

Photographs 3.1.4 and 3.1.5: The south-facing aperture in the external stonework (green arrow) where the clerestory meets the tower, which is used by approximately two thirds of the soprano pipistrelles to exit and return to the church. The bats that use this feature access and egress the church interior in the location shown by the green arrow in photograph 3.1.11.



Photographs 3.1.6 and 3.1.7: The north-facing aperture in the external stonework (blue arrow) where the clerestory meets the tower. This is used by approximately one third of the soprano pipistrelles that roost in the church. The bats that use this feature (feature 3b, Figure 10.1) access and egress the church interior in the location shown by the blue arrow in photograph 3.1.11.



- 3.2.6 The 2019 nocturnal surveys also identified three features used by the Natterer's bats to access and egress the church, all of which comprise apertures in the stonework below the eaves of the north aisle alongside protruding rafters. Two of these features (features 4a and 4b, Figure 10.1; photographs 3.1.8 and 3.1.9) are at the two opposing corners of the north aisle, and these were used by most of the Natterer's bat colony to access and egress the church. The third feature (feature 4c, Figure 10.1) is located approximately halfway along the north aisle eaves; this was used by only three Natterer's bats to exit the church on one survey.

Photograph 3.1.8: The Natterer’s bats (re)enter the church via three gaps at the eaves of the north aisle. The red arrow shows the external location of one of these features – feature 4a, Figure 10.1.



Photograph 3.1.9: The Natterer’s bats (re)enter the church via three gaps at the eaves of the north aisle. The red arrow shows the external location of one of these features - feature 4b, Figure 10.1.



Photograph 3.1.10: The Natterer’s bats (re)enter the church via gaps at the wall plate of the north aisle. The red arrow shows an internal view of one of the three features used (feature 4b, Figure 10.1), in the north-east corner.



3.2.7 Table 3.1 shows the peak counts from the 2019 nocturnal bat surveys of St John the Baptist Church.

Table 3.1: Peak bat counts recorded on the 2019 nocturnal bat surveys.

Date	Survey Type	Peak Count of Natterer's Bats	Peak Count of Soprano Pipistrelles
16 May	Dusk Emergence	c.15	173
26 May	Pre-Dawn Re-Entry	17	258
4 July	Dusk Emergence	19	193
9 August	Dusk Emergence	23	178

3.2.8 Bat activity inside the church on the 2019 nocturnal surveys initially comprised multiple soprano pipistrelles flying mainly within the western half of the clerestory after their emergence; then, once the majority of soprano pipistrelles had left the church, the Natterer's bats emerged to fly briefly around the clerestory, nave and north aisle before they also exited. The pre-dawn survey indicated that as sunrise approached the Natterer's bats (re)entered the church first, and the soprano pipistrelles (re)entered somewhat later. Upon (re)entering the church interior the two species then tended to fly within the same internal areas of the church as they did at dusk.

3.2.9 The church is surrounded by a small graveyard, which supports a large yew tree outside the south porch and a large floodlight in the south-east corner. It is likely that the yew tree provides important cover for the soprano pipistrelles as they egress and access the southern elevation of the church, particularly as the floodlight would otherwise shine directly on the feature used by the bats on this elevation. It is also likely that the Natterer's bats access and egress the church on its northern elevation because this is the darkest aspect.

3.2.10 In addition to the features that are known to be used by bats from surveys at the church, there are several other features that may be important to roosting and / or hibernating bats. Principally, these features comprise apertures, gaps, cavities and crevices in the following locations:

- Between rafters (principle and common) and between rafters and ceiling boards;
- On wall tops, below the wall plate;
- Among and between other structural roof timbers;
- Where the structural roof timbers abut internal walls; and,
- Within stonework, particularly below the eaves alongside protruding rafters.

3.2.11 In 2018, two bespoke bat boxes were installed within the roof timbers of the church nave as bat mitigation / compensation measures to accompany previous church renovations. These bat boxes are shown in Photograph 3.1.11. They were designed to a specification provided by Philip Parker Associates and located opposite the two main features used by the soprano pipistrelles to egress and access the church - see Photographs 3.1.4 to 3.1.7 above. There was no evidence that either of these boxes were used by bats during the 2019 bat surveys and they do not appear to have altered the behaviour of either bat colony that uses the church.

Photograph 3.1.11: The two bespoke bat boxes within the nave roof of the church are shown by the yellow boxes. The arrows show the two main locations where the soprano pipistrelles egress and access the church, on the southern elevation to the left and the northern elevation to the right.



4 Relevant Wildlife Legislation

4.1 Bats¹

4.1.1 Annex IV of the EC Habitats Directive (Council Directive 92/43/EEC 1992 on the conservation of natural habitats and of wild fauna and flora) lists animal and plant species of Community interest in need of strict protection across member states, which includes all bat species (and their habitats). The EC Habitats Directive is transposed into law in England and Wales via the Conservation of Habitats and Species Regulations 2017, which are usually referred to as the 'Habitats Regulations'. As a result of this legislation all UK bats are considered European Protected Species (EPS). In addition to EU regulations however, all bats and their habitats are also protected by UK law under the Wildlife and Countryside Act 1981 (as amended), which was reinforced in England and Wales by the Countryside and Rights of Way Act 2000.

4.1.2 In combination, the above legislation makes it an offence to:

- Deliberately capture, injure or kill a bat;
- Deliberately disturb any bat; in particular, any disturbance which is likely to (i) impair a bats' ability to survive, breed, reproduce or to rear or nurture their young; or in the case of hibernating or migratory species, to hibernate or migrate; or (ii) to affect significantly the local distribution or abundance of the species to which they belong;
- To be in possession or control of any live or dead bat or any part of, or anything derived from a bat;
- Damage or destroy a breeding site or resting place of a bat;
- Intentionally or recklessly obstruct access to any place that a bat uses for shelter or protection; and
- Intentionally or recklessly disturb a bat while it is occupying a structure or place that it uses for shelter or protection.

4.1.3 Note that *damaging or destroying* a place used by a bat for breeding or resting anywhere in the UK is an *absolute offence* carrying *strict liability* under the Habitats Regulations. This means that no element of intent, reckless, or deliberate action needs to be evidenced to establish guilt; the prosecution only needs to demonstrate that the accused performed the prohibited act.

4.1.4 Also note that the term 'roost' is not used in the above legislation, however a site that a bat uses for breeding, resting, shelter or protection is called a roost in ecological terms. Bats tend to re-use the same roost sites and sometimes over many years but may not always be in residence. Current legal opinion is that a roost is protected irrespective of whether the bats are present.

4.1.5 As a result of the above legislation, where work will result in any destruction, damage or obstruction of any bat roost, whether occupied or not, or risks harming or disturbing bats then an EPS derogation licence (often also called a development licence or a mitigation licence) is required from the Statutory Nature Conservation Body (e.g. Natural England) before such work can proceed.

¹ This legislation is understood to be applicable at the time of writing, prior to the UK's withdrawal from the European Union.

- 4.1.6 In determining whether to grant a licence for an activity affecting EPS Natural England must apply the requirements of Regulation 53 of the Habitats Regulations, and, in particular, apply the following three tests set out in sub-paragraphs (2)(e), (9)(a) and (9)(b):
1. Regulation 53(2)(e) states that: a licence can [only] be granted for the purposes of *“preserving public health or public safety or other imperative reasons of overriding public interest including those of a social or economic nature and beneficial consequences of primary importance for the environment”*;
 2. Regulation 53(9)(a) states that the appropriate authority (i.e. Natural England) shall not grant a licence unless they are satisfied *“that there is no satisfactory alternative”* to the proposed actions; and,
 3. Regulation 53(9)(b) states that the appropriate authority shall not grant a licence unless they are satisfied *“that the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range”*.
- 4.1.7 These three tests are commonly referred to as the ‘purpose test’, the ‘NSA test’ and the ‘FCS test’ respectively.

4.2 Nesting Birds

- 4.2.1 All species of bird are protected under Section 1 of the Wildlife and Countryside Act 1981 (as amended). This protection was extended by the Countryside & Rights of Way Act, 2000. This legislation makes it an offence to:
- Kill, injure or take any wild bird;
 - Take, damage or destroy the nest of any wild bird while that nest is in use or being built; and / or,
 - Take or destroy an egg of any wild bird.
- 4.2.2 In addition to the above, certain species of bird are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) and receive protection under Sections 1(4) and 1(5) of this Act. This protection was extended by the Countryside & Rights of Way Act, 2000. This legislation confers special penalties where the above offences are committed for any such bird and it also makes it an offence to intentionally or recklessly:
- Disturb any such bird, while building its nest or it is in or near a nest containing dependant young; and / or,
 - Disturb the dependant young of such a bird.

5 Evaluation

5.1 Bat Survey Effort and Expertise

- 5.1.1 The suite of bat surveys undertaken at St John the Baptist Church in 2019 was completed in accordance with current best practice guidance in respect of professional bat surveys and churches – see Collins (ed.) 2016 and the BiCCL Annex B ‘*Minimum Survey Standards for Site Registration*’. For further detail on this and the bat surveys undertaken at the church refer to B.A.T. Ecological report B.A.T.191102 (November, 2019).
- 5.1.2 This management plan has been authored by Matt Cook BSc (Hons) MSc MCIEEM, who also authored the 2019 B.A.T. Ecological bat survey report and led all of the 2019 field surveys of St John the Baptist Church. Matt is a BiCCL Registered Consultant (RC) with Natural England – licence reference B32RC004. He has been a professional ecologist for >11 years and has been licensed by Natural England to undertake bat surveys for >9 years. Matt was awarded Full Membership of the Chartered Institute of Ecology and Environmental Management (CIEEM) in 2013 and in 2014 Matt was licensed by Natural England to an advanced level to undertake professional bat surveys (Class licence levels 3 and 4, licence references 2015-10167-CLS-CLS and 2015-10176-CLS-CLS). In 2017 Matt also acquired the Bat Low Impact / Mitigation Class Licence (licence reference RC167). During his time as a professional bat ecologist Matt has led innumerable bat surveys. He has also been the Named Ecologist on 15 EPSM licenses issued by Natural England for development and renovation purposes affecting bat roosts, for different species and roost types and in various buildings and structures, including several with heritage listed status.
- 5.1.3 In a voluntary capacity Matt is a (Level 2) Volunteer Bat Roost Visitor Trainer on behalf of Natural England. He has led several Natural England licensed Science, Education and Conservation projects for local bat conservation groups, including the Nottinghamshire Barbastelle Project² and the National Nathusius’ Pipistrelle Project³, and he has trained many local bat group members in surveying for, identifying, and handling bats. Matt also supports, facilitates and undertakes bat conservation work in Romania.

5.2 Stakeholder Consultation

- 5.2.1 The following provides a timeline of formal consultations with the representatives of St John the Baptist Church within the scope of the BiC Project:

13 September 2017 – Within round one of the BiC Project Philip Parker of Philip Parker Associates met with the church’s representatives (led by Peter Rycroft, Church Warden) to undertake an initial Light Touch Survey (LTS). The BiC LTS requires a suitably experienced ecologist to collect physical and social information about the church; the names and roles of its representatives and architect; information about the bat species present and how bats use the church; the social and physical impacts caused by bats; and recommendations for solving the problems. This information was then collated and presented to the BiC Project team in a standardised LTS report form intended to help them construct their round two funding application to the HLF in 2018.

² <https://insideecology.com/2018/01/22/the-nottinghamshire-barbastelle-project/>

³ <https://www.bats.org.uk/our-work/national-bat-monitoring-programme/surveys/national-nathusius-pipistrelle-survey>

17 April 2019 – Within round two of the BiC Project Matt Cook of B.A.T. Ecological (also referred to as the Bat Ecologist or RC) met onsite with Rudy Ike and Peter Rycroft (the Church Wardens and its representatives) to gain an up-to-date understanding of: the bat impacts at St John the Baptist; the needs and requirements of the church in respect of these; to provide information about the project and the constraints around any solutions that can be offered; and to answer questions. During this meeting the LTS from 2017 was updated (to the 2019 LTS) to reflect any changes, and the scope, aims and programme of the 2019 bat surveys was discussed.

2 May 2019 – In addition to the April meeting, the Ecologist and Church Wardens also met with Rose Riddell (BiC Engagement Officer, Church of England). The purpose of this meeting was principally for the Engagement Officer to start building relationships with the church representatives, establish what progress has been made since the development stage, and assess how well the church community is engaging with the BiC project; however, it also presented an opportunity for the Bat Ecologist to meet with and discuss relevant matters with the Engagement Officer, and to progress the relationship with the Church Wardens. The BiC Conservation Officer (Rachel Arnold) was also invited to this meeting but could not attend.

1 October 2019 – Following the successful completion of the summer bat surveys of St John the Baptist Church a progress meeting between the church representatives and the Bat Ecologist was held onsite. The BiC Engagement Officer was also invited but was unable to attend. The proposed bat mitigation measures, and the next steps regarding these, were discussed and agreed at this meeting. Following this meeting the agreed bat mitigation proposals (bespoke bat compartments - see Section 6.6) were sent to the Church Architect (Mark Stewart) and the Diocesan Advisory Committee (DAC) for their comments including, in the case of the DAC, as to whether specific Faculty permissions would be required. The DAC (Reverend Rupert Allen) subsequently confirmed on 3 October 2019 that no specific Faculty permissions were required for the proposed bat mitigation measures. No comments were received from the Architect.

- 5.2.2 Records of the above can be provided by the BiC Project team and / or B.A.T. Ecological upon request.
- 5.2.3 In addition to the above formal consultations, informal discussions regarding the bat impacts and proposed mitigation have been ongoing (via email and onsite) between Matt Cook, and Rudy Ike and / or Peter Rycroft, from April 2019 to date. Matt Cook also contacted Philip Parker of Philip Parker Associates in June 2019 for any input based on his previous involvement at the church.

5.3 Overall Evaluation

- 5.3.1 Based on the above, it is considered that the level of bat survey effort and expertise, stakeholder consultation, and reference to relevant research (see below) involved at St John the Baptist Church provides a robust platform for the recommendations contained within this report. Every effort has been made to provide a comprehensive ecological appraisal and appropriate recommendations in the context of the commissioned scope of works and the overall aims of the BiC Project.
- 5.3.2 Notwithstanding the above however, it remains important to note that it is impossible to completely characterise or predict the natural environment as wild animals are inherently unpredictable, all habitats are subject to change, and species may colonise or vacate areas for a variety of reasons after surveys have taken place or mitigation has been implemented.

6 Consideration of Bat Management Options

- 6.1.1 The focus of the proposed mitigation for St John the Baptist Church is the largest bat colony that resides there: the c.250 adult female soprano pipistrelles. This maternity colony is responsible for the majority of the negative impacts on the church. These impacts comprise several sizeable accumulations of droppings below roosts, and urine splashed by the bats in flight, which mainly affects the nave and aisles.
- 6.1.2 Investigations at St John the Baptist Church to date have not revealed a significant impact on the church from the small maternity colony of Natterer's bats that resides there. The mitigation measures discussed hereafter will therefore aim not to have any significant effects on these animals. British populations of Natterer's bats are important in an international context (Stebbing, 1993). The colony at this church is small, however any unwarranted actions could still have serious consequences for the local population of this uncommon bat species, which relies extensively on churches and other old buildings for roost sites.
- 6.1.3 All of the bat management options considered hereafter propose to retain both of the bat maternity roosts within St John the Baptist Church. The principle reason for not excluding either bat colony from the church is because, based on the relevant research described below, the Favourable Conservation Status (FCS) of the local populations of the two bat species concerned could be adversely affected by such an action. In this scenario Regulation 53(9)(b) of the Habitats Regulations, 2017 (see above) states that the appropriate authority (Natural England) cannot grant a licence for any activity affecting bats (as EPS) unless they are satisfied "*that the action authorised will not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range*".
- 6.1.4 The relevant research referred to above principally comprises that conducted by Zeale *et al.* (2014 and 2016) and Stone *et al.* (2015) into the effects of excluding Natterer's bats and / or soprano pipistrelles from roosts. These studies found that, following exclusion, a soprano pipistrelle colony may be able to relocate to a new colony roost quickly and without an obvious short-term impact on behaviour or welfare, however, this was critically dependent on the availability of suitable alternative roost sites, which may be unknown. Population modelling also suggested that while a reduction in productivity following an exclusion would have less of an effect on a soprano pipistrelle colony than any reduction in survival rates, the latter could have a negative impact on population growth. The effect of exclusion on the FCS of soprano pipistrelles would therefore be uncertain without any research into its long-term impacts on both survival and productivity.
- 6.1.5 Zeale *et al.* (2014, 2016) also used population modelling to predict the impacts of exclusion on colonies of Natterer's bats when researching strategies to mitigate the impacts on churches from this species. This research concluded that exclusion is likely to have a negative impact on the welfare and FCS of Natterer's bats, principally because they may struggle to relocate to new roosts and establish new foraging areas quickly, which could then reduce productivity and affect survival, and so have a negative impact on population growth.
- 6.1.6 To date, there is only one known study to have examined the demographic consequence of roost exclusion on any bat species – the big brown bat *Eptesicus fuscus* in Canada. Brigham & Fenton (1986) showed that despite individuals of this species relocating to roosts nearby, mean litter size was significantly lower (56% reduction) following exclusion (0.86 ± 0.30 at control sites; 0.38 ± 0.30 following exclusion). All three studies above (Zeale *et al.*, 2014, 2016; Stone *et al.*, 2015) concluded that a change of similar magnitude could have profound consequences for both soprano pipistrelle and Natterer's bat populations in England.
- 6.1.7 In addition to the risks that exclusion would pose to the welfare and FCS of the two protected

bat species it unwarranted when other less harmful and potentially more effective options are currently available at St John the Baptist Church - see below. The church's representatives also have no desire to exclude the bats. Furthermore, exclusion would be against the spirit of the BiC Project and its principle aim "to transform support for church communities with nationally important historic churches with protected bat roosts to create a sustainable partnership that will safeguard a future for bats, historic places of worship and for the people who use them". In practical terms it is also very difficult to exclude bats from a large old church where there are many apertures that provide potential roost and roost access opportunities.

- 6.1.8 Based on the above, the following options (sections 6.2 to 6.6) were considered as potential solutions to mitigate and reduce the impacts from the bats (principally from the soprano pipistrelles) at St John the Baptist Church, while allowing the two bat maternity colonies that reside within the fabric of the church to continue to do so. These options have been considered within the context of the suite of bat surveys undertaken at the church in 2017 and 2019, ongoing stakeholder consultation, and relevant research.

6.2 Option 1: Do Nothing

- 6.2.1 Balancing the need to protect churches and bats - our cultural and our natural heritage - is very challenging. Conserving the bat colonies that occupy churches is important because the bats may not have any alternative suitable roost sites and the loss of an important roost could significantly harm bat populations that are already threatened. At the same time however, churches are often very important buildings historically and communally, and they can suffer significant negative effects from large colonies of bats. St John the Baptist Church comprises the primary community focus in Cold Overton as there is no village hall, pub, or shop. The upkeep of an old church is difficult, and the mess left by large colonies of bats places an added burden on those that use it.

- 6.2.2 The Executive Summary from the 2017 BiC SoS (Halsey, 2017) for St John the Baptist Church made the following statement regarding the impacts from bats on this building:

"The original wall paintings of the south aisle have suffered from damp and like other surfaces, have been affected by bats exercising and roosting in the building. The damage to walls, fittings and memorials of high significance is regrettable but not yet critical. Efforts should be made now to ensure it does not get worse".

- 6.2.3 In addition, the principal recommendation provided within the main text of that report (Halsey, 2017) is as follows:

"As the most significant and vulnerable item, the conservation and protection of the south aisle wall paintings is the highest heritage priority, but the reduction of damage to the medieval walls and surfaces is also an important, if longer term outcome".

- 6.2.4 More recently, within the 2019 BiC LTS, the church's representatives described themselves as being "generally positive about bats but negative about them being in the church". As such, their preferred solution and outcome for St John the Baptist Church from the BiC Project work is as follows:

"Firstly, to have the bats roosting on the outside of the church; or, secondly, by them being still able to roost in the church in a contained way. [We] are quite happy for the bats to stay in the church if the problems of the droppings and urine can be eliminated".

- 6.2.5 There is no evidence that the bespoke bat boxes already in place at St John the Baptist Church have been used by any bats to date - see paragraph 3.1.11 above. Based on this, the recommendations from the SoS (Halsey, 2017), the solutions and outcomes preferred by the church's representatives (BiC LTS, 2019), and the wider context and principle aim of the BiC

Project as described above, it is not appropriate to ‘do nothing’ at St John the Baptist Church in respect of the impacts from the bats. As such, this option was rejected at an early stage.

6.3 Option 2: Light Deterrents

- 6.3.1 All European bat species are nocturnal and adapted to low-light conditions, and the artificial lighting of areas where bats are active can affect their activities. Several studies undertaken prior to the research referred to above (e.g. Stone *et al.*, 2009, 2012) have already shown that the effects of lighting on bats and bat assemblages are often detrimental. There is no “light threshold” where adverse effects on bats from artificial light are negligible (Stone, 2013).
- 6.3.2 In several of the studies into mitigating the impacts from bats in churches, namely Zeale *et al.* (2014, 2016) and Packman *et al.* (2015), the responses of Natterer’s bats and soprano pipistrelles to artificial lighting was tested to determine whether light could be used to deter these animals from using sensitive areas of these buildings, without affecting their welfare, and therefore to help alleviate some of the issues caused by their droppings and urine.
- 6.3.3 These studies concluded that the directed use of artificial lighting to raise ambient light levels in churches is effective at excluding Natterer’s bats from large areas of a church. Importantly however, lights shone at their roost entrances causes Natterer’s bats to become entombed in these roosts potentially leading to their death. The studies showed that soprano pipistrelles may be less deterred by lights and may therefore habituate to this form of deterrence, however overall the research found that the sustained use of lights in churches could result in the death of large numbers of bats. It was therefore concluded that the unregulated use of lighting in churches could seriously harm bats, and as such it would be illegal without a licence.
- 6.3.4 Prior to the research by Zeale *et al.* (2014, 2016) and Packman *et al.* (2015) illumination around soprano pipistrelle roosts had already been proven to delay the nightly emergence time of these bats (Downs *et al.*, 2003), and such an effect had also been proven to cause bats to miss the limited peak abundance of their insect prey (Jones & Rydell, 1994).
- 6.3.5 Based on the above, the use of light deterrents at St John the Baptist Church is likely to pose a high risk to the welfare of the resident bats, particularly the Natterer’s bats, and as such it cannot reasonably be considered as a possible strategy to reduce the impacts from these animals. It is also likely that Natural England would reject any licence application that involved the use of light deterrents because they could not be satisfied that this “*would not be detrimental to the maintenance of the population of the species concerned at a favourable conservation status in their natural range*” – see section 4. The option of using light deterrents at St John the Baptist Church has therefore been rejected.
- 6.3.6 Following on from the above it is also important to note that if any bat mitigation measures are to be successful at St John the Baptist Church then light-spill onto all roost entrances should be negligible (<0.1 lux). As such, it is strongly recommended that the floodlight that is currently located in the south-east corner of the graveyard is moved (and cowls are installed if necessary) to ensure that it does not illuminate any areas of the southern or northern elevations of the church, which should be retained in darkness. This is imperative if the yew tree that currently provides important cover for the bats emerging from the southern elevation is to be pruned.

6.4 Option 3: Acoustic Deterrents

- 6.4.1 Research by Zeale *et al.* (2014, 2016) into mitigating the impacts of Natterer’s bats on churches concluded that “*acoustic deterrence has considerable value as a tool for moving bats humanely from specific locations inside churches to prevent accumulations of droppings and urine below roosts*”. The judicious use of high intensity ultrasound can therefore help mitigate

and reduce some of the problems caused by this bat species.

- 6.4.2 It is important to note however, that follow-on research by Packman *et al.* (2015) concerning soprano pipistrelles, which void most of the droppings and urine at St John the Baptist Church, showed that ultrasonic devices were not as effective at deterring and manipulating the church roosts of this species. This study found that while soprano pipistrelle roost locations in a church could be manipulated effectively by acoustic deterrents in the spring / early summer (pre-parturition) period, this species habituated to them in the longer-term and these devices were less effective in discouraging bats from certain areas during the mid-summer periods, when they were heavily pregnant (entering parturition) or when pups were volant. Essentially, acoustic deterrents lacked efficacy during the mid-summer period when soprano pipistrelle maternity roosts reach capacity and the depositions of droppings and urine are at their worst.
- 6.4.3 The research above has demonstrated that acoustic deterrents can be an effective way of moving bat roosting sites away from sensitive areas within churches at certain times of year, and that they may be useful for moving Natterer's bat roosts in particular. However, it is important to note that these devices are not intended (nor licensed by Natural England) to evict bats from churches entirely and therefore the droppings and urine associated with roosts are still likely to accumulate elsewhere inside the church. Similarly, irrespective of where the acoustic deterrents move the bat roost/s to within the church the bats will continue to fly within its interior if they did previously. This does not, therefore, help reduce the significant impacts from the urine and droppings voided by the bats in flight.
- 6.4.4 Based on the above, it is considered unlikely that acoustic deterrents would provide an effective method for reducing the impacts from the soprano pipistrelles at St John the Baptist Church. As such, this option has currently been rejected as a possible bat mitigation strategy for this church.

6.5 Option 4: Bat Boxes

- 6.5.1 The rate of occupancy of bat boxes can be affected by a number of variables, such as: microclimate within the box, including temperature fluctuations during the day and night; light levels; sources of disturbance; proximity to foraging habitat or other bat roosts, and some bat species are considered more likely to occupy bat boxes than others (e.g. Bartonicka & Rehak, 2007; Bat Conservation Trust, 2006; Flaquer *et al.*, 2006; Lourenço & Palmeirim, 2004; Poulton, 2006; Dodds & Bilston, 2013).
- 6.5.2 The studies referred to above by Zeale *et al.* (2014, 2016) and Packman *et al.* (2015), as well as further work by Packman (2016) and Ryan (2016), investigated the occupancy by Natterer's bats and soprano pipistrelles of bat boxes installed in and around churches. Zeale *et al.* (2014, 2016) found that no Natterer's bats or soprano pipistrelles were observed using the artificial roosts (including heated bat boxes) provided for them at several churches during their experimental periods, however some limited use was observed subsequently. Similarly, Ryan (2016) reported no occupancy by soprano pipistrelles of the bat boxes (including heated ones) installed at churches during this 12-month study period. Furthermore, the uptake of bat boxes provided for soprano pipistrelles at another BiC Project church with a maternity colony, where research for the project has been piloted, has also been slow: heated bat boxes were not used for several early years of monitoring (Stiles and Shepherd, 2013), and only individual bats occupied unheated boxes in the first year of monitoring them (Packman, 2016).
- 6.5.3 Zeale *et al.* (2016) provided the following rationale for the lack of bat box occupancy during this research: *"If multiple roosts already exist in churches, and these roosts have been used historically by bats, new bat box installations are unlikely to be used preferentially. Indeed, it may take years rather than days before boxes are used to any great extent, as has been shown for soprano pipistrelles in Norway [Michaelson, 2011], and so the benefits of bat boxes in*

short-term mitigation strategies may be limited”

- 6.5.4 Similarly, Ryan (2016) stated that *“provisioned heated (internal) and non-heated (external) bat boxes largely provided suitable thermal conditions for [soprano pipistrelle] roosts, though the non-heated (external) bat box did not provide the same amelioration of outside temperature conditions (i.e. at night) that church buildings as a whole provide. The small scale, short-term pilot study using heated and non-heated bat boxes demonstrates that although good roosting conditions can be provided using artificial bat boxes, they are not a guaranteed solution or a ‘quick fix’, as boxes were not occupied by bats within a 12 month monitored period”*.
- 6.5.5 Based on the above, and a general consensus that bats are often slow to occupy bat boxes, it is considered that a bat mitigation strategy focused upon their installation and usage at St John the Baptist Church would be too speculative and susceptible to failure, certainly in the short-term, and as such this option has been rejected as the principle strategy to alleviate the impacts of the bats at this church.
- 6.5.6 Despite their unsuitability as the principle mitigation strategy for St John the Baptist Church bat boxes will be installed at the church in addition to the bat compartments to provide long-term bat roosting and hibernating habitat. Soprano pipistrelles are known to occupy various ‘standard’ bat box designs if the boxes are appropriately sited in a favourable habitat, sometimes to breed or hibernate, and there is no recorded negative effect of installing bat boxes at churches. Section 8 provides the recommendations for the church in respect of bat boxes. Ryan (2016) recommends that where summer colonies of soprano pipistrelles are present in churches, and these will be affected by work, bat box provisions should include hibernation boxes (usually in church towers) as well as boxes suitable for breeding bats.

6.6 Option 5: Boxing In (Bat Compartments)

- 6.6.1 The final bat management option considered for St John the Baptist Church comprised the installation of bespoke roost spaces – bat compartments – which allow the bats to continue to roost within the fabric of the building, but don’t allow them to access and fly within the church interior. Often referred to as ‘boxing in’, this strategy usually involves designing and installing the bespoke compartments at the main bat entry points to the church, so that bats entering the building emerge into an enclosed area that is sealed off from the interior. The preferred designs of the compartments incorporate the existing roof timbers of the church and are therefore discreet, and are also appropriately sized, aerated, and located for the resident bats to occupy.
- 6.6.2 Several of the studies referred to previously have demonstrated or proposed the efficacy of the ‘boxing in’ approach in reducing the impacts of soprano pipistrelles and Natterer’s bats inside churches. Packman *et al.* (2015, 2016), for example, found that ‘boxing-in’ roosting areas around bats’ entry points into a church provided a promising solution whereby roosting spaces were retained while the bats were prevented from accessing the rest of the church interior, and therefore the deposition of droppings and urine inside was reduced.
- 6.6.3 Similarly, Zeale *et al.* (2016) recorded the frequent use of a bespoke bat compartment that resulted in fewer Natterer’s bats roosting within a church, and therefore a considerable associated reduction in the extents of deposited droppings and urine. Indeed Zeale *et al.* (2016) concluded that *“encompassing major access points into a church within bespoke boxes fitted internally within churches is likely to prove more useful [than installing bat boxes], as bats entering churches will enter the boxes directly. This approach will be useful in allowing bats to continue to roost within the fabric of the building while preventing access to the internal spaces, where conflict between bats and humans is typically most acute”*.
- 6.6.4 A further advantage of this approach is that the bespoke bat boxes already in-situ at St John

the Baptist Church (see paragraph 3.1.11 above) can be adapted to create two ‘boxed-in’ compartments that are potentially suitable for the resident soprano pipistrelle colony to occupy. Importantly, the soprano pipistrelles will also be familiar with these two spaces as they have been located immediately opposite the features that the bats use to exit and access the church since early 2019. It is also anticipated that the compartment on the southern elevation can incorporate the span beam where most of the soprano pipistrelles roost.

6.6.5 In addition to the above, it is anticipated that the ‘boxing-in’ of the soprano pipistrelle roosts would not have any adverse impact on the resident Natterer’s bats, which roost elsewhere in the nave and use alternative access and egress features.

6.6.6 Based on the above rationales, it is proposed that the ‘boxing-in’ option is that which is most likely to be successful and cost-effective in reducing the impacts from the bats inside St John the Baptist Church while maintaining the FCS of both the resident bat species.

6.7 The Preferred Bat Mitigation Strategy: Boxing-In (Bat Compartments)

6.7.1 The bat mitigation strategy selected for St John the Baptist Church will provide two bespoke bat compartments for the breeding soprano pipistrelles, in locations within the fabric of the church that these animals are already familiar with. The two main access / egress features used by the soprano pipistrelles already (see Appendix Figure 10.1) will be incorporated into these compartments, which will be created by extending the two bespoke boxes already in-situ. The compartments will be suitably designed and constructed to support >300 soprano pipistrelles. These bats will not be able to access the church interior from the compartments.

6.7.2 Photographs 6.7.1 and 6.7.2 provide a visual representation of how and where the two bespoke bat compartments will be installed. The yellow shapes represent the existing bespoke bat boxes as they were installed at the church in early 2019, opposite the main soprano pipistrelle access and egress features on the northern and southern elevations, and the green shapes represent the locations of the two bespoke bat compartments that will be created by extending the original boxes.

Photograph 6.7.1: The proposed location for the bespoke bat compartment to be created for the soprano pipistrelles within the southern elevation of the nave roof is shown by the green box. The location of the access / egress feature used by the soprano pipistrelles is shown by the green arrow.



Photograph 6.7.2: The proposed location for the bespoke bat compartment to be created for the soprano pipistrelles within the northern elevation of the nave roof is shown by the blue box. The location of the access / egress feature used by the soprano pipistrelles is shown by the blue arrow.



- 6.7.3 The locations of the bat compartments to be created at St John the Baptist Church are shown in Appendix Figure 10.1. They will predominantly be constructed from aged oak panels designed to be inconspicuous within the context of the church roof. The panels at the lowest point on the underside of each compartment will be removable to allow the accumulated droppings to be cleared out. Where the compartments straddle the rafters two or three holes of 30mm diameter will be drilled through each rafter to allow the movement of bats and air.

7 Bat Management Objectives

7.1 Objectives

7.1.1 The overall aim of the management plan and bat mitigation strategy for St John the Baptist Church is to reduce the negative impacts from the resident bats while maintaining the FCS of both the soprano pipistrelle and Natterer's bat maternity colonies.

7.1.2 Based on the information that has been gathered at St John the Baptist Church there are three key bat management objectives for 2020 to 2023 within the scope of the BiC Project; these are provided below. The success (or otherwise) of this bat management plan can be measured against these objectives.

Objective 1

7.1.3 To carefully provide a range of long-term, suitable artificial alternative roosts for the bats at the church – both bespoke compartments and generic bat boxes - and monitor their occupancy.

Objective 2

7.1.4 To reduce the usage of the church interior by the soprano pipistrelle maternity colony to a level that is acceptable to the church users, including diminishing the depositions of droppings and urine on important wall paintings, fittings and memorials.

Objective 3

7.1.5 To monitor and maintain the status of the soprano pipistrelle and Natterer's bat roosts within the church, and thereby ensure that the FCS of the local populations of these two species is also maintained.

7.2 Achieving the Objectives

Objective 1

7.2.1 To achieve Objective 1 Underwood and Weston Ltd. (<https://underwoodandweston.co.uk/>) of Northampton will manufacture and install the bespoke bat compartments at St John the Baptist Church as they are specified in section 6.7 above. Underwood and Weston are the specialist contractors who installed the original bespoke boxes and who renovated the tower stonework in 2018/19.

7.2.2 The bat compartments will be installed in February or March 2020 - prior to the breeding bats returning to the church - under the direct guidance of the BiCCL RC. Due to the nature and necessary timing of the work there is a low risk that low numbers of bats could be disturbed, potentially including some hibernating individuals. In the event that bats are uncovered at any time during the licensed work, the work will cease until an assessment can be made by the RC as to the best course of action. As a precaution, a local bat carer will be on standby throughout the work on the church roofs in case of unexpected discoveries of bats. Any bat that is uncovered during the work will be taken into care and fed and watered as required, until a suitably mild night when it can safely be returned to the site.

7.2.3 In February or March 2020, the contracted Ecologist will also purchase and install four bat boxes at the church to provide longer-term roosting habitat as recommended in section 6.5 above.

7.2.4 More information on the actions and expenditure required to achieve Objective 1 are provided in section 8 below.

Objective 2

- 7.2.5 The proposed bat compartments comprise the principle strategy intended to achieve Objective 2. The simultaneous aims of these ‘boxed-in’ compartments are to provide suitable roosting habitat for the soprano pipistrelles, while preventing the majority of these bats from accessing and flying inside the church. This thereby reduces the negative impacts from their deposited droppings and urine.
- 7.2.6 The success or otherwise of the proposed bat mitigation strategy in meeting Objective 2 will be formally evaluated in consultation with the regular church users at the end of each summer from 2020 to 2023, for example by annually revisiting and updating the 2019 LTS findings.
- 7.2.7 More information on the actions and expenditure required to achieve Objective 2 are provided in section 8 below.

Objective 3

- 7.2.8 In the first instance, monitoring is required during the early stages of implementing the bat management plan at St John the Baptist Church to ensure that no bats are harmed, and to inform any remedial actions if the risks to bat welfare are higher than anticipated. In such a scenario, if monitoring confirms that the colonies of Natterer’s bats and soprano pipistrelles have not responded as predicted to the proposed activities, and risks to the bats have increased, an adaptive management plan will need to be devised and agreed with Natural England as a matter of urgency.
- 7.2.9 Beyond this, monitoring is also critical at St John the Baptist Church to allow a comprehensive appraisal of the success or otherwise of the proposed bat mitigation strategy, and to establish whether the FCS of the local populations of soprano pipistrelles and Natterer’s bats are being maintained. Establishing this is imperative because the law that usually protects the bats and their roosts has been derogated on this basis – see paragraph 4.1.6 above.
- 7.2.10 To achieve Objective 3 the proposed bat mitigation measures must ensure that the primary ecological function of St John the Baptist Church for the local populations of soprano pipistrelles and Natterer’s bats is maintained. The current primary ecological function of the church for both species is to provide suitable conditions for maternity roosts of adult female bats (c.250 soprano pipistrelles and c.20 Natterer’s bats) and their young.
- 7.2.11 The adult female bats begin to congregate at St John the Baptist Church in noticeable numbers in May, after the hibernation and spring flux periods, presumably because the church is warm, sizeable and sheltered enough to allow them to give birth mid-summer and to rear their pups largely undisturbed. Once the juvenile bats are weaned and volant most of the soprano pipistrelles then disperse from the church through August and September. It is likely that low numbers of soprano pipistrelles and Natterer’s bats roost in some areas of the church in the autumn and / or spring, and also hibernate in it during the colder winter months. Individual male soprano pipistrelles may also occasionally occupy mating roosts within the church.
- 7.2.12 The actions that are prescribed to accompany the above objectives at St John the Baptist Church are provided in Section 8 along with the associated costs. The following criteria will be used to evaluate whether Objective 3 has been achieved:
- An initial favourable outcome will comprise the usage of the bespoke bat compartments by soprano pipistrelles in 2020.
 - Beyond this, the bat compartments will be considered a success if 200 or more adult female soprano pipistrelles occupy them during the pre-partum period (i.e. before the end of June) in any single summer from 2020 to 2023. This figure allows for a c.20% reduction in the number of soprano pipistrelles using the church since 2019. In this scenario it would be reasonable to assume that the reduction in the colony size was due to natural changes such as bats not surviving the winter months and / or using alternative maternity roosts (e.g. see Zeale *et al.*, 2014 and Stone *et al.*, 2015).

- Following on, a sub-optimal but still acceptable outcome would comprise c.150 soprano pipistrelles using the bat compartments during the pre-partum period in any summer from 2020 to 2023. This would comprise a c.40% reduction in the number of soprano pipistrelles using the church since 2019, however, based on recent research (Zeale *et al.*, 2014 and Stone *et al.*, 2015) it would be reasonable to assume that the overall FCS of the local population was still being maintained because the bats from the church colony were occupying alternative nearby roosts.
- Beyond the above, the proposed mitigation would be considered largely unsuccessful if c.100 or fewer adult female soprano pipistrelles occupied the bat compartments during the pre-partum period in any summer from 2020 to 2023. This would comprise a c.60% reduction in the number of soprano pipistrelles using the church since 2019. In such a scenario it would be important to establish whether most of the colony had moved to an alternative nearby maternity roost, to determine whether the FCS of the local soprano pipistrelle population had been maintained despite the apparent failure of the proposed bat management plan for the church.
- It is not anticipated that the proposed bat mitigation strategy will have any adverse effects on the small Natterer's bat colony that occupies the church, however this will be monitored from 2020 to 2023 as a precaution.
- Importantly, success will also be measured in terms of harm to, or the death of, individual bats during the intended work, and in this regard the proposed mitigation may be considered unsuccessful if such events occur.

8 Prescribed Actions and Costings

8.1 2020

Bespoke Bat Compartments – February / March 2020

- 8.1.1 Estimated costings have been provided by Underwood and Weston Ltd. of Northampton for the manufacture and installation of the bespoke bat compartments at St John the Baptist Church.
- 8.1.2 In addition, it is recommended by all parties that a 25% contingency fund be set aside in case of unexpected costs during the manufacturing and fitting of the bespoke bat compartments, or for any remediation required at a later point.

Bat Boxes – February / March 2020

- 8.1.3 Costs for purchasing the bat boxes that will provide compensatory roost habitat on the site are based on prices shown online (<https://www.nhbs.com/>) for four woodcrete boxes including one colony box and one hibernation box. This durable material and the designs chosen are typically suitable for the two bat species that reside within St John the Baptist Church.
- 8.1.4 Note that the availability of woodcrete boxes can vary and so an alternative manufacturer and designs may be used, which may result in different costs. Similarly, it may be decided in consultation with the church's representatives that a standalone wooden 'bat house' is a more appropriate design for the site than two of the 'hanging' woodcrete boxes, and as such costs may also vary in this regard.

BiCCL Registered Consultant Fees – February / March 2020

- 8.1.5 In order to ensure that the bespoke bat compartments are manufactured and installed to the correct specification and according to the terms of the BiCCL, the RC will attend site during the key phases of this work. The RC will also check the bat compartments are fit-for-purpose following their completion and install the additional purchased bat boxes.
- 8.1.6 It is estimated that the RC will be required onsite for up to five days in February / March 2020, prior to the commencement of the formal monitoring in the Spring.

Bat Monitoring Costs – April to September 2020

- 8.1.7 The bat monitoring at St John the Baptist Church is critical to allow a comprehensive appraisal of the success or otherwise of the proposed bat mitigation strategy, to ensure that the welfare of bats is not at risk, and to establish whether the FCS of the local populations of soprano pipistrelles and Natterer's bats are being maintained including for licensing purposes.
- 8.1.8 Following the installation of the above bat roost habitat the BiCCL RC will attend site in April to inspect it and ensure that it remains fit-for-purpose, before female bats begin to gather in numbers ahead of the main parturition period.
- 8.1.9 On the same April site visit the RC will also lead an early-season emergence survey (in suitable weather for bat activity) to identify any potential issues with the new bat roost habitat and to establish if there is any early-season occupancy.
- 8.1.10 From May to August 2020, when bats are typically more active and their numbers are most likely to peak at St John the Baptist Church, the monitoring effort should reflect the detailed survey effort undertaken in 2019, which comprised that required as a minimum standard to register the church for a BiCCL. It is anticipated that the comprehensive survey effort and findings from 2019 will then provide an important baseline against which the initial success or otherwise of the prescribed bat mitigation strategy can be measured.
- 8.1.11 The monitoring effort required at St John the Baptist Church from May to August 2020 will therefore

consist of four nocturnal bat activity surveys of the whole building as follows, to be conducted in suitable conditions for bat activity:

- One dusk emergence and one pre-dawn re-entry survey within the pre-parturition period (i.e. mid-May to mid-June);
- One dusk emergence survey in the parturition period (i.e. mid-June to mid-July); and,
- One dusk emergence survey in the post-parturition period (i.e. mid-July to mid-August).

Contingencies – 2020-22

- 8.1.12 It is important to have a contingency fund available for St John the Baptist Church in the event that remedial actions are required because the proposed bat mitigation measures present an unanticipated risk to the welfare of the bats. In such a scenario the RC (or an authorised agent) will need to attend site, and an adaptive management plan will need to be devised and agreed with Natural England as a matter of urgency. Both the RC and Natural England will then need to be satisfied that the impacts to the affected bats can be returned to the predicted range.
- 8.1.13 As a minimum it is therefore recommended that contingency funds are allocated to St John the Baptist Church to allow for up to five days 'emergency' attendance onsite by the RC, one additional nocturnal survey, and a day for reporting and correspondence.
- 8.1.14 In addition to the above it is recommended that funds are also available for radio-tracking a small number of bats at the church if this is required, for example to locate alternative roosts if either of the resident bat species abandon the church due to the proposed changes to their habitats. Fees for 60 hours of fieldwork (two people, excluding expenses) have been provided below (to catch, radio-tag and radio-track bats, and then monitor any new roosts) along with the estimated cost of eight radio-tags.

Church Cleaning – October / November 2020

- 8.1.15 Upon completion of the fieldwork at St John the Baptist Church, and in anticipation that the measures recommended in this report are successful in reducing the mess from the bats inside the building going forward, it is recommended that funds are provided to the church for a 'professional deep-clean' of the mess previously left by the bats. These funds will be managed by the church.
- 8.1.16 In addition to the above, funds should also be provided to the church in 2020 for scaffold tower hire to enable the bat compartments to be emptied of droppings. Ideally this would be done in partnership with volunteers from Leicestershire and Rutland Bat Group.

BiCCL Registered Consultant Reporting – December 2020

- 8.1.17 Once the bat mitigation work at St John the Baptist Church has been completed a progress report will be provided by B.A.T. Ecological to Natural England and the church in late 2020. This report will comprise pertinent information on the work completed at the church in 2020 including, for example; information on works completed to date; summary results of bat surveys and monitoring; an appraisal of the success or otherwise of the prescribed bat mitigation measures; and any recommendations for 2021 onwards.
- 8.1.18 In addition to the above, the BiCCL annual report for St John the Baptist Church will also be completed and submitted by the RC to Natural England in December 2020.

8.2 Proposed Costings - 2020

- 8.2.1 The costs below are estimated to implement and monitor the bat mitigation strategy at St John the Baptist Church in 2020 as described above. Prior approval will be sought from Natural England where any contingency funds may be required. Unless otherwise stated all costs stated exclude VAT where this is applicable.

Bespoke Bat Compartments – February / March 2020

- 8.2.2 The costs in Table 8.2.1 have been provided by Underwood and Weston Ltd. for the manufacture and installation of the bespoke bat compartments at St John the Baptist Church in 2020, which includes a 25% contingency fund.

Table 8.2.1: Costs to manufacture and fit bespoke bat compartments at St John the Baptist Church.

Bespoke Bat Compartments - February / March 2020		
<u>Item</u>	<u>Description</u>	<u>Cost</u>
1	Labour to Manufacture and Fit	£960
2	Materials	£250
3	Scaffold Access	£400
	<u>Total without contingency</u>	<u>£1,610</u>
	<u>Total with contingency</u>	<u>£2,012.50</u>

Bat Boxes – February / March 2020

- 8.2.3 The prices provided in Table 8.2.2 have been taken from <https://www.nhbs.com/> and include VAT. Note that costs for the bat boxes at St John the Baptist Church may vary as described above.

Table 8.2.2: Costs of the bat boxes for St John the Baptist Church in 2020.

Bat Boxes – February / March 2020				
<u>Item</u>	<u>Box Manufacturer and Design</u>	<u>Price Per Unit</u>	<u>No. Required</u>	<u>Total Cost</u>
1	Schwegler 1FF or 3FF	£80	2	£160
2	Schwegler 1FW Hibernation Box	£255	1	£255
3	Schwegler 1FS Large Colony Box	£115	1	£115
4	Delivery			£15
			<u>Total (incl. VAT)</u>	<u>£545</u>

BiCCL Registered Consultant Fees and Bat Monitoring Costs – 2020

- 8.2.4 The proposed costs for bat consultancy and monitoring at St John the Baptist Church in 2020 are provided in Table 8.2.3. These are based on the rates and fees provided by B.A.T. Ecological Ltd. to Natural England when tendering for phase 1 of the work at this church (*Activity 1 – Full suite of 4 nocturnal surveys*) and include travel expenses.

Table 8.2.3: BiCCL RC fees and bat monitoring costs for St John the Baptist Church in 2020.

BiCCL RC Fees and Bat Monitoring Costs - 2020			
<u>Item</u>	<u>Description</u>	<u>Timescale</u>	<u>Fees</u>
1	BiC RC attendance onsite x 5 days	February / March 2020	£1,953
2	Daytime inspection	April 2020	£241
3	Early-season emergence survey	April 2020	£1,115
4	Nocturnal bat surveys x 4	May to August 2020	£5,850
5	<i>Monitoring Contingency Fund</i>	<i>TBC</i>	<i>£3,775</i>

6	<i>Radio-Tracking Contingency Fund</i>	<i>TBC</i>	<i>£3,900</i>
7	BiCCL RC reporting	December 2020	£1,800
		<u>Total without contingencies:</u>	<u>£10,959</u>
		<u>Total with contingencies:</u>	<u>£18,634</u>

Church Cleaning – October / November 2020

- 8.2.5 The costs of cleaning the church and emptying the new bat compartments as described above are provided in Table 8.2.4.

Table 8.2.4: Costs for cleaning the church and emptying the bat compartments at St John the Baptist Church in 2020.

Church Cleaning – October / November 2020		
<u>Item</u>	<u>Description</u>	<u>Costs</u>
1	Professional ‘deep clean’	£600
2	Scaffold tower hire	£400
	<u>Total</u>	<u>£1,000</u>

Total Costs - 2020

- 8.2.6 Table 8.2.5 provides a summary of all the estimated costs and timescales for the bat mitigation work proposed at St John the Baptist Church in 2020 as described above.

Table 8.2.5: Summary of the estimated costs for the bat mitigation work at St John the Baptist Church in 2020.

<u>Item</u>	<u>Description</u>	<u>Cost</u>
1	Bespoke Bat Compartments - February / March 2020	£1,610
2	<i>Contingency</i>	<i>£402.50</i>
3	Bat Boxes - February / March 2020	£540
4	BiCCL RC Fees & Bat Monitoring Costs - February to December 2020	£10,959
5	<i>Contingencies</i>	<i>£7,675</i>
6	Church Cleaning - October / November 2020	£1,000
	<u>Grand Total without contingencies</u>	<u>£14,109</u>
	<u>Grand Total with contingencies</u>	<u>£22,186.50</u>

8.3 2021 to 2023

- 8.3.1 The costs at St John the Baptist Church from 2021 to 2023 principally comprise those for monitoring and reporting the conservation status of the resident bats following the implementation of the prescribed mitigation measures, and the annual maintenance of the bespoke bat compartments.
- 8.3.2 The annual bat monitoring at the church from 2021 to 2023 will be based on the minimum level of monitoring effort required to comply with the BiCCL survey standards for site registration (BiC ITT Annex 2). This comprises two bat activity surveys of the whole building: one in the pre-maternity period (i.e. mid-May to mid-June) and one in the post-maternity period (i.e. mid-July to mid-August). The fees for these two monitoring surveys are based on the rates and fees provided by B.A.T. Ecological to Natural England when tendering for the initial work at this church (*Annual BiCCL surveys - 2 x activity surveys of the whole building in the pre and post maternity periods – 2021 to 2023*) and

include travel expenses.

- 8.3.3 In addition to the above an inspection of the bespoke bat compartments and bat boxes will be completed each Spring by the BiCCL RC to ensure that they remain fit-for-purpose ahead of the summer period of bat activity. Following this period, the bat compartments will then be emptied of droppings each autumn by the church volunteers and the local bat conservation group. A scaffold tower will be required for each visit.
- 8.3.4 Following the above, the initial report provided in 2020 by B.A.T. Ecological will be updated each December to include the results of the annual monitoring, and the annual BiCCL report will also be sent to Natural England at this time.
- 8.3.5 It is not anticipated that any further funds will be required beyond those described above. However, as a precaution it is recommended that any unused contingency funds from 2020 (see above) be ring-fenced for St John the Baptist Church until at least 2022 in case of unforeseen circumstances.

Table 8.3.1: Estimated costs for the annual bat roost monitoring and maintenance at St John the Baptist Church from 2021 to 2023.

Annual Bat Roost Monitoring and Maintenance Costs – 2021 to 2023			
<u>Item</u>	<u>Description</u>	<u>Timescale</u>	<u>Cost</u>
1	<i>Annual 'fit-for-purpose' inspection of bat compartments and boxes</i>	<i>March / April</i>	<i>£600 (incl. scaffold tower hire and expenses)</i>
2	Bat monitoring (two bat activity surveys)	May to August	£2,225 (incl. expenses)
3	<i>Emptying of bespoke bat compartments</i>	<i>October / November</i>	<i>£300 (incl. scaffold tower hire and volunteer travel expenses)</i>
4	<i>BiCCL RC reporting</i>	<i>December</i>	<i>£1,440 (incl. expenses)</i>
		<u>Total annual costs:</u>	<u>£4,565</u>

- 8.3.6 Finally, from 2021 members of the local bat conservation group will be encouraged to assist with the monitoring at the church with a view to them continuing this voluntarily beyond 2023 in cooperation with the church wardens.

9 References

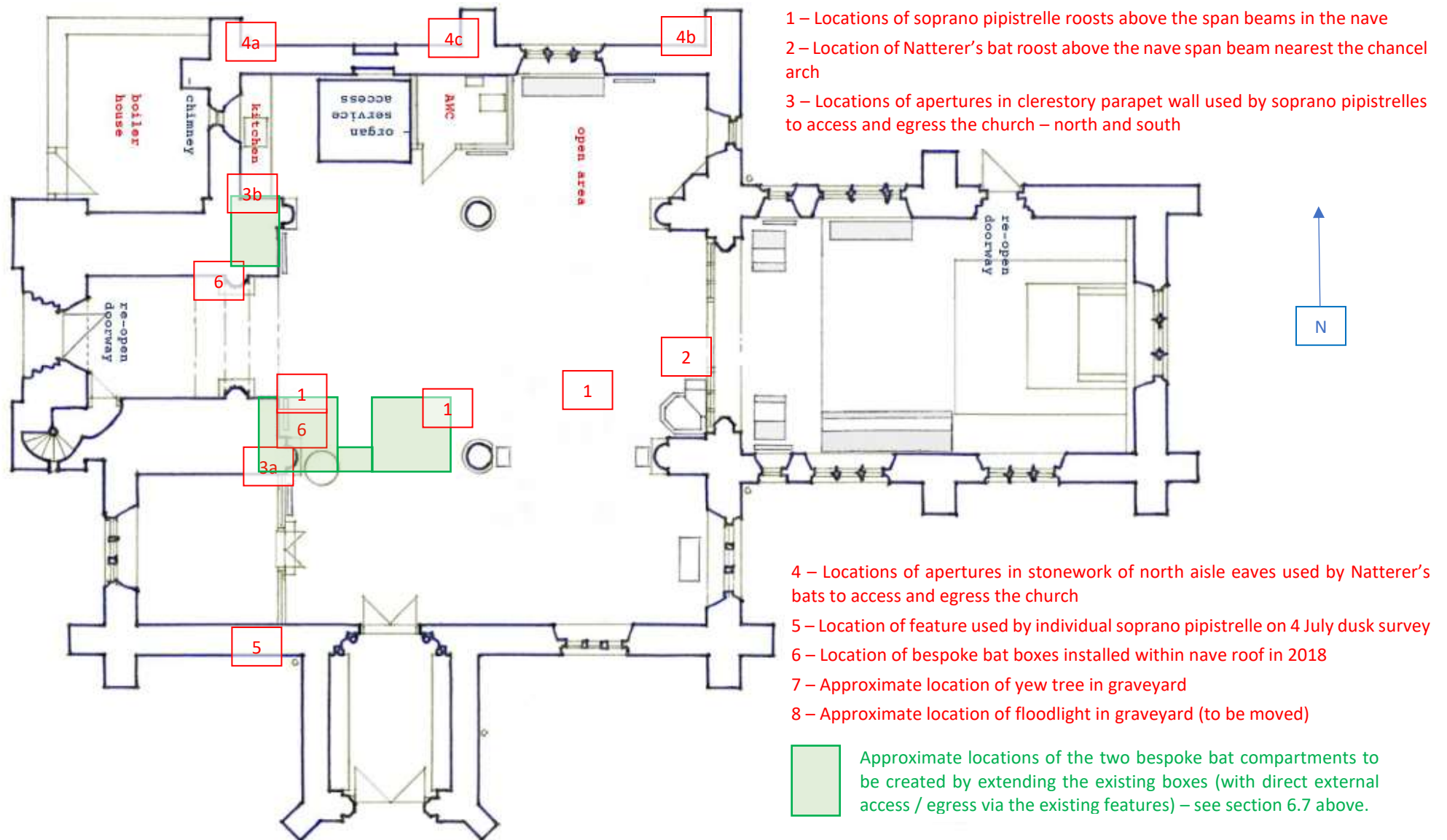
- Bartonička, T. and Řehák, Z. (2007) *Influence of the microclimate of bat boxes on their occupation by the soprano pipistrelle *Pipistrellus pygmaeus*: possible cause of roost switching*. *Acta Chiropterologica* 9: 517-526.
- Bat Conservation Trust (2006). *A review of the success of bat boxes in houses*. Scottish Natural Heritage Commissioned Report No. 160 (ROAME No. F01AC310).
- Collins, J. (ed.) (2016) *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition)*. The Bat Conservation Trust, London.
- Dodds, M. & Bilston, H. (2013) A comparison of different bat box types by bat occupancy in deciduous woodland, Buckinghamshire, UK. *Conservation Evidence* (2013) 10, 24-28.
- Downs, N.C., Beaton, V., Guest, J., Polanski, J., Robinson, S.L. & Racey, P.A. (2003) *The effects of illuminating the roost entrance on the emergence behaviour of *Pipistrellus pygmaeus**. *Biological Conservation*, 111, 247-252.
- Flaquer, C., Torre, I. and Ruiz-Jarillo, R. (2006) *The value of bat boxes in the conservation of *Pipistrellus pygmaeus* in wetland rice paddies*. *Biological Conservation* 128: 223-230.
- Jones, G. & Rydell, J. (1994) *Foraging strategy and predation risk as factors influencing emergence time in echolocating bats*. *Philosophical Transactions: Biological Sciences*, 346, 445-455.
- Lourenço SI and Palmeirim JM. (2004) *Influence of temperature in roost selection by *Pipistrellus pygmaeus* (Chiroptera): relevance for the design of bat boxes*. *Biological Conservation* 119: 237-243.
- Michaelson, T. C. (2011) *BCI bat houses pay off in Norway*. *Bats*. 2011; 29: 9–11.
- Packman, C.E., Zeale, M., Harris, S. and Jones, G. (2015) *Management of Bats in Churches – a pilot*. English Heritage Research Project: 6199.
- Packman (2016) *Wild Frontier Ecology – St Nicholas Church, Stanford on Avon, Northamptonshire – Bats in Churches Class Licence Trial*. Wild Frontier Ecology, Norfolk.
- Poulton, S.M.C. (2006) *An analysis of the usage of bat boxes in England, Wales and Ireland*. Ledbury. The Vincent Wildlife Trust.
- Ryan, M.S. (2016) *Bats, churches and landscape: ecology of soprano pipistrelle bats in eastern England: A dissertation submitted to the University of Bristol in accordance with the requirements for award of the degree of PhD in the Faculty of Science*.
- Stebbing RE. (1993) *The Greywell Tunnel: an internationally important haven for bats*. English Nature. Peterborough.
- Stiles, K. and Shepherd, P. (2013) *St Nicholas Church, Stanford on Avon, Northamptonshire: Bats and Historic Churches 5532 Phase 2 Report*. Derbyshire, UK: BSG Ecology.
- Stone, E.L., Jones, G., Harris, S. (2009). *Street lighting disturbs commuting bats*. *Curr Biol*. 2009; 19: 1123–1127.
- Stone, E.L., Jones, G. & Harris, S. (2012) *Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats*. *Global Change Biology*.
- Stone, E.L. (2013) *Bats and lighting: Overview of current evidence and mitigation guidance*. University of Bristol.
- Stone, E., Zeale, M.R.K., Newson, S.E., Browne, W.J., Harris, S. and Jones, G. (2015) *Managing Conflict between Bats and Humans: the response of soprano pipistrelles (*Pipistrellus pygmaeus*) to exclusion from roosts in houses*. *PLoS One* 10(8).

Zeale, M.R., Stone, E., Bennitt, E., Newson, S., Parker, S., Haysom, K., Browne, W.J., Harris, S. and Jones, G. (2014) *Improving mitigation success where bats occupy houses and historic buildings, particularly churches*. Defra Research Project WM0322 Final Report.

Zeale, M.R.K., Bennitt, E., Newson, S.E., Packman, C.E., Browne, W.J., Harris, S., Jones, G. and Stone, E. (2016) *Mitigating the Impact of Bats in Historic Churches: the response of Natterer's bats *Myotis nattereri* to artificial roosts and deterrence*. PLoS ONE 11(1): e0146782.

10 Appendix

10.1 Figure 10.1: Bat Activity and Proposed Mitigation for St John the Baptist Church



END OF REPORT



B.A.T. Ecological Ltd. | www.bat-ecological.co.uk | info@bat-ecological.co.uk | +44 (0) 7870 15702