Melksham Oak School Link

Ecological Impact Assessment Report

Final

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1 INTRODUCTION

1.1 BACKGROUND

Johns Associates Ltd was commissioned by Sustrans in March 2022 to undertake a Preliminary Ecological Appraisal of the land between Melksham Oak School and the housing development to the north (Preliminary Ecological Appraisal Report, Johns Associates, April 2022). In June 2022, the client instructed Johns Associates to undertake further Phase 2 surveys in relation to protected species and to produce an Ecological Impact Assessment.

This EcIA was compiled by Myles Sedgwick BSc (Hons) QCIEEM, Consultant Ecologist at Johns Associates and who has four years' experience in ecological consultancy.

1.2 SUMMARY OF PROPOSALS

The proposals include the creation of a shared-use path linking Melksham Oak School to the new housing development located to the north. The pathway will be constructed from a non-permeable, all-weather surface, and will be 3m in width with a 2m buffer and 5m head clearance. Associated lighting will be required for the safety of users, particularly at night.

1.3 PURPOSE OF THIS ASSESSMENT

This Ecological Impact Assessment report presents the current ecological baseline at the Site and informs a complete assessment of the potential effects of the proposed scheme on those ecological features (including legally protected species) associated with the Site, as defined by the information set out in this report.

It provides a description of elements of the ecological baseline, presents a scope of the assessment, defines integrated and embedded ecological mitigation and enhancement measures before considering the potential effects of the proposed development, and makes further recommendations for further monitoring and management measures.

1.4 ABOUT THIS ECOLOGICAL IMPACT ASSESSMENT

The EcIA assessment methodology used has been adapted from the Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2019). EcIA is a process of identifying, quantifying, and evaluating potential effects of development-related or other proposed actions on habitats, species and ecosystems. The findings of this EcIA will inform Wiltshire Council of the ecological issues when determining the planning application for the site.

A key consideration in scoping and subsequently assessing the impacts of any development is to define the habitats and species that need to be considered. The approach set out below follows the standard guidance published by CIEEM and is widely considered to be current best practice.

Ecological features (habitats, species and ecosystems) present within the site and its zone of influence are scoped through the desk study and field survey process and their ecological importance determined with reference to a geographical context. In identifying these 'features' or receptors, it is important to recognise that a development can affect habitats and species directly (e.g. the land-take required) and indirectly, (e.g. through noise generation or lighting).

The key elements of the assessment process are as follows:

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- Identifying and characterising impacts which may be beneficial (positive) or adverse (negative);
- Incorporating measures to avoid and/or mitigate these impacts;
- Assessment of the significance of any residual effects after mitigation has been applied;
- Where there are significant residual effects, identification of appropriate compensation measures to offset these; and
- Identifying opportunities for ecological enhancement.

A key principle of EcIA is to identify those impacts that are ecologically significant. A significant effect is an effect that is sufficiently important to require assessment and reporting so that the decision maker is adequately informed of the ecological consequences of permitting such a project (CIEEM, 2019).

Importantly, the design process has been iterative, drawing on ecological information from data search results and field surveys undertaken by Johns Associates in 2021 and 2022, (with further surveys to be completed in 2022/ 2023) and making use of best practice design principals to ensure that avoidance, mitigation, compensation and enhancement measures have been formally incorporated into the final design taken forward for the planning submission.

The key elements of this EcIA report are:

- Section 1: Introduction – Overview of the proposals, the Site and purpose of report.
- Section 2: Legislation, Planning Policy & Technical Guidance.
- Section 3: Data Gathering Methodology - Consultation undertaken to ensure the most effective input to defining the initial scope of the assessment; Zones of Influence; proposed surveys and methods for survey, evaluation and assessment provided.
- Section 4: Baseline Ecological Conditions – Desk study and field survey results and describing the ecological conditions.
- Section 5: Scope of the Assessment – Approach to identifying receptors, potential receptors, and significant effects.
- Section 6: Environmental Measures Integrated and Embedded into the Proposals.
- Section 7: Ecological Impact Assessment – An assessment of whether ecological features will be subject to impacts and characterisation of these impacts and their effects. Assessment of the significance of the residual effects following implementation of embedded mitigation.
- Section 8: Cumulative Effects – An assessment of cumulative impacts and effects including multiple activities and projects creating an additive effect; associated or connected development activity within the Site and consented or unconsented proposals within the agreed Zone of Influence.
- Section 9: Implementation of Biodiversity measures and Monitoring – Provision of mechanisms to evaluate and monitor impacts and their effects and evaluate implemented mitigation, compensation, and enhancement measures.
- Section 10: Conclusion of Significance Evaluation.

1.5 SITE LOCATION AND CONTEXT

The proposed shared-use path (hereafter referred to as 'the Site'), is located on the eastern fringes of Melksham and Bowerhill, Wiltshire, and is a current public right of way between the A365 through fields to a new housing development to the north. The surrounding land includes Melksham Oak School playing fields, residential gardens and open council-owned green space.

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The wider area to the north, east and south is urban, with the centre of the town of Melksham.

A plan showing the location and context of the Site is provided as Figure 1.

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Figure 1: Site Location



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2 LEGISLATION AND PLANNING POLICY

2.1 LEGISLATIVE CONTEXT

Many species of animal and plant receive some degree of legal protection. For the purposes of this report, legal protection refers to: species included on Annex II of the Habitats Directive 1992 (Council of European Communitites, 22/07/1992), Schedules 2 and 5 of the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (UK Government, 2019) and Schedules 1, 5 and 8 of the Wildlife and Countryside Act 1981 (as amended) (UK Government, 1981), excluding species that are only protected in relation to their sale (see Section 9[5] and 13[2]) reflecting the fact that the proposed development does not include any proposals relating to the sale of species.

Legal offences associated with species listed on Schedule 2 of the Conservation of Habitats and Species Regulations and Schedule 5 of the Wildlife and Countryside Act in England and Wales include *inter alia*:

- Deliberate capture, injury or killing of animals or taking or destroying their eggs;
- Deliberately disturb animals in a way that would significantly affect their local distribution or abundance, or affect their ability to survive, breed or rear young;
- Intentional or reckless disturbance of an animal in its place of shelter or protection;
- Damaging or destroying a resting place or breeding site;
- Intentionally or recklessly obstructing access to a place of shelter or protection; and
- Possess, control, transport, sell, exchange or offer for sale/exchange any live or dead animal or any part of an animal.

Relevant species listed on these Schedules that are potentially associated with this Site include bats. All bat species receive full protection from all legal offences listed above.

All species of wild bird are protected under the Wildlife and Countryside Act (1981) (as amended) from killing or injury. In addition, it is an offence to take or damage/destroy their eggs and to damage or destroy a nest whilst it is in use. Species listed on Schedule 1 (such as barn owl) receive additional protection in that it is illegal to disturb birds or their young whilst occupying, or near to, an active nest.

Badgers *Meles meles* are protected under the Protection of Badgers Act 1992 (UK Government, 1992), which makes it an offence to wilfully kill, injure or take (or attempt to kill, injure or take) a badger; or to disturb badgers whilst occupying their setts.

A number of wild plants, habitats and animals (including reptiles, hedgehog and most species of bat) are also included within Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006 (UK Government, 2006) which lists flora, fauna and habitats considered by the Secretary of State to be of principal importance for conserving biodiversity. The publication of the "England Biodiversity List" satisfies the requirements of Section 41 of the NERC Act 2006 for the conservation of biodiversity. Section 40 of the NERC Act 2006 requires public bodies, including local planning authorities, to have regard for the conservation of biodiversity in England, when carrying out their normal functions.

Relevant habitats listed within Section 41 that are potentially associated with the development proposals include hedgerows (although the habitat areas present on Site would not fall under the formal classification of BAP Priority Habitat or S41 Habitat of Principal Importance, these habitats are still considered to be of ecological importance and should be retained and protected as part of the development of the Site).

The Environment Act 2021 includes a provision for Biodiversity Net Gain, whereby developments must deliver at least 10% net gain from Autumn 2023 (although some local planning authorities already have policies in place which require delivery of net gain, or at least no are able to demonstrate net loss).

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2.2 POLICY CONTEXT

National

There are numerous national and local planning policies associated with flora and fauna (also referred to as biodiversity) that need to be addressed as part of the planning process. The Government has issued its National Planning Policy Framework (NPPF) 2021, which requires impacts to biodiversity to be minimised. Paragraph 181 of the NPPF applies the same protection to Ramsar sites as that conferred by the Habitats Regulations to SACs and SPAs. The NPPF requires development to apply the following principles (Paragraphs 179-180):

- Minimise impacts on and provide net gains for biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressure;
- Identify and pursue opportunities for securing measurable net gains for biodiversity;
- Ensure that there will be no adverse impacts to SSSIs (such development would not normally be permitted);
- Ensure that there will be no loss or deterioration of irreplaceable habitats (such as ancient woodland and ancient or veteran trees), unless there are wholly exceptional reasons and a suitable compensation strategy exists; and
- Where significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts) adequate mitigation, or as a last resort compensation, must be provided.
- The NPPF and associated Planning Practice Guidance also emphasise the requirement for ecological networks and wildlife corridors to be created throughout the wider landscape (paragraph 179).

Planning authorities should follow key principles to ensure that the potential impacts of planning decisions on biodiversity conservation are considered. Circular 06/05: Biodiversity and Geological Conservation provides guidance on the application of the law relating to planning and nature conservation and complements the NPPF.

Local – Wiltshire Council

As well as national policy, there is relevant biodiversity policy contained within Wiltshire Core Strategy adopted in January 2015. Core Policy 50 is relevant to the proposed application and is summarised below.

Core Policy 50 Biodiversity and Geodiversity

Protection

Development proposals must demonstrate how they protect features of nature conservation and geological value as part of the design rationale. There is an expectation that such features shall be retained, buffered, and managed favourably in order to maintain their ecological value, connectivity and functionality in the long-term. Where it has been demonstrated that such features cannot be retained, removal or damage shall only be acceptable in circumstances where the anticipated ecological impacts have been mitigated as far as possible and appropriate compensatory measures can be secured to ensure no net loss of the local biodiversity resource and secure the integrity of local ecological networks and provision of ecosystem services.

All development proposals shall incorporate appropriate measures to avoid and reduce disturbance of sensitive wildlife species and habitats throughout the lifetime of the development.

Any development potentially affecting a Natura 2000 site must provide avoidance measures in accordance with the strategic plans or guidance set out in paragraphs 6.75-6.77 above where possible, otherwise bespoke measures must be provided to demonstrate that the proposals would have no adverse effect upon the Natura 2000 network. Any

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development that would have an adverse effect on the integrity of a European nature conservation site will not be in accordance with the Core Strategy.

Biodiversity enhancement

All development should seek opportunities to enhance biodiversity. Major development in particular must include measures to deliver biodiversity gains through opportunities to restore, enhance and create valuable habitats, ecological networks and ecosystem services. Such enhancement measures will contribute to the objectives and targets of the Biodiversity Action Plan (BAP) or River Basin/Catchment Management Plan, particularly through landscape scale projects, and be relevant to the local landscape character.

Local sites

Sustainable development will avoid direct and indirect impacts upon local sites through sensitive site location and layout, and by maintaining sufficient buffers and ecological connectivity with the wider environment. Damage or disturbance to local sites will generally be unacceptable, other than in exceptional circumstances where it has been demonstrated that such impacts:

i. cannot reasonably be avoided

ii. are reduced as far as possible

iii. are outweighed by other planning considerations in the public interest

iv. where appropriate compensation measures can be secured through planning

v. obligations or agreements.

Development proposals affecting local sites must make a reasonable contribution to their favourable management in the long-term

Local Biodiversity Action Plans

The "England Biodiversity List" satisfies the requirements of Section 41 of the NERC Act 2006 and includes those habitat and species considered to be of Principal Importance for the conservation of biodiversity in England and Wales. This list replaces the UK BAP Priority Habitats and Species.

However, many local authorities/counties still maintain a Local Biodiversity Action Plan (LBAP) document which includes those habitats and species considered to be a priority within the local area in terms of their biodiversity importance.

The Wiltshire Biodiversity Action Plan produced in 2008 has a separate action plan for the 15 species of bats found in the county. The county is a stronghold for bats, and they utilise a wide range of habitats. Existing roosts, hibernation sites and key flight lines are protected, and more potential hibernation and roost sites should be created.

2.3 TECHNICAL GUIDANCE

There are a number of technical guidance documents that have been used to define the adopted approach to undertaking EcIA. These include methods for characterising the ecological baseline and the appropriate interpretation of data, as well as the specific approach to be adopted for the EcIA. The technical guidance of relevance to this EcIA is listed in Table 2.1.

The Natural Environment White Paper 'The Natural Choice: Securing the Value of Nature' outlines the Government's approach and vision for nature in the UK including protecting and improving our natural environment, growing a green economy and reconnecting people and nature.

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Biodiversity 2020: A strategy for England's wildlife and ecosystem services, are the country level strategies for England and builds on the Natural Environment White Paper. It sets out the strategic direction for biodiversity policy for the next decade on land (including rivers and lakes) and at sea. The proprieties for action include a more integrated large-scale approach to conservation, putting people at the heart of biodiversity policy, reducing environmental pressure and improving knowledge.

A Green Future: Our 25 Year Plan to Improve the Environment (2018) is the UK Government's 25-year plan for the environment and frames its goals and targets around the primary goods and benefits provided by a healthy environment. It is underpinned by the natural capital approach and seeks to embed a 'net environmental gain' principle into development.

Table 2.1: Technical guidance adopted for assessing the impacts on Biodiversity

Guidance reference	Usage
Bat Conservation Trust: Bat Surveys for Professional Ecologists	Provides standard good practice guidelines for conducting bat surveys including ecological considerations, timings, preliminary roost assessments, emergence and re-entry surveys, bat activity, licensing, data analysis and interpretation and reporting.
British Standards Institute (BSI): BS 42020:2013 Biodiversity – Code of practice for planning and development	Provides recommendations on topics such as professional practice, proportionality, pre-application discussions, ecological surveys, adequacy of ecological information, reporting and monitoring.
Chartered Institute of Ecology and Environmental Management (CIEEM): Guidelines for Ecological Impact Assessment in the UK and Ireland – Terrestrial, Freshwater, Coastal and Marine	Provides technical guidance for assessing the potential ecological impacts of a development. EcIA is a process of identifying, quantifying and evaluating potential effects of development- related or other proposed actions on habitats, species and ecosystems. EcIA can be used for the appraisal of projects of any scale including the ecological component of EIA. When undertaken as part of an EIA, EcIA is subject to the relevant EIA Regulations. Includes guidance on scoping; establishing the baseline; identifying important ecological features; assessing potential impacts; incorporating measures to avoid, reduce and compensate ecological impacts and the provision of ecological enhancements. Guidance on the consideration of the legal and policy framework throughout the EcIA process is also included.
UK Government	Provides standing advice on assessing impacts on a range of protected species, including bats, great crested newts (GCN), badgers, otters, water voles, dormouse, reptiles, wild birds, protected plants, invertebrates and ancient woodland. Includes guidance on survey effort, methods, assessing impacts and mitigation. Incorporates current Natural England (NE) guidance.

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3 DATA GATHERING METHODOLOGY

3.1 ZONE OF INFLUENCE AND FEATURES OF INTEREST

The proposed development comprises the creation of a shared-use path linking Melksham Oak School to a new housing development to the north. The pathway will be constructed from a non-permeable, all-weather surface, 3m in width with a 2m buffer and 5m head clearance. Associated lighting is required.

Figure 1 shows the proposed route of the shared path.

Detailed knowledge regarding the biodiversity associated with the proposed development Site has been informed through an extended Phase 1 Habitat survey conducted in February 2022, followed by pond eDNA survey for great crested newt, bat automated detector surveys, bat activity surveys, reptile surveys, badger survey, otter and water vole surveys, hedgerow regulations assessment and biodiversity net gain assessment, all conducted by Johns Associates from June – October 2022.

This baseline information has been used to unform the study area associated with the multiple ecological receptors under consideration, which include:

- The habitats and plants and associated fauna within the planning application boundary as shown in **Error! Reference source not found.**;
- Adjacent land where accessible/observed from its boundary and/or interpreted using imagery provided by Google Maps; and
- Consideration of potential effects on designated sites and their features of interest, with an examination of statutorily designated sites extending to 2km from the proposed development site. This allows consideration of potential effects beyond the Site boundary, particularly in relation to mobile species such as bats.

Data from the desk study and field surveys were used to determine the current ecological baseline for the Site in terms of the priority habitats and species, legally protected and notable species and statutory and non-statutory designated sites located within the likely Zone of Influence (ZoI) of the proposals. In line with current CIEEM guidance, these are the sites, habitats and species that are of sufficient importance that effects upon them could be deemed significant (see **Error! Reference source not found.** and **Error! Reference source not found.**).

The data has been used to enable a full assessment of the likely impacts of the proposed activities on habitats and species of conservation interest both on Site, in immediately adjacent areas and within the wider local area.

Box 3.1: Designated Biodiversity Sites

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Statutory biodiversity sites

Internationally important sites (collectively referred to in this EcIA as European sites – whilst recognising that Ramsar sites are designated at a global level):

- SACs
- Candidate SACs
- SPAs
- Listed or proposed Ramsar sites, potential SPAs, possible/ proposed SACs; and
- Sites identified or required as compensatory measures for adverse effects on other European sites.

Nationally important sites:

- SSSIs; and
- National Nature Reserves (NNRs).

Locally important sites:

Local Nature Reserves (LNR): Statutory sites that are of importance for recreation and education as well as biodiversity. Their level of importance is defined by their other statutory or any non-statutory designations (e.g. if an LNR is also an SSSI but is not a European site, it will be of national importance). If an LNR has no other statutory or non-statutory designation it should be treated as being of borough/district-level importance for biodiversity (although it may be of greater socio-economic value).

Non-statutory nature conservation sites

- Sites of county importance: non statutory nature conservation sites in Eastleigh are called Sites of Importance for Nature Conservation (SINCs).

Priority Habitats and Species

In this EcIA (and following the CIEEM guidance), the geographic level at which a species/habitat has been identified as a priority for biodiversity conservation is referred to as its level of 'species/habitat importance'. For example, habitats and species of principal importance for the conservation of biological diversity in England are identified as of national species or habitat importance reflecting the fact that the importance of these species or habitats has been defined at a national level. The level of importance pertains to the species or habitat as a whole rather than to individual areas of habitat or species populations, which cannot be objectively valued (other than for waterfowl, for which thresholds have been defined for national or international 'population' importance).

- International importance: populations of species or areas of habitat for which European sites are designated
- International importance: populations of birds meeting the threshold for European importance (1% of the relevant international population)[1]
- National importance: priority habitats and species of principal importance (HPI and SPI) for the conservation of biological diversity in England[1]
- National importance: species listed as being of conservation concern in the relevant UK Red Data Book (RDB) or the Birds of Conservation Concern (BoCC) Red List

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- National importance: Nationally Rare and Nationally Scarce species, which are species recorded from, 1-15 and 16-100 hectads (10x10km squares of the national grid) respectively
- National importance: populations of birds comprising at least 1% of the relevant British breeding/wintering population (where data are available); and
- Borough/district importance: habitats and species listed in the Borough or District Biodiversity Action Plan (BAP).

Notes to Box 3.1:

- SACs are designated under Article 4(4) of Directive 92/43/EEC
- Candidate SACs are designated under Article 4.1 of Directive 92/43/EEC
- SCIs are sites that have been nominated or submitted by Member States and entered onto the list of sites compiled by the European Commission that form (along with SACs and SPAs) the Natura 2000 network. SCIs are subject to the provisions of Article 6(2) of Directive 92/43/EEC. SCIs are afforded full protection by law under the Conservation of Habitats and Species Regulations 2017 (regulation 8(1)(b)) as amended.
- SPAs are classified pursuant to the requirements of Directive2009/147/EC (Article 4). As European Sites, they are provided with full protection by law under the Conservation of Habitats and Species Regulations 2017 as amended.
- Government policy in England (see paragraph 176 of the NPPF) protects Ramsar sites, potential SPAs and possible SACs as if they were fully classified SPAs or a fully designated SACs.
- Government policy in England (see paragraph 176 of the NPPF) is that any such compensatory land or water must itself be protected as if it were a fully classified SPA or a fully designated SAC.
- Some SSSIs also wholly or partially fall within a European Site boundary
- The JNCC prepared guidelines to assist in the selection of SPAs (The Birds Directive: Selection guidelines for Special Protection Areas). Stage 1 of the two-stage process identifies those areas used regularly by 1% or more of the Great Britain (or in Northern Ireland, the all-Ireland) population of a species listed in Annex I of the Birds Directive in any season. The JNCC undertakes reviews of the SPA network and populations of its qualification species at roughly decadal intervals with the last (third) review published in 2016.
- Habitats and Species of Principle Importance (HPI and SPI).
- Natural England (2018). UK BAP priority species and habitats, [online]. Available at: http://naturalengland.org.uk/ourwork/conservation/biodiversity/protectandmanage/prioritylist.aspx

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Box 3.2: Legally protected and controlled species

Legal Protection

Many species of animal and plant receive some degree of legal protection. For the purposes of this document, legal protection refers to:

- Species included in Schedules 1, 5 and 8 of the WCA (as amended), excluding:
  - Species that are only protected in relation to their sale (see Section 9(5) and 13(2) of the WCA 1981), given that the Proposed Development does not include any proposals relating to the sale of species; and
  - Species that are listed in Schedule 1 of the WCA 1981 that are likely to breed on or near the site (given that this schedule is only applicable whilst birds are breeding).
- Species included in Schedules 2 and 5 of the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019
- Badgers, which are protected under the Protection of Badgers Act 1992; and
- Hedgerows, some of which are protected under The Hedgerows Regulations 1997.

Legal Control

Schedule 9 of the WCA 1981 lists species of animal that it is an offence to release or allow to escape into the wild and species of plant that it is an offence to plant or otherwise cause to grow in the wild.

3.2 DESK STUDY

An ecological desk study collating all relevant open-source information and records held by the Wiltshire and Swindon Biological Records Centre (WSBRC) relating to the Site and its surrounding area was undertaken by Johns Associates Ltd in March 2022. The data was used to inform the scope of the initial Site survey and an assessment of the likely effects of the development proposals on legally protected and/or notable species that may be present at the Site. The following sources of information were used:

- Multi Agency Geographic Information for the Countryside (MAGIC) website. The locations of national and international statutory designated sites and granted Natural England European Protected Species mitigation licences to a radius of 2km of the Site (5km for bats) were reviewed in March 2022
- Records of legally protected and/or notable species and non-statutory designated sites provided by WSBRC
- Google Maps (www.maps.google.com) for ecological context

Results of the Desk Study are reported in the Preliminary Ecological Appraisal (Johns Associates, April 2022), which is provided as Appendix A to this EcIA.

3.3 FIELD SURVEYS

Habitats

Full methodologies and results of the habitat survey undertaken at the Site are presented in the Preliminary Ecological Appraisal Report contained in Appendix A to this Ecological Impact Assessment.

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An extended Phase 1 Habitat survey of the Site was undertaken on 17 February 2022 by Charlotte Mason BSc (Hons), from Johns Associates Ltd. The weather was sunny and dry with good visibility. This survey was completed in accordance with Guidelines for Preliminary Ecological Appraisal (CIEEM, 2017) and BS42020:2013 Biodiversity -Code of practice for planning and development (British Standards Institute, 2013) and the results later classified following UK Habitat Classification (UKHab) (2020) guidelines[1], which provides a more detailed interpretation of baseline habitat survey data than previous habitat classifications systems, such as Phase 1 Habitat Assessments.

Following the initial extended Phase 1 Habitat Survey, the following Phase 2 surveys were completed between June and October 2022.

Great Crested Newt eDNA Pond Survey

Two ponds within 200m of the Site were sampled for great crested newt (GCN) eDNA on 29th June 2022. The plan in Appendix B provides the locations of the ponds and the pond numbers. A third pond and a number of ditches were located within 200m; however these were found to be dry during the survey and therefore water samples could not be taken. It is considered unlikely that these waterbodies support breeding GCN owing to their inability to hold water during the breeding season.

Water was sampled from each of the ponds following standard guidance outlined in the Freshwater Habitats Trust Technical advice note for field and laboratory sampling of great crested newt environmental DNA, 2014. Twenty water samples were taken from the entire perimeter of each pond margin where access was possible. The water was mixed for ten seconds in a plastic sterile Whirl-Pak bag. 15 ml of the water was then put into six conical tubes with a preservative and shaken for ten seconds to mix. The water samples were then sent to SureScreen Scientifics to be analysed.

Automated Static Detector Surveys

The site was assessed as presenting moderate suitability for bats (Bat Conservation Trust, 2016) and as such, automated detector surveys were required to ensure suitable survey effort could be demonstrated throughout the active season following current industry guidelines. Three Elekon BatLogger C high sensitivity omnidirectional automated ultrasonic detectors were deployed to obtain a sufficient volume of data for each location. These units were selected as they are extremely durable and reliable whilst displaying best in class sensitivity.

The automated detectors were configured to record for a maximum of 15 seconds after being triggered and would cease to record in the absence of no further trigger events within 1.5 seconds. Pre-trigger and post trigger settings were designed to capture approach and exit phases of bat calls. The "SD" trigger was used to reduce the potential for a large volume of insects to be recorded and thus preserve battery life and reduce the volume of noise files without compromising the detectability and recording of bat calls. This filter algorithm measures the periodicity of the waveform as it is received so that only sinusoidal waveforms (i.e. calls with an even periodicity such as those created using vocal chords) are recorded. The period trigger parameters were those recommended by Elekon as a suitable compromise between low frequency sensitivity and increased insect noise recordings.

The static detector locations are shown in Appendix C.

Bat Activity Surveys

Activity surveys were designed to comply with current industry guidelines (Bat Conservation Trust, 2016 and www.gov.uk). Five surveys were undertaken during the period June – October 2022, as the habitats on Site were assessed as having low-moderate suitability for commuting/foraging bats following the criteria detailed in Bat Survey Guidelines for Professional Ecologists: Good Practice Guidelines (Bat Conservation Trust, 2016).

[1] UK Habitat Classification (UKHab) (2020) guidelines

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An appropriate transect route was determined in order to sufficiently survey the different habitats and areas identified as having suitability for bat foraging and commuting which are likely to be impacted by the proposed development. During transect survey(s), an appropriately qualified ecologist walked at a constant speed along the planned route stopping at 14 locations for 7 minutes. All bat calls were recorded using an Elekon Batlogger M ultrasonic bat detector which provides high definition and GPS referenced recordings in combination with direct observations i.e. number of bats, flight direction and behaviour (e.g. commuting or foraging). All echolocation calls were recorded and subsequently analysed to species, if possible. Table 4.5 in Section 4.2.4 sets out transect details, and Appendix D displays the transect route.

Reptile Presence/Absence Surveys

The habitats on-Site were assessed as having low suitability to support common reptile species, but due to surrounding habitats offering more suitability it was concluded that presence/absence surveys should be conducted.

A suitably experienced ecologist from Johns Associates Ltd undertook reptile surveys on seven occasions in suitable conditions during September and early October 2022, in line with guidance from www.gov.uk, Natural England (Natural England, 2015) and Froglife (1999).

A total of 30 artificial refugia comprising 0.5m x 0.5m and 1m x 0.5m squares of roofing felt were laid out within suitable areas in the north of the Site, as the other areas were shaded most of the day by trees/hedgerows. Refugia were deployed at least one week before the survey visits commenced.

On each survey visit all artificial refugia were checked for the presence of basking reptiles. Natural refugia (such as debris, logs and rocks) and potential basking areas (such as bare ground) were included in each survey. Where possible the surveys were conducted between 08:00 and 11:00 hours or between 16:00 and 19:00 hours, and/or during suitable weather conditions throughout the day, i.e. cloudy with sunny breaks and temperatures between 9 – 20°C, when the refugia were warmer than the surrounding habitat. Weather conditions during each survey are outlined in Table 4.8 in Section 4.2.5 and the plan in Appendix E shows the locations of deployed refugia.

Badger Survey

A badger survey of land within the Site boundary and in immediately adjacent areas (where access was permitted) was undertaken on 26 July 2022. This survey involved a search for characteristic signs of badger activity including the presence of setts, latrines/dung pits, paths, fence push-ups, hairs caught on fences, vegetation or in spoil heaps, paw prints and feeding signs. A plan of the findings can be seen in Appendix E.

Badger setts are classified following an assessment of their status (i.e. as main, annex, subsidiary or outlier) and the level of activity at the sett recorded, as defined below (Harris, Cresswell & Jefferies, 1989). Potential signs of badger recorded during the survey were mapped and photographed.

- Main Setts – These are in continuous use; they are large, well-established, often extensive and may have large spoil heaps outside the entrances. There are likely to be well-worn paths leading to the sett. It is where cubs are most likely to be born. There is only one main sett per social group of badgers.
- Annex Setts – These occur in close association with the main sett (usually within 150 m), and are linked to the main sett by clear, well-used paths. Annex setts consist of several holes, but they are not necessarily in use all the time, even if the main sett is very active. If a second litter of cubs are born, this may be where they are reared.

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- Subsidiary Setts – These usually comprise five holes or more but are not in continuous use and are usually some distance from the main sett (50m or more). There is no obvious path connecting them to the main sett and their 'ownership' or clan can often only be determined by bait-marking.
- Outlier Setts – These consist of only one or two entrance holes. They can be found anywhere within the territory and usually have small spoil heaps, indicating that they are not very extensive underground. There are no obvious paths connecting them to other setts, they are only used sporadically and often used by foxes or rabbits when not occupied by badgers.

The size, status and level of activity of potential setts was assessed by counting the number of entrance holes. The degree of use of potential entrance holes was classified as follows:

- Well-used Holes – These are clear of any debris or vegetation and are obviously in regular use. There may be evidence of recent excavation or fresh footprints.
- Partially-used Holes – These are not in regular use and have debris such as twigs or leaves in the entrance and moss or other plants growing in or around the entrance. A minimal amount of clearance would be necessary for badgers to continue using the hole.
- Disused Holes – These are holes which have not been in use for some time and would require a considerable amount of clearance before they could be used. A very long-disused hole may be just a depression in the ground and the remains of a spoil heaps.

Otter and Water Vole Survey

A single survey of the main watercourses and ditches was undertaken on 26th July 2022 recording any evidence of otter and/ or water vole (if present). Weather conditions were dry, clear and sunny, during a warm spell. The ditches running parallel to the Site along with one of the three ponds was dry during the survey, however habitats were closely examined up to at least 2 metres from the bank top (and beyond for otter) with the following signs observed and recorded:

- Water vole – faeces; latrines; feeding stations; burrows; footprints; runs or pathways.
- Otters – dung (spraints); tracks (footprints); feeding remains; otter slides (into water); holts (underground dens); and couches (above ground sites where otters rest during the day).

Hedgerow Assessment

A Hedgerow Regulations Assessment survey was completed on the 26 July 2022 by Myles Sedgwick BSc (Hons) and was completed in accordance with the requirements set out Hedgerow Regulations 1997 (UK Government, 1997).

The survey identified notable woody species and ground flora species present, with regard to Schedules 2 & 3 within the Hedgerow Regulations 1997. The survey was also used to identify the presence of any notable features such as earth banks, ditches and footpaths/bridleways.

Four hedgerows were surveyed, all measuring over 100m in length, therefore the number of woody species present in the central stretch of 30 m within each half of the hedgerow were counted and the aggregate was divided by 2.

Flora taxonomy follows the nomenclature detailed in New Flora of the British Isles (4th Edition) (Stace, New Flora of the British Isles, 2019).

3.4 THE BIODIVERSITY METRIC

The Defra Biodiversity Metric 3.1 provides a nationally measurable structured calculation methodology to account for biodiversity losses and gains resulting from development or land management change. The calculation for this assessment has used the 'beta test' version which is the most up to date version for consultant use.

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The Defra Metric Biodiversity score has been calculated for the existing and proposed habitats within the planning application boundary. Biodiversity Net Gain (BNG) is an approach to development that seeks to halt the current loss of biodiversity through development and through the planning system; restore ecological networks through early masterplanning and increase the natural habitat resource and ecological features. This has been outlined within the Environment Act 2021, with a legal requirement for developments to enhance the ecological value of a site by a minimum of 10% to come into force in 2023. However, many Local Planning Authorities already have planning policies covering the need for biodiversity net gain to be demonstrated as part of development proposals through the planning system.

3.5 ECOLOGICAL ASSESSMENT METHODOLOGY

Information for the assessment derives from the results of the desk study, baseline surveys, supplemented by published information (e.g. on potential biodiversity receptors' status, distribution, sensitivity to ecological changes) and professional knowledge of ecological processes and functions.

For each scoped-in receptor, effects have been assessed against the predicted future baseline conditions for that receptor (assumed to be no notable difference to the current baseline as noted in Section 4 during construction and operation). This future baseline has been defined using information as defined in Section 5 about the likely future use and management of the site in the absence of development, known population trends (for species) and any other proposed developments (consented or otherwise) that may act cumulatively with the scheme to affect biodiversity receptors. A precautionary basis has also been taken where appropriate.

Throughout the assessment process, findings about potential for significant effects were used to inform the definition of requirements for additional baseline data collection and the identification of ecological measures to be incorporated into the Proposed Development design (in order to avoid or reduce adverse effects or to deliver enhancements). Measures to comply with relevant policies and legislation have also been included. The results of the assessment reflect the final design (i.e. incorporating the ecological measures).

For each receptor, the assessment deals with the effects of construction, and the effects of the operational phase of the shared-use path. As more information has become available about the Proposed Development and about the populations of important and legally protected species, the scope of the assessment has been refined to focus on those receptors that have potential to be significantly affected. Each scoped-in receptor has then been subject to further assessment of how it was likely to be affected by the Proposed Development, allowing for ecological changes that could affect the receptor during construction and operation.

3.5.1 Methodology for Prediction of Effects

The method for the prediction of effects is based on Chartered Institute of Ecology and Environmental Management (CIEEM) guidelines, 2019; these guidelines are widely regarded by the ecology profession as the 'industry standard'.

The assessment is based upon not only the results of the desk study and field surveys, but also relevant published information (on potential biodiversity receptors' status, distribution, sensitivity to environmental changes and ecology), and professional knowledge of ecological processes and functions.

The effects on each scoped-in receptor have been assessed against the predicted future baseline conditions for that receptor during construction and operation. The future baseline has been defined using information about the likely future use and management of the area in the absence of the Proposed Development, known population trends (for species where available) and any other proposed developments (consented or otherwise) that may act cumulatively with the Proposed Development to affect biodiversity receptors.

Throughout the assessment process, findings about potential likely significant effects were used to inform the definition of requirements for additional baseline data collection and the identification of embedded ecological measures that are incorporated into the Proposed Development design (in order to avoid or reduce adverse effects

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or to deliver required enhancements as necessary for receptors where legislation has been derogated). The results of the assessment, as set out later in Section 6, reflect the final proposed scheme design (i.e. incorporating the embedded ecological measures, which include construction methodology and design) as well as location specific embedded ecological measures.

The spatial extent of the assessment of each potential likely significant effect reflects the area occupied by the receptor that is being assessed and the ZoI associated with the environmental changes that are likely to affect the receptor. Thus, if part of a designated biodiversity site is located within the ecological ZoI relating to a particular ecological change, an assessment would be made of the effects on the Site as a whole. A similar approach was taken for areas of notable habitat. For species that occur within an ecological ZoI that relates to a change that could significantly affect that species, an assessment was carried out on the total area that is used by the affected individuals or population of the species (e.g. for foraging).

Significance Evaluation Methodology

The assessment has been informed by the specific details of all proposed development works, and embedded ecological mitigation. The evaluation of effects on receptors are considered following the methodology presented below, and in the context of the scheme description (see Section 1.2). Integrated and embedded ecological measures consist of those described in Section 6.

This EcIA uses Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine (CIEEM, 2019) to assess the significance of effects upon ecological receptors.

Using information about the way in which sites/habitats/species are likely to be affected by the Proposed Development, each change (from the baseline situation) that is assessed has been assigned a level of 'magnitude', based on the definitions set out in Table 3.1.

Table 3.1: Guidelines for the Assessment of Change Magnitude

Magnitude of Change	Criteria and Resultant Effect
Major	The change permanently (or over the long-term) negatively affects the conservation status of a habitat/species, reducing the ability to sustain the habitat or the population level of the species within a given geographic area. Relative to the wider habitat resource/species population, a large area of habitat or large proportion of the wider species population is affected. For designated sites, integrity is compromised. There may be a decrease in the level of biodiversity conservation value of the receptor.
Moderate	The change permanently (or over the long-term) negatively affects the conservation status of a habitat/species reducing the ability to sustain the habitat or the population level of the species within a given geographic area. Relative to the wider habitat resource/species population, a small-medium area of habitat or small-medium proportion of the wider species population is affected. There may be a decrease in the level of biodiversity conservation value of the receptor. Although there may be some effects on individuals or parts of a habitat area or designated site, the quality or extent of sites and habitats, or the size of species populations would experience little or no reduction. Any changes are likely to be within the range of natural variability and there would be no short-term or long-term change to the conservation status of habitat/species receptors or the integrity of designated sites.
Minor	The quality or extent of designated sites or habitats or the sizes of species' populations, experience some small-scale reduction. These changes are likely to be within the range of natural variability and there is not expected to be any permanent change in the conservation status of the species/habitat or integrity of the designated site. The change is unlikely to modify the evaluation of the receptor in terms of its biodiversity conservation value
Minor/Neutral	A change to the level of which is so low, it is not discernible on designated sites or habitats or the sizes of species' populations, or changes that balance each other out over the lifespan of a project.

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Magnitude of Change	Criteria and Resultant Effect
Will not occur	The effect will not occur due to an absence of an environmental pathway to the sensitive receptor.

The criteria in Table 3.1 refer to the terms: 'integrity' and 'conservation status'. For habitat areas and species, an effect is assessed as being significant if the favourable conservation status of a receptor would be changed by the Proposed Development. Conservation status is defined by the CIEEM guidelines as follows:

- For habitats –the sum of the influences acting on the habitat and its typical species, that may affect its long-term distribution, structure and functions as well as the long-term survival of its typical species within a given geographical area; and

- For species -the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within a given geographical area.

Negative Effects

A negative effect is considered to be significant if the favourable conservation status of a receptor is compromised by the Proposed Development.

A similar procedure has been used for designated sites that are affected by the development, except that the focus is on the effects on the integrity of each site, defined by the CIEEM guidelines as:

"...the coherence of its ecological structure and function, across its whole area, that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was classified."

The assessment of effects on integrity draws upon the assessment of effects on the conservation status of the features for which the site has been designated.

The decision as to whether the favourable conservation status has been compromised is made using informed judgement based on the findings of the assessment of how the resource would be affected.

Positive Effects

A positive effect is assessed as being significant if development activities are predicted to cause:

- An improvement in the condition of a habitat/species population from unfavourable to favourable recovering or favourable (noting that condition data are only available for SSSIs but that professional judgement has been used to apply the same principle to habitats/species elsewhere); or
- Partial or total restoration of a site's favourable condition.

If a species population, habitat or site is already in favourable condition, it is still possible for there to be a significant positive effect. There is, however, no simple formula for determining when such effects are significant and decisions about significance therefore have to be made on a case-by-case basis using professional judgement.

3.6 LIMITATIONS, CONSTRAINTS AND ASSUMPTIONS

Due to instruction timings, automated static detector surveys started in July, missing out on the Spring months of April, May and June. As a result, three statics were used in favour of two and the detectors were deployed monthly until mid-October.

As three automated static detectors were deployed in suitable and diverse locations throughout the Site, and activity surveys from late Spring through Summer were conveying low numbers of bats in the area, it was decided that a dawn activity survey would not provide any further information than the automated detectors could acquire and was therefore deemed unnecessary.

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On the day of the pond eDNA surveys, due to a dry and hot Spring, Pond 2 was dry, along with the ditches running parallel through the Site, meaning eDNA samples could not be collected for analysis. eDNA samples were only taken from Ponds 1 and 3.

The findings of this report are considered valid at the time of writing (November 2022). Should there be delays to the project timetable and/or implementation of the proposed development, updated desk study and/or survey work may be required. In this instance, advice should be sought to ensure the data, recommendations and conclusions set out in this report remain valid.

It has been assumed that the development proposals are as described in this document and that all proposed mitigation, enhancement and management measures will be implemented in full.

This EcIA has been produced by Johns Associates Ltd using data gathered from baseline surveys carried out in 2022 supported by desk study data. The assessment based upon the data presented in this report is considered to be robust.

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4 BASELINE ECOOLOGICAL CONDITIONS

4.1 DESK STUDY

4.1.1 Statutory Designated Sites

There are no statutory designated sites of nature conservation interest within 2 km of the Site or any statutory designated site for bats located within 5km of the Site.

4.1.2 Non-Statutory Designated Sites

There are three non-statutory designated Sites within 2km of the Site, all of which are Local Wildlife Sites (LWSs).

Kennet and Avon Canal LWS is located approximately 1.5km south of the Site. This comprises a restored canal used for recreation and features bounding lowland mixed deciduous woodland.

Conigre Mead LWS, managed as a Wiltshire Wildlife Trust (WWT) reserve, is located approximately 1.7km north-west of the Site. It is a small wet fen-meadow on the outskirts of Melksham, managed as a nature reserve and extensively planted with trees and shrubs.

Bristol Avon River LWS is located approximately 1.8km north-west of the Site. It is one of the main river systems draining north-west Wiltshire.

4.1.3 Granted European Protected Species Licences

There are nine European Protected Species (EPS) licences which have been granted within 2km of the Site. Four of these are for great crested newt *Triturus cristatus* and the remaining five are for species of bat including common pipistrelle *Pipistrellus pipistrellus*, brown long-eared *Plecotus auritus* and serotine *Eptesicus serotinus*. Details of these are provided in Table 4.1.

Table 4.1: Granted EPS Licenses Within 2 km of the Site

Species	Approximate Location and Bearing from Site	Date	Breeding Site or Resting place	Licence number(s)
Great crested newt	260m east	2014-2017 20016-2017 2016-2017	Resting place	2014-3352-EPS-MIT 2014-3352-EPS-MIT-1 2014-3352-EPS-MIT-2
Common pipistrelle	800m south-east	2015-2020	Resting place	2015-14789-EPS-MIT
Great crested newt	1.2km south-west	2013-2015	Resting place	EPSM2013-6453
Brown long eared, common pipistrelle, serotine	1.3km west	2015-2025	Resting place	2015-14691-EPS-MIT
Brown long eared, common pipistrelle	1.7-km west	2017-2018	Resting place	2017-31272-EPS-MIT
Brown long eared	1.7 km north-east	2015-2025 2017-2025	Resting place	2015-13094-EPS-MIT 2015-13094-EPS-MIT-1

A further 14 licenses have been granted for bat species within a 2-5km radius of the Site. Species included brown long-eared, common pipistrelle, soprano pipistrelle *Pipistrellus pygmaeus*, whiskered bat *Myotis mystacinus*, serotine, greater horseshoe *Rhinolophus ferrumequinum*, and lesser horseshoe *R. hipposideros*.

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4.1.4 Local Records Centre Data Search

A total of 1,398 records were returned by WSRC, of which 53 were low resolution (to a 4-digit grid reference). Two records of species are held for the Site itself; these are for brown hare *Lepus europaeus* (dated 2000) and hedgehog *Erinaceus europaeus* (dated 2015).

Of the records returned, 733 were for within the last ten years. A summary of these is provided in Table 4.2.

Table 4.2: WSBRC Data Search Results

Species/Groups	Details
Plants	There were 46 records returned for plants comprising 24 species. Records included three IUCN Vulnerable species; strawberry clover *Trifolium fragiferum*, stinking chamomile *Anthemis cotula* and slender tare *Vicia parviflora*. The closest record was for sweet-briar *Rosa rubiginosa* located approximately 250m east of the Site (dated 2021). No records of invasive plants are held.
Birds	There were189 records for birds returned, including 27 different species. This included eight UKBAP species, 11 species listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended) and 15 Birds of Conservation Concern (BOCC5) Red List species. The closest record is for a starling *Sturnus vulgaris,* a red listed species located approximately 90m south-west of the Site (dated 2013). Other notable species included barn owl *Tyto alba* and skylark *Alauda arvensis.*
Bats	There were 149 records returned for bats with 41 of these being for roosts. Species for which roost records are held include serotine, common pipistrelle, lesser horseshoe, soprano, brown long-eared, whiskered, Daubenton's *Myotis daubentonii* and greater horseshoe. Roost records are given to a grid reference accuracy of 1 km and one record is held for within the same 1 km square as the Site. This is for a record of a roost for one male brown long-eared bat (dated 2016). The remaining 106 records relate to foraging, commuting and grounded bats. Records are held for common pipistrelle, soprano pipistrelle, Nathusius's pipistrelle *Pipistrellus nathusii*, and *Myotis* species (including Daubenton's and Natterer's *M. nattereri*). The closest record is for a common pipistrelle located approximately 470m south-west of the Site (dated 2018).
Badger	Seven records are held for badger *Meles meles*; the closest of which is located approximately 1.1km north of the Site (dated 2016).
Other mammals	Three records are held for otter *Lutra lutra*. The closest record is given to a 1km grid-reference, which is located >300m east of the Site (dated 2018). There were 16 records returned for water vole *Arvicola amphibius*. The closest record is located approximately 600m north of the Site (dated 2014). Further records are held for locations at the Kennet and Avon Canal LWS, Conigre Mead WWT Reserve LWS and Clackers Brook. No records were returned for dormouse *Muscardinus avellanarius*. Four records are held for brown hare, the closest of which is located approximately 760m south-east of the Site (dated 2015). There were 240 records held for hedgehog, the closest of which is located approximately 180m south of the Site (dated 2019). Three records are held for water shrew *Neomys fodiens* the closest of which is located approximately 1.3km south of the Site (dated 2018).
Reptiles	A total of 54 records are held for reptile species. Of these records, 41 are for slow worm *Anguis fragilis*; the closest of which is located approximately 1.1km north-west of the Site (dated 2017). The remaining 13 records are for grass snake *Natrix helvetica*; the closest of which is located approximately 300m north-west of the Site (dated 2011).
Amphibians	There were 36 records returned for amphibians, 30 of which were for great crested newt. The closest

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Species/Groups	Details
	record held for great crested newt is a record of one female and five males located approximately 350m south-west of the Site (dated 2014). Three records were returned for common frog *Rana temporaria*; the closest being located approximately 1.2km north-west of the Site (dated 2020). Three records are held for common toad *Bufo bufo*; the closest of which is located approximately 1.3km west of the Site (dated 2017).
Invertebrates	There were 29 records returned for invertebrates, comprising eight species. Records of four UKBAP species were recorded including small heath butterfly *Coenonympha pamphilus,* white-letter hairstreak butterfly *Satyrium w-album,* cinnabar moth *Tyria jacobaeae* and shaded broad-bar moth *Scotopteryx chenopodiata.* The closest record is for a count of five small heath butterflies located approximately 120m east of the Site (dated 2014).

4.2 FIELD SURVEYS

4.2.1 Habitats

The Site comprises a linear track which is used by maintenance and agricultural vehicles fields and recreationally by walkers/ dog walkers. In the south it comprised of urban, man-made habitats; predominantly an area of concrete hard-standing adjacent to industrial/ agricultural and derelict sites. The track then opened to an area of modified, managed grassland and created a glade-type habitat of unmade surface between adjacent hedgerows and a small area of adjacent plantation woodland. The northern end of the track opened to a large modified agricultural grassland field unit. The Site is approximately 0.961 hectares in size.

With reference to the red-line boundary of the Site and the UKHab classification, the Site comprised habitats of:

- u1c-artificial unvegetated unsealed surface (approximately 0.168 hectares), and
- g4-modified grassland (approximately 0.793 hectares).

U1c- Artificial unvegetated unsealed surface (Secondary codes 17, 20)

A section of bare ground was present in the south of the Site. This serves as a footpath for pedestrians and is well-trodden with compacted ground. Ecotones are present at the edges, comprising encroaching blackthorn *Prunus spinosa*, bramble *Rubus fruticosus* aggregate and rose *Rosa* scrub at the east, adjacent to fencing; with woodland ground flora and ephemeral species encroaching at the west. Species included herb Robert *Geranium robertianum* (a), thistle *Cirsium* species (o), moss *Sphagnum* species(a), teasel *Dipsacus fullonum* (f), ribwort plantain *Plantago lanceolata* (a), oxeye daisy *Leucanthemum vulgare* (f), dove's foot cranesbill *Geranium molle* (o), wild strawberry *Fragaria vesca* (o), cleavers *Galium aparine* (o), clover *Trifolium* species (o) and common sorrel *Rumex acetosa* (o).

The southern end of the Site comprises bare ground which is sparsely vegetated with self-established plant species. It is adjacent to derelict land and industrial/ agricultural buildings. Species present include annual meadow grass *Poa annua* (a), soft-rush *Juncus effusus* (o), willowherb *Epilobuim* species (f), Yorshire fog *Holcus lanatus*, a clover species, teasel, bramble, a mayweed *Tripleurospermum* species and a moss.

The Site comprises approximately 0.168 hectares of artificial, unvegetated unsealed surface.

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Plate 1: View of the south of the Site with a view of adjacent agricultural buildings.

g4- Modified grassland (Secondary codes 10, 14, 16, 103, 199,160, 420

Then north of the Site comprises a strip of modified grassland within a wider agricultural field unit. The linear strip of on-Site grassland comprises a combination of well-trodden ground dominated by perennial rye-grass at the western edge, with a tall, tussocky grassland sward at the east, adjacent to hedgerows and scrub. Species composition was poor, comprising <9 species per m^2 and being dominated by rye-grass and Yorkshire fog. The grassland appears infrequently managed, with the further grassland to the west (off-Site) comprising a tall tussocky sward <1m in height.

A further linear strip of grassland is located in the centre of the Site. This had a short sward at the time of survey and a poor species composition <9 species per m2. The grassland comprised Yorkshire fog (a), with red fescue (f), cock's foot (o), herb Robert (o), hogweed *Heracleum sphondylium*, nettle, cleavers, clover species and stands of young hemlock water drop-wort *Oenanthe crocata.*

The ground was inundated with ground and surface water in places, with shallow pools (puddles) present; and appears regularly saturated owing to the species of flora present. An ecotone is present at the north-east comprising blackthorn suckers and self-established young hazel specimens. Patches of scrub are present with mammal paths leading into tunnels through the scrub (Target Note 1).



Plate 2: View of modified grassland with scrub and location of mammal paths (Target Note 1).

A small area of modified grassland is located in the south of the Site. This comprised a combination of well-trodden/ disturbed areas with a short sward <5cm, owing to its use as a farm track and footpath; with a tussocky, tall sward <30cm at the peripheries. The grassland was inundated with ground and surface water at the time of surveys with a number of shallow temporary pools (puddles) present and low numbers of soft rush *Juncus effusus* at the peripheries.

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The species composition was poor, comprising <9 species per m^2, predominantly perennial rye-grass *Lolium perenne* (a) and Yorkshire fog (a), with creeping buttercup *Ranunculaus repens* (a), red fescue (f), dock *Rumex* species (f), greater plantain *Plantago major* (a) and a sow thistle species *Sonchus* (f). A higher percentage of herb cover was present at the edges of the grassland including common nettle *Urtica doica* (d), white dead-nettle *Lamium album*, cleavers *Galium aparine* (f) herb Robert (f) and an umbellifer species.

The Site comprises approximately 0.793 hectares of modified grassland. With reference to the Defra 3.1 Metric Condition Assessment[2], the grassland is in overall Moderate condition. The Condition Assessment sheet is provided at Appendix C.



Plate 3: View of modified grassland in the south of the Site.



Plate 4: View of modified grassland in south of the Site showing taller tussocky margin and adjacent woodland.

Details of adjacent habitats and the results of the extended element of the Phase 1 survey completed in February 2022 are provided in Appendix A to this EcIA (Preliminary Ecological Appraisal, Johns Associates, April 2022).

The following sections provide the results of the Phase 2 species surveys carried out between June and October 2022.

4.2.2 Great Crested Newt (GCN) eDNA Pond Survey

Negative results for GCN eDNA were returned for both Pond 1 and Pond 3 by SureScreen Scientifics on 25 July 2022. It is therefore considered that GCN are absent from these ponds and that any potential for GCN to be using the Site

2 Natural England (2021) Biodiversity Metric 3.1 - Habitat Condition Assessment Sheets with Instructions. Available at http://publications.naturalengland.org.uk/publication/6049804846366720 (Accessed 28 April 2022)

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is low. Although the surrounding area offers moderate foraging, commuting and hibernating habitat, the lack of GCN evidence in the ponds means that they unlikely to be encountered during the construction works. The proposed shared-use pathway would not represent a significant barrier to GCN movement.

4.2.3 Automated Static Detector Surveys

Automated static detector surveys were conducted monthly from July to October 2022, with bat pass data and species ID being recorded for 5 consecutive nights each month. Table 4.3 below displays the maximum count for all species recorded during the surveys. Common pipistrelle dominated, with 51.25% of the total recordings. Rarer species including lesser horseshoe (1.98% or 77 recordings), greater horseshoe (0.62% or 62 recordings) and barbastelle (0.21% or 8 recordings) were also recorded. No greater horseshoe or barbastelle bats were recorded during the activity surveys (see Section 4.2.4).

Table 4.3: Total Bat Species Count

Scientific Name	Common Name	Count (No)	Percentage of total (%)
Pipistrellus pipistrellus	**Common pipistrelle**	1990	51.25
Myotis spp.	**Myotis**	943	24.29
Pipistrellus pygmaeus	**Soprano pipistrelle**	633	16.30
Nyctalus noctula	**Noctule**	175	4.51
Rhinolophus hipposideros	**Lesser horseshoe**	77	1.98
Rhinolophus ferrumequinum	**Greater horseshoe**	24	0.62
Nyctalus spp.	**Noctule or Leisler's**	18	0.46
Eptesicus serotinus	**Serotine**	14	0.36
Barbastella barbastellus	**Barbastelle**	8	0.21
Pipistrellus nathusii	**Nathusius pipistrelle**	1	0.03

Table 4.4 below displays the bat species recorded each month from each location. Automated detector number ST2, located in the central area of the Site within the dark hedgerow corridor demonstrated the highest bat activity levels, with pipistrelle and myotis species the most recorded (527 passes by common pipistrelle bats were recorded over the five nights in July).

Automated detector number ST1 recorded the second highest number of bat passes. This detector was located closer to the road, which was relatively well lit, and more light-tolerant species (such as common pipistrelle) were recorded using this area for foraging.

The higher number of recordings of both lesser and greater horseshoe bats in October could suggest that there is a hibernation roost nearby, as 17 passes on ST1 by GHS and 44 on ST2 by LHS are relatively high compared to the summer months.

Detector ST3 recorded significantly fewer bat passes than either ST1 or ST2. ST3 was located in the northern field along the hedgerow with trees. The more open grassland habitat nearby meant that larger bat species such as noctule and serotine were present, as well as pipistrelle and myotis species foraging over the grassland and commuting along the hedgerow.

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Table 4.4: Bat Species Recorded by Month and Location

Month	Location	*Barbastella barbastellus*	*Eptesicus serotinus*	*Myotis spp.*	*Nyctalus noctula*	*Nyctalus spp.*	*Pipistrellus nathusii*	*Pipistrellus pipistrellus*	*Pipistrellus pygmaeus*	*Rhinolophus ferrumequinum*	*Rhinolophus hipposideros*
	ST1		3	48	9	3	1	628	65		6
July	**ST2**		6	381	7	5		527	184	1	5
	ST3		4	27	5	5		157	37		
	ST1			1				5	1		1
August	**ST2**			238	77	1		257	127	1	10
	ST3		1	3				3	3		
	ST1			20	28			41	2		1
September	**ST2**	3		48	20			86	9	1	3
	ST3			17	10	1		3	2		
	ST1	2		52	5	3		140	29	17	7
October	**ST2**	3		104	14			143	174	4	44
	ST3			4							

A full copy of the R-report can be found in Appendix G.

4.2.4 Bat Activity Surveys

Five activity surveys were conducted, in suitable conditions (Table 4.5 below), to assess use of the Site by bats. The transect route followed the route of the proposed shared-use path, from well-lit open habitat to the south where a derelict farm is located, through a dark corridor with a hedgerow running adjacent to the school boundary, and into the open grassland to the north towards the housing estate. A plan of the transect route can be found in Appendix D.

Table 4.5: Bat Activity Survey Information

Survey Visit	Date	Surveyors	Temperature Start/End (°C)	Cloud Cover (Oktas)	Wind (Beaufort Scale)	Rain
1	29/06/22	MS + NE	16 – 15	8/8	1/12	None
2	26/07/22	AB + NE	19 – 17	2/8	1/12	None
3	25/08/22	LY + AB	21 – 20	2/8	3/12	None
4	28/09/22	MS + NE	13 - 13	8/8	2/12	Rain before start
5	11/10/22	CR + AB	15 – 12	6/8	2/12	None
Surveyors: Myles Sedgwick BSc (Hons) QCIEEM - Consultant Ecologist Anna Byatt BSc (Hons) MSc Q CIEEM – Assistant Ecologist Lexi Yates BSc (Hons) MSc ACIEEM – Senior Ecologist & level 2 class licence for bats (2022-10159-CL18-BAT) Cerys Read – Trainee Assistant Ecologist Nicole Evans – Survey Assistant						

Tables 4.6 and 4.7 below display total numbers of each species recorded over the course of the five survey months, and species numbers per month, respectively. Common UK bat species were the most frequently recorded, including common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle *Pipistrellus pygmaeus*, noctule bat *Nyctalus noctula,*

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and Myotis species. Two Brown long-eared bats *Plecotus auritus* were recorded, as well as two rare lesser horseshoe bats *Rhinolophus hipposideros*.

Table 4.6: Bat Species and Numbers Recorded During Activity Surveys

Common Name	Scientific Name	Total Bat Passes over the 5 Survey Months
Common pipistrelle	Pipistrellus pipistrellus	113
Myotis Species	Myotis sp.	36
Soprano pipistrelle	Pipistrellus pygmaeus	31
Noctule	Nyctalus noctula	9
Nyctalus Species	Nyctalus sp.	7
Brown long-eared bat	Plecotus auritus	2
Lesser horseshoe bat	Rhinolophus hipposideros	2

Table 4.7: Bat Species and Numbers Recorded Each Month

Transect No.	Month	Common Name	Bat Passes per Species	Total Bat Passes per Survey
1	June	Common pipistrelle Myotis species Soprano pipistrelle Brown long-eared bat Noctule	22 5 3 1 1	32
2	July	Common pipistrelle Soprano pipistrelle Myotis species Lesser horseshoe bat	17 9 4 1	31
3	August	Common pipistrelle Soprano pipistrelle Myotis species Nyctalus species Noctule Lesser horseshoe bat	68 24 18 7 6 1	124
4	September	Noctule Myotis species Common pipistrelle Brown long-eared bat	2 2 1 1	6
5	October	Common pipistrelle Myotis species	5 2	7

The plan in Appendix D shows the locations of all bat passes recorded during the five transects. The northern area of the Site, where the (proposed) shared pathway meets the new housing development, had high levels of bat activity, as did the corridor through the woodland and hedgerow strip (H1, H2 & H4) in the central area of the Site. This corridor is very dark after sunset, making it a highly suitable commuting route for most bat species using the Site, including the rare and light sensitive species e.g. lesser horseshoe. It can be inferred that due to species numbers recorded during the surveys, as well as behaviours noted and lack of potential roosting features in any of the on-Site or nearby trees (see Appendix A), the Site is only used as a commuting and foraging corridor for bat species roosting in the wider local area.

Lighting within this area will need to be carefully considered to minimise effects on foraging and commuting bats.

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4.2.5 Reptile Presence/Absence Surveys

Seven reptile survey visits were conducted in optimal conditions (see Table 4.8), to assess the presence/ likely absence of common reptile species on Site. Although the Site was assessed as having low suitability for these species and comprises modified grassland, with areas of scrub and hedgerow immediately adjacent, no reptiles were seen or recorded during any of the seven visits, nor during any other site surveys. It is therefore considered likely that these species are absent from the Site and immediately adjacent areas of suitable habitat and are unlikely to be encountered during the proposed works.

Table 4.8: Reptile Survey Information

Survey Visit	Date	Surveyors	Temperature Start/End (°C)	Cloud Cover (Oktas)	Wind (Beaufort Scale)	Rain
1	06.09.22	MS	20 – 20	4/8	4/12	None
2	07.09.22	MS	18 – 19	3/8	4/12	None
3	13.09.22	CR	16 – 18	7/8	2/12	None
4	20.09.22	CR	19 – 19	5/8	2/12	None
5	22.09.22	CR	13 – 14	6/8	2/12	None
6	06.10.22	CR	15 - 15	6/8	2/12	None
7	11.10.22	MS	14 – 15	6/8	2/12	None

4.2.6 Badger Survey

A badger survey was conducted of the Site and habitats within the wider local area. The plan in Appendix E shows the location of a dis-used badger sett, located approximately 150m west of the Site boundary. Three dis-used entrances containing nettles and leaf litter were recorded, with mammal pathways noted throughout the small woodland. No further evidence of badgers was recorded in the area. It is likely that this is an old outlier sett, with a main sett located somewhere in the wider local area. Badgers are therefore considered to be absent from the Site.

4.2.7 Otter and Water Vole Survey

No field signs of otter or water vole were recorded during the survey.

The banks of the ditches surveyed had a shallow gradient, sub-optimal for burrow excavation and due to the hot weather were completely dry and offered no suitability for otter or water voles. Connectivity to the wider local area was limited. The ponds in the immediate vicinity of the Site offered low suitability for otter and water vole. Referring to the plan in Appendix B, Pond 1 was almost dry with leaf litter covering all the banks and Pond 2 was dry at the time of survey. Pond 3, located in the school grounds had very shallow banks offering no suitability for either species.

4.2.8 Hedgerow Assessment

A Hedgerow Regulations Assessment was conducted of four hedgerows within the immediate vicinity of the Site boundary: H1, H2, H3 and H4 (see Appendix A). H1 and H2 lie within the boundary of Melksham Oak School, whereas H3 and H4 are situated adjacent to the existing pathway that runs through the Site. The results of the assessment are shown in Table 4.9 below.

Table 4.9: Hedge Regs Survey Results

Hedgerow Criteria	Hedgerow Requirements			
	H1	H2	H3	H4
Length, Height, Width (m)	200 x 3 x 1	110 x 4 x 1	200 x 8 x 5	122 x 4 x 2
Associated Features				
Bank or wall (at least half of length)	No	No	No	No
Gaps in hedge <10%	Yes	Yes	Yes	Yes
1 or more standard tree per 50m	No	Yes	Yes	Yes

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3 or ore Sch 2 woodland plants	No	No	No	No
Ditch (at least half of length)	No	No	Yes	Yes
Parallel hedge within 15m	No	Yes	No	Yes
Connections scoring >4 pts (ponds 2pts, woodland 2pts, hedgerow 1pt)	Yes - 7	No - 2	No - 2	Yes - 6
No. of associated features	2	3	3	5
Notable Trees (black poplar, large/small leaved lime, wild service tree.	None	None	None	None
Average woody species in 30m	3	3	3	4
Woody Species List	Blackthorn Dog rose Willow sp.	Blackthorn Hazel Field maple	Blackthorn Field maple Hawthorn Hazel Willow sp.	Blackthorn Hawthorn Hazel Malus sp.
IMPORTANCE	Not Important	Not Important	Important	Important

Hedgerow 1 has been classified as Not-Important due to failing to meet the required number of associated features, only scoring two out of seven, these being <10% gaps and having a high score in connections (7). Hedge 1 only contained three woody species: blackthorn, dog rose and willow sp., which is low in diversity.

Hedgerow 2 has been classified as Not Important due to failing to meet the required conditions; only containing three woody species – blackthorn, hazel and field maple and only scoring three out of seven for associated features, these being <10% gaps, one or more standard tree per 50m and a parallel hedge within 15m.

Both H1 and H2 are within the grounds of Melksham Oak School and are regularly maintained.

Hedgerow 3 has been classified as Important as it contained 5 woody species – blackthorn, field maple, hawthorn, hazel, and willow sp., as well as scoring three out of seven associated features: <10% gaps, one or more standard tree per 50m and having an associated ditch (running at least half of its length). This hedgerow provides a valuable green corridor adjacent to an area of open grassland. Hedge 3 appeared unmanaged at the time of survey.

Hedgerow 4 has been classified as Important due as it contained four woody species – blackthorn, hawthorn, hazel and *Malus* sp., as well as scoring five out of seven associated features, including <10% gaps, one or more standard tree per 50m, having a ditch running (at least half of its length), having a parallel hedge within 15m and having a high score in connections (6). Hedge 4 appeared to be managed, as there was evidence of arisings on the ground at the time of survey.

Although two out of the four hedgerows surveyed resulted in Important status, the proposed works will not affect any of the hedgerows in the immediate vicinity of the Site.

4.3 BIODIVERSITY NET GAIN ASSESSMENT

A summary of the baseline BNG calculations is provided in Table 4.10. The current habitats affected by the proposed works include modified grassland and urban-unsealed surface. These habitats are to be offset by a 0.25ha area of land to the north of the Site which will be enhanced (Table 4.11) from modified grassland (g4) to provide other neutral grassland (g3c) habitat.

Overall, this enhancement will provide a positive net gain to the Site of 13.96%.

Table 4.10: On-Site Baseline Habitats

Habitat Type	Area (Ha)	Condition	Total Habitat Units	Units Lost	Units Enhanced
Modified Grassland	0.124	Moderate	0.50	0.50	0

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Habitat Type	Area (Ha)	Condition	Total Habitat Units	Units Lost	Units Enhanced
Artificial unvegetated, unsealed surface	0.104	N/A	0	0	0
Total	**0.228**	**-**	**0.50**	**0.50**	**0**

Table 4.11: Off-Site Habitat Enhancement Units Delivered

Habitat Type	Area (Ha)	Condition	Total Habitat Units Enhanced	Total Habitat Units Delivered
Modified Grassland	0.252	Moderate	1	1.71
Total	**0.252**		**1**	**1.71**

The percentage increase meets the requirement for measurable net gain as a result of proposed development outlined within the NPPF 2019 and exceeds the 10% Biodiversity Net Gain that will be a requirement of the Environment Act from autumn 2023.

The proposed works Site plan, scheme designs and recommended BNG enhancement areas are displayed in Appendix F.

The headline results of the Defra Biodiversity Metric 3.1 are provided in Appendix G.

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5 SCOPE OF THE ASSESSMENT

The scope the assessment was established through the review of the overall baseline and the proposed development design.

5.1 APPROACH TO IDENTIFYING RECEPTORS

The identification of receptors is based on relevant guidance and the professional judgement of qualified technical specialists who have undertaken a desk study and a range of ecological field surveys at the application Site.

In some cases, even without quantified information, it is reasonable to conclude that some potential receptors will not experience significant effects. This is sometimes the result of mitigation measures that have been incorporated into the proposed development, which might reasonably be expected to be effective.

The following considerations have been considered in identifying potential receptors:

- The importance (or value) of the receptor at a local, regional and national level
- The extent to which important ecological receptors will be affected by changes that are expected to result from the proposed development
- The sensitivity of the important ecological receptors to the changes that are likely to occur
- The likely magnitude, duration and other characteristics of the effects
- Relevant best practice and guidance where specialist methodologies have been developed as detailed below

5.2 POTENTIAL RECEPTORS

A key consideration in assessing the effects of the proposed development on flora and fauna is to define the habitats and species that need to be included in the assessment. In identifying these receptors, it is important to recognise that a development can affect flora and fauna both within the site (e.g. through the land-take required) as well as beyond the site (e.g. through noise generation, changes in air quality or lighting levels etc.). The approach that has been taken in preparing this EcIA is to identify important biodiversity resources, (the sites, habitats and species of sufficient importance that effects upon them could be significant), as well as considering legally protected species.

Assessment of the effects of the proposed development on biodiversity was undertaken with reference to CIEEM's EcIA Guidelines (September 2019). The assessment has focused on legally protected and otherwise important biodiversity resources (refer to Boxes 3.1 and 3.2).

The starting point for the assessment was to undertake an exercise, using the baseline data that were collected through the desk study and knowledge of the local area, to subdivide the recorded biodiversity receptors (i.e. designated sites, together with species populations and habitats) into:

- Those that could be significantly affected by the proposed development or for which the development could result in the contravention of relevant legislation, and that therefore required more detailed assessment; and
- Those that were assessed as not being likely either to be significantly affected or whose presence was not likely to result in any relevant legislation being contravened, and that did not therefore require further assessment (i.e. that were 'scoped out' of the assessment).

For sites/habitats/species that meet the criteria in Boxes 5.1 and/or 5.2, the next stage of the scoping assessment is to determine whether the identified receptors are likely to be of sufficient 'biodiversity conservation value' that an effect upon them could be significant in EIA terms. In this context:

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- Biodiversity conservation value relates to the quality and/or size of sites or habitats, or the size of species populations (see Box 5.1); and
- Potential significance means that the effect could be of sufficient concern, or for positive effects, of such substantial benefit that it could influence the decision about whether or not development consent or a specified other consent should be granted.

Box 5.1: Value and Importance for Biodiversity Conservation

The distinction between importance and value can be illustrated by common species such as the house sparrow. This species is important at a national level because it is a priority species (Section 41, NERC Act 2006). However, a small population that could be affected by a development would often be assessed as being of insufficient value for an effect (whether adverse or beneficial) to be of potential significance, due to the small size of the population. On this basis, it would not need to be assessed further (i.e. it would be 'scoped out' of the assessment).

5.3 SPATIAL SCOPE

The spatial scope of the assessment of each potential significant effect reflects:

- The area occupied by the receptor that is being assessed; and
- The ZoI associated with the ecological changes that will result from the proposed development that are likely to affect the receptor.

Thus, if part of a designated biodiversity site is located within the ecological ZoI relating to a particular ecological change, an assessment is made of the effects on the biodiversity site as a whole. A similar approach has been taken for areas of notable habitat. For species that occur within an ecological ZoI that relates to a change that could significantly affect the species, an assessment has been carried out on the total area that is used by the affected individuals or population of the species (e.g. for foraging or commuting).

Receptors that are of sufficient value that an effect upon them would have the potential to be significant, together with all relevant legally protected species, are taken through to the assessment stage. This involves identifying, for each receptor:

- Any ecological changes that are likely to be caused by the proposed development which have the potential to lead to a significant effect and/or to contravene relevant legislation
- For these ecological changes, determining the area within which each change could cause a likely significant effect or could contravene relevant legislation (i.e. an 'ecological ZoI' – see Box 5.2)
- Comparing the area where the receptor occurs with the ecological ZoI
- If the receptor occurs or is likely to occur within the ZoI, concluding that either the receptor could be subject to a significant effect and/or the relevant legislation could be contravened, in which case the effects upon the receptor are scoped in, or no significant effect is likely to occur and it is scoped out.

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Box 5.2: Defining Ecological ZoI

The ecological ZoI that is the most straightforward to define is the area affected by land- take and direct land-cover changes associated with the development. This zone is the same for all affected receptors. By contrast, for each environmental change that can extend beyond the area affected by land-take and land-cover change (e.g. changes in noise associated with development activities within the land-take area), the ZoI may vary between receptors, dependent upon the receptors' sensitivity to the change and the precise nature of the change.

For example, dormouse might be unaffected by noise associated with a development unless the noise is generated very close to where the dormouse nests, while another mammalian species might be disturbed at much greater distances; other species (e.g. of invertebrate) may be unaffected by changes in noise. A further complication is that the response of a receptor to a change associated with one development may differ to the response of the same receptor to a similar change on another development. This can occur as a result of the wide range of variables that influences the precise nature of any change (e.g. for noise this can include: differing baseline noise conditions; specific magnitude, timing or other characteristics of the noise; and the effects of screening and topography).

In view of these complexities, the definition of the zones of influence that extend beyond the land-take area will be based upon professional judgement, informed by discussions with the technical specialists who are working on other aspects of the planning application. These specialists will provide information about the environmental changes that they have assessed if required. This information will be combined with available ecological information about receptors' sensitivities to different environmental changes in order to define the extent of each ecological ZoI.

The key issues relating to biodiversity receptors and the proposed development are as follows:

- The effects of temporary and permanent habitat loss from land take by construction areas
- Damage/harm to flora and fauna
- The effects of pollution (construction dust and pollution from accidental spillage of fuels, lubricants etc. that may affect terrestrial habitats
- Noise, visual or light disturbance to fauna
- The positive effects of ecological enhancement from creation, enhancement and management of habitats

There are a range of biodiversity receptors at the application Site and there is also a wide variation in the spatial influence of different elements of the development proposals. For example, the majority of changes are localised (e.g. physical changes to habitats along the corridor of the proposed shared-use pathway).

Consequentially, the spatial scope of the assessment varies between different receptors and the ZoI associated with each of the different components of the construction and operational phases of the development proposals.

The effects of temporary and permanent habitat loss from land take construction and operational phases of the proposed development were initially considered across the whole application Site, but then refined on the basis of the presence/absence of specific habitats within the development footprint (e.g. undisturbed potential breeding bird habitat within or adjacent to an area of change/development), the affinity of particular species for these habitats, in combination with the function of the on-site habitat to species that use key habitats located off-site (e.g. great crested newt breeding in ponds up to 250m away, or bats roosting within 2km).

Consideration of potential disturbance to ecological receptors from light was extended across the application Site and surrounding parcels of land.

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5.4 POTENTIAL ECOLOGICAL RECEPTORS AND SIGNIFICANT EFFECTS

Table 5.1 summarises information regarding the receptor ecological habitats and species that have been identified through the scoping process as having the potential to be significantly affected by the proposed development and the legislation that could be contravened as a result of the proposed development without implemented mitigation and the potential effects that need to be assessed.

Additionally, Table 5.1 below summarises the details of receptor habitats and species that have been scoped out of further assessment due to non-presence or no potential impacts predicted from the proposed development.

Table 5.1: Scoping Results of Potential Ecological Receptors and Legislation

Potential Receptor	Important/ valued and/or legally protected?	Relevant criteria and legislation	Potentially significant effects/ legal contravention and causal changes
Non-statutory designated sites: • Kennet & Avon Canal LWS • Conigre Mead LWS • Bristol River Avon LWS	Biodiversity conservation status	County importance NERC Act 2006 S.41 Habitats and Species of Principal Importance	These non-statutory Local Wildlife Sites are all located more than 1.5km from the Site. Given the small-scale nature of the proposals and distance from the Site, effects on the ecological status of these sites is considered unlikely. **Scoped out of the assessment**
Hedgerows	Biodiversity conservation value	Local importance NERC Act 2006 S.41 Habitat of Principal Importance	There is the potential for accidental damage to this adjacent habitat from construction activities including dust deposition, soil compaction and direct damage from plant and/or machinery. **Scoped into the assessment**
U1c: Artificial unvegetated unsealed surface	No	N/A	This habitat type is widespread and of negligible ecological value. **Scoped out of the assessment**
G4: modified grassland	No	N/A	0.123ha of modified grassland will be lost to the scheme. However, 0.25ha of grassland will be improved to provide 'other neutral grassland' habitat which is of higher ecological value. **Scoped out of the assessment**
Bats	Biodiversity conservation value Legal status	District importance Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 NERC Act 2006 S.41 Species of Principal Importance Wildlife & Countryside Act 1981	Vegetation management/ change as well as introduced lighting could result in modification of bat activity, which could have implications for the viability of local populations. Habitat management will result in an increase in grassland foraging habitat. **Scoped into assessment**

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Potential Receptor	Important/ valued and/or legally protected?	Relevant criteria and legislation	Potentially significant effects/ legal contravention and causal changes
Amphibians (GCN)	Biodiversity conservation value Legal status	District importance Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 NERC Act 2006 S.41 Species of Principal Importance Wildlife & Countryside Act 1981	Ponds surveyed in 2022 as part of the current study returned negative results for GCN eDNA. It is therefore considered unlikely that this species will be present on Site, as habitats are sub-optimal. **Scoped out of the assessment**
Badger	Legal status	Local importance Protection of Badgers Act 1992	No signs of badger activity identified from surveys of the Site and immediately adjacent areas. Loss of limited foraging habitat as a result of the proposals. Occupational affects from increased artificial lighting (external and internal) could result in indirect low-level impacts on foraging and commuting badgers if present in the wider local area. **Scoped out of the assessment.**
Common reptiles	Biodiversity conservation value Legal status	Local importance Wildlife & Countryside Act 1981	No evidence of common reptile species was recorded during the course of presence/ absence surveys carried out in 2022. It is therefore considered unlikely that this species will be present on Site, as habitats are sub-optimal. **Scoped out of the assessment**
Otter	Biodiversity conservation value Legal status	District importance Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 NERC Act 2006 S.41 Species of Principal Importance Wildlife & Countryside Act 1981	No evidence of otter was recorded during the course of surveys conducted in 2022. It is therefore considered unlikely that this species will be present on Site, as habitats are sub-optimal. **Scoped out of the assessment**
Water vole	Biodiversity conservation value Legal status	Local importance Wildlife & Countryside Act 1981	No evidence of water vole was recorded during the course of surveys conducted in 2022. It is therefore considered unlikely that this species will be present on Site, as habitats are sub-optimal. **Scoped out of the assessment**

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Potential Receptor	Important/ valued and/or legally protected?	Relevant criteria and legislation	Potentially significant effects/ legal contravention and causal changes
Birds (see Appendix A)	Biodiversity conservation value Legal status	National importance (BoCC Red List Species) Wildlife & Countryside Act 1981	Construction activities could result in the risk of accidental disturbance of nesting birds/ loss of adults/ young/ eggs. Habitat management would result in an increase in suitable foraging and nesting habitat within the Site. **Scoped into the assessment**

5.5 CLIMATE CHANGE

Greenhouse gas (GHG) emissions contribute to climate change, which could affect the designated features of local sites, habitats and species considered in this EcIA. For example: climate change may lead to changes in the distribution of bats due to other areas within the UK and abroad becoming more suitable for the species, leading to decline in local populations.

The Climate Change Adaptation Manual – Evidence to Support Nature Conservation in a Changing Climate produced by Natural England (2020) supports practical and pragmatic decision making and guides reasonable judgement on the potential effects of climate change on the key habitats associated with the application Site. The habitats that characterise the application site: for example, modified grassland, artificial unvegetated unsealed surface and hedgerows are of low vulnerability to climate change.

Climate change and its implications for biodiversity have been incorporated into the design of embedded ecological mitigation and enhancement habitats to reduce the risk of impact on legally protected and other species. Selection of measures that are based on habitats that are known to be more resilient to climate change and provide extended ecological functionality for a wide range of species across the Site have been selected.

This has largely been achieved through the creation of additional areas of replacement habitat that are considered to have a low level of sensitivity to climate change (subject to appropriate management). These measures are associated with the creation of 'other neutral grassland' habitat and the retention of hedgerows, woodland and ponds with the primary objective to support native wildlife.

As a result, no further biodiversity mitigation for climate change as part of the proposed development is required beyond that included in the embedded mitigation and enhancements set out in Section 7, including management and monitoring beyond that identified.

5.6 TEMPORAL SCOPE

The temporal scope of the assessment of biodiversity is consistent with the period over which the proposed development would be carried out and therefore covers the construction and operational periods. Should permission be granted, the pre-construction phase of the proposed development is likely to commence in 2023.

Potential effects on biodiversity receptors have the potential to arise for part of, or the entirety of, the construction phase and the operational phase. The impacts from all construction and operational activities have been considered and the assessment has identified which activities are likely to cause effects on each specific biodiversity receptor.

5.7 INTER-RELATED EFFECTS

There are two types of inter-related effect:

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- Combined effects: when individual effects of the proposed development combine to create a cumulative effect; and
- Interactive effects: consideration of interactions between different effects in relation to a specific receptor.

Combined effects normally occur when different activities associated with a project act upon the same ecological receptor (e.g. the additive effect of physical disturbance from construction activities upon nesting birds may occur at the same time as transport related noise and lighting, that may act upon the same receptor(s) during the construction phase). In determining such effects, consideration would be given to the sensitivity of the receptor and the magnitude of ecological change. This is considered directly within the assessments included in this EcIA and, as such, is not reported separately.

Interactive effects are assessed in relation to a specific receptor where the effect could be caused by the interactions of different types of effect from project activities even if individually these are insignificant (e.g. the interaction of noise disturbance and lighting changes on bats).

The assessment of effects on biodiversity receptors has the potential to be exacerbated by climate change, and this has been incorporated into the approach to integrated and embedded mitigation as set out in this EcIA.

5.8 RECEPTORS SCOPED OUT OF FURTHER ASSESSMENT

The following receptors have been scoped out from being subject to further assessment because the potential effects are either absent or not considered likely to be significant:

- The three non-statutory designated sites within 2km of the Site have been scoped out of further assessment as the scale and nature of the proposals and distance from the Site, effects on the ecological status of these sites is considered unlikely.
- UKHab classifications that are not S41 Priority Habitat types, including modified grassland and artificial unvegetated unsealed surfaces have been scoped out of further assessment as they are of limited biodiversity value and potential effects to these habitats are not considered significant (although they are taken into account in terms of the Defra 3.1 Biodiversity Metric and calculation of Biodiversity Net Gain).
- Badger – No evidence of badger was recorded during the surveys. The level of survey effort undertaken is considered sufficient to conclude the likely absence of this species from the Site. Therefore, on this basis, badgers have been scoped out of further assessment.
- Common Reptiles – No evidence of common reptiles was found during the surveys, nor during the course of other protected species surveys. The level of survey effort undertaken is considered sufficient to conclude the likely absence of this species from the Site. Therefore, on this basis, badgers have been scoped out of further assessment.
- Great Crested Newt – Negative eDNA results were returned for ponds within the immediate vicinity of the Site and it is therefore considered reasonable to conclude that GCN are absent from the Site. On this basis the species group has been scoped out of further assessment.
- Otter and Water Vole – No evidence of either species was identified during the site surveys, and it is therefore reasonable to conclude that these species are absent from the Site and immediately adjacent habitats. Therefore, on this basis, otters and water voles have been scoped out of further assessment.

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6 ENVIRONMENTAL MEASURES INTEGRATED AND EMBEDDED INTO THE PROPOSALS

6.1 INTRODUCTION

A range of environmental measures have been integrated and embedded into the development proposals as outlined in this Section. The design process has included consideration of the ecological constraints and has incorporated measures to reduce the potential for adverse ecological effects in accordance with the 'mitigation hierarchy' (Avoid, Mitigate, Restore, Offset, Compensate) and relevant legal requirements and planning policy. The measures identified and adopted include those that are inherent to the proposed development and can be expected to be applied as part of construction environmental best practice methods, which are a result of legislative requirements.

The development design and impact avoidance measures will be adopted during the construction and occupation phases of the proposed development. Table 6.1 outlines how these embedded measures will influence the biodiversity assessment. A Construction Ecological Management Plan (CEMP) will be produced through Planning Condition that will set out full details of the requirements of these measures during the pre-commencement and construction phases of the proposals.

Table 6.1: Summary of Integrated and Embedded Biodiversity Mitigation and Enhancement Measures

Receptor	Changes and Effects	Integrated/Embedded Measures and Influence on Assessment
Hedgerows	All hedgerows will be retained as part of the proposals. However, there is the potential for the proposals to affect hedgerows through accidental damage by plant/ machinery movements, soil compaction, accidental spillages of contaminants (e.g. fuels) and dust deposition. An increase in anthropogenic pressure from use of the shared-use pathway and an increase in artificial lighting may impact the biodiversity value of this habitat. On-going appropriate management will increase the biodiversity value of this habitat and provide suitable habitat for a range of legally protected and/or notable species.	<u>Construction</u> 1. Preparation and implementation of an appropriate Construction Ecological Management Plan (CEMP) through Planning Condition to set out specific measures, supervision and monitoring to avoid or minimise all potential construction related effects arising from: lighting; vibration; noise; dust and pollutants affecting retained vegetation, using industry best practice methodologies and guidance. All ecological elements to be supervised by a suitable qualified ecologist (Ecological Clerk of Works – EcoW) or carried out by ecologists and ecological contractors. 2. Preparation of an appropriate Landscape and Ecological Management Plan (LEMP) through Planning Condition to introduce a long-term programme of high quality and appropriate of retained, enhanced and newly created habitats to maximise habitat diversity, quality and ecological value. All works to be supervised by a suitably qualified ecologist and carried out by ecologists and ecological contractors. 3. Linear habitats (such as hedgerows) will not be subject to an increase in lighting levels (<0.5 lux) during construction works. There will be no construction lighting used between dusk and dawn, to minimise impacts on nocturnal species i.e. bats.

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Receptor	Changes and Effects	Integrated/Embedded Measures and Influence on Assessment
		Operation A. A detailed lighting strategy for the Site will be prepared by specialist lighting consultants in consultation with a suitable qualified ecologist to ensure continued ecological functionality of linear habitats for a range of legally protected and/or notable species such as bats whilst ensuring the pathway is safe for users. B. The LEMP will be implemented during operation to manage the retained and newly created habitats within the Site to maximise their biodiversity value.
Bats	Potential for direct negative effects to the foraging and commuting behaviour of bat species associated with the Site. Negative effects could result from habitat degradation and increased lighting impacts on existing commuting routes as a result of the proposed development. Creation of a dark corridors adjacent to the shared-use pathway and retention of existing confirmed commuting routes and foraging habitat will maintain the ecological functionality of the Site, with low lux levels maintained throughout the year.	Construction Measures 1, 2, and 3 Operation Measures A and B
Birds	Potential direct effects on birds, young and/or eggs due to disturbance, damage or destruction of active nests associated with limited vegetation removal/ management and from construction related noise, lighting and vibration. On-going habitat management will provide enhanced areas of suitable nesting habitat.	Construction Measures 1, 2, and 3 4. Avoidance of potential effects on actively nesting birds, young, eggs and nest through the avoidance of vegetation clearance between February and August inclusive, or through the use of a suitably qualified ecologist who has confirmed no nesting activity present within 48 hours of works commencing between February and August. Operation Measures A and B

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7 ASSESSMENT OF RESIDUAL EFFECTS AND EMBEDDED MITIGATION MEASURES

7.1 INTRODUCTION

A range of measures have been integrated and embedded into the development proposals as outlined in Table 6.1 in Section 6. The design process for the proposed development has included consideration of the ecological constraints from an early stage and has incorporated measures to reduce the potential for adverse ecological effects in accordance with the 'mitigation hierarchy', legal requirements and relevant planning policy. The measures identified and adopted include those that are inherent to the proposed development and can be expected to be delivered as part of the scheme.

7.2 LIKELY SIGNIFICANT EFFECTS

Based on the assessment methodology set out in Section 3, Table 5.1presents those receptors that have been identified (through the scoping process) as having the potential to be significantly affected by the proposed development (due to their biodiversity conservation value and/or for which legislation could be contravened). Table 5.1 identifies the potential changes and effects that need to be assessed for each of these receptors.

In broad terms, the changes and effects that may occur as a result of the proposals and which may give rise to significant effects on those ecological receptors scoped into this assessment have been identified as:

- Habitat loss from construction
- Pollution incidents during construction including dust generation
- Damage/harm to flora and fauna during construction activities from machinery/ plant or as a result of un-authorised access into valued areas of habitat
- Disturbance (from noise, vibration, visual and light) to surrounding habitats and associated species
- Habitat enhancement and creation prior to or during the construction phase
- Habitat management once the shared-use pathway is in use

The following sections present the assessment of effects on each of the receptors that have been scoped into this EcIA, taking the embedded mitigation measures into account for both construction and occupational phases of the development. Where significant residual effects remain, Section 10 presents the additional mitigation/ compensation measures that will be implemented in order to further reduce these residual effects until they are considered to be not significant.

7.3 ASSESSMENT OF RESIDUAL EFFECTS: HEDGEROW

Hedgerows H1, H2, H3 and H4 will run alongside the proposed shared-use pathway and there is therefore the potential for this habitat to be affected by the proposals both during the construction and operational phases. Hedgerows H3 and H4 were identified as Important under the Hedgerow Regulations, owing to their species diversity and associated features and should therefore be protected. The hedgerows also provide valuable habitat for a range of legally protected and/or notable species, including bats and breeding birds.

Construction

Accidental damage to habitat

There is the potential for construction damage of the hedgerow habitat adjacent to the working area to occur as a result of soil compaction and/or direct damage to the woody species present from the movement of plant/

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machinery/ construction vehicles. There is also the potential for construction related contaminants (e.g. fuels) to enter the soil through accidental spillages during construction and for airborne pollutants (e.g. dust) to settle on vegetation. Accumulation of rubbish/ waste may also occur.

The implementation of embedded Mitigation Measures 1 and 2 outlined in Table 6.1 will ensure these potential effects are avoided or minimised. The production and implementation of a CEMP will reduce the potential for construction related effects through the adoption of industry standard working methods, including those for dust suppression, correct storage of fuels and other potential contaminants and correct disposal of waste materials. Ecological toolbox talks will be mandatory for all construction personnel, with certain tasks being supervised by an ECoW. The production of a LEMP will ensure that all retained habitats (including the hedgerow) are managed appropriately to maximise their biodiversity value.

The installation of suitable protection fencing to prevent accidental access would protect hedgerows from direct damage by plant/ machinery and also reduce the likelihood of root damage occurring as a result of soil compaction. Signage should be used as appropriate to identify no-access areas.

Taking into account the inherent mitigation measures contained in Table 6.1 and discussed above, a minor magnitude of change is predicted which generates no likely significant effect on hedgerows.

Lighting

There is the potential for disturbance to foraging and commuting bats and other nocturnal species (e.g. badgers and hedgehogs) from construction lighting illuminating hedgerow habitats. Integrated/ embedded Mitigation Measure 3 will ensure that artificial lighting of hedgerows is kept below 0.5 lux during construction. There will be no overnight lighting during the construction phase of the development.

Taking into account the inherent mitigation measures contained in Table 6.1 and discussed above, a minor magnitude of change is predicted which generates no likely significant effect on hedgerow habitat.

Operation

Habitat Management

Appropriate management of all retained and newly created habitat during the operational phase of the shared-use pathway will be required to ensure the pathway remains usable (with no vegetation encroachment) and ensure maximum biodiversity net gain is achieved (and maintained) as a result of the proposals and no habitat loss through degradation/ increased recreational pressure occurs. The implementation of Measure B in Table 6.1 (LEMP) will ensure that all habitats are appropriately managed.

Consequently, a minor magnitude of change is predicted, which is positive but does not constitute a significant effect on hedgerow habitat at the Site.

Lighting

The shared-use path must be illuminated for the safety of users, particularly in low light conditions or at night. It is likely to be used by schoolchildren travelling from the new residential development in the north to/from Melksham Oak School, and as such must be a safe route for them to use. Integrated/ embedded Mitigation Measure A (see Table 6.1) will ensure that safety and biodiversity are both accounted for within an appropriate lighting strategy for the pathway. No boundary habitats (including hedgerows) will be exposed to operational lighting levels that exceed those required for safety (ideally 0.5 lux) to ensure their continued functionality for nocturnal species. Operational lighting for the site will be designed by specialist lighting consultants in consultation with the project ecologists to ensure continued ecological functionality of the Site.

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Taking account of the inherent mitigation measures contained in Table 6.1 and discussed above, a minor magnitude of change is predicted which generates no likely significant effect on hedgerows.

7.4 BREEDING BIRDS

Habitats associated with the Site (including those in immediately adjacent areas) have the potential to support a range of bird species during the breeding season.

7.4.1 Construction

Disturbance and Habitat Loss

Construction phase impacts on birds relate to the potential disturbance to foraging and active nests and breeding birds/ eggs and young through the removal/ management of limited areas of suitable habitat (e.g. management of hedgerows to provide an adequate working area during construction of the pathway). The implementation of embedded Mitigation Measures 1, 2 and 4 will avoid or minimise potential effects to breeding birds during the construction phase.

The implementation of a CEMP, (Measure 1 in Table 6.1) will minimise potential construction related effects through the use of best practice industry working methods. Potential effects to birds, their nests, eggs and/or young will also be avoided through the implantation of integrated/ embedded Measure 4, whereby vegetation clearance/ management will occur outside the bird nesting season (February to August inclusive). Where this is not possible, a suitable qualified ecologist will confirm no nesting activity is present within 48 hours of clearance/ management by undertaking a careful search of the vegetation. Should active nests be present, the nest and a 5-10m buffer will need to be protected and clearance/ management works within this area delayed until the chicks have fledged (as confirmed by an ecologist).

By undertaking vegetation management/ removal works outside of the bird nesting season, or by implementing a system of checks immediately prior to works where this is not possible, legal offences under the Wildlife & Countryside Act 1981 (as amended) are considered unlikely to occur. Alternative areas of suitable habitat exist both within retained on-Site habitats and in immediately adjacent areas.

Taking into account the inherent mitigation measures contained in Table 6.1 and discussed above, a minor/ neutral magnitude of change is predicted which generates no likely significant effect on the local breeding bird population.

7.4.2 Operation

Habitat Management

Potential operational effects on breeding birds relate to improved habitat quality through the integrated measures associated with management of habitats (particularly hedgerows) along the route of the proposed shared-use pathway. Detailed management prescriptions will be agreed with Wiltshire Council and implemented for all retained and newly created habitats as part of a LEMP (Measure B). A considered Lighting Strategy will be produced (Measure A) to minimize potential disturbance effects to breeding birds through inappropriate lighting of suitable habitats during the operational phase of the proposed pathway.

Consequently, a positive minor magnitude of change is predicted, but which generates no significant effect as a result of the habitat management proposals across the Site for breeding birds.

7.5 BATS

Multiple bat species were recorded using linear habitats within the Site for commuting and foraging during the activity and automated detector surveys.

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A number of light sensitive species were recorded, including lesser and greater horseshoe bat, barbastelle, Myotis species as well as brown long-eared bat. These slower flying bats species typically avoid illuminated areas in favour of other, potentially less-desirable areas for foraging and commuting. Although they have been recorded using the dark corridor strip through the centre of the Site, the hedgerow, trees and woodland in this area are being retained. This will ensure that commuting routes along existing hedgerows will be maintained.

Other species, (including common pipistrelle, soprano pipistrelle, noctule and serotine), are typically light tolerant. These species have been seen to use outdoor lighting to their advantage by feeding on the invertebrates attracted to some short wave (UV) light sources.

The following section presents an assessment of the residual effects associated with all bat species using the Site as a result of the proposals.

7.5.1 Construction

Implementation of integrated/ embedded Mitigation Measures 1,2 and 3 will ensure that potential impacts on bat species as a result of the development proposals are avoided or minimised.

Foraging and Commuting Habitat

There is the potential for direct negative effects to the foraging and commuting behaviour of bat species associated with the Site and adjacent habitats. Negative effects could result from habitat degradation and increased lighting impacts on existing commuting routes.

The CEMP (Measure 1) will minimize potential construction related effects on bats through the implementation of good practice industry working methods. The installation of appropriate fencing (as required) to prevent accidental access will protect hedgerow habitats from damage by vehicle movements and plant/ machinery, with signage to be used thereby maintaining dark corridors for foraging and commuting bats.

Hedgerows will not be subject to an increase in lighting levels (<0.5 lux) during the construction phase. There will be no construction lighting used between dusk and dawn, to minimize impacts on nocturnal species such as bats (Measure 3).

Based on the information currently available, there is considered to be a minor negative effect on foraging and commuting bats, although this is not likely to be significant.

7.5.2 Operation

Habitat Management

There is the potential for habitats adjacent to the shared-use pathway that are used by bats to become degraded over time through a lack of appropriate management and increased anthropogenic pressure from users of the pathway. The production and implementation of a LEMP (Measure B) will introduce a long-term programme of high-quality and appropriate management of all retained hedgerows/ linear features within the Site which will increase their ecological quality and function. All works will be supervised where necessary by a suitable qualified ecologist and carried out by experienced contractors.

Taking into account the inherent mitigation measures contained in Table 6.1 as discussed above, a positive minor magnitude of change is predicted which generates no likely significant effect on the local bat population.

Lighting

Integrated/ embedded Measure A will ensure that a considered Lighting Strategy is produced for approval by Wiltshire Council which will minimize potential disturbance effects to foraging and commuting bats through the use

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of appropriate lighting during the operational phase of the proposed pathway. Section 7.6 provides guidance around lighting and bats which should be considered during development of the detailed lighting strategy for the pathway.

Taking into account the inherent mitigation measures contained in Table 6.1 and discussed above, a neutral magnitude of change is predicted which generates no likely significant effect on the local bat population.

7.6 LIGHTING RECOMMENDATIONS

7.6.1 Desirable height, style, and lumen levels

- The lighting on Site should come in the form of council approved lighting columns with hoods and cowls to angle the light downwards and towards the path; shading the grassland, hedgerow and sky, as best as possible.
- LED luminaires should be used where possible due to their sharp cut-off, lower intensity, good colour rendition and dimming capability.
- A warm white spectrum (ideally <2700Kelvin) should be adopted to reduce blue light component.
- Luminaires should feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats (Stone, 2012).
- No Site boundary habitats (hedgerow and grassland) will be exposed to lighting levels as the path alignment in the northern field was altered following the bat surveys and discussion with the LPA ecologist. The alignment was moved 5m into the field to protect boundary habitats from any light spill.

7.6.2 Quantity of lighting

- Lighting should be staggered along the pathway, only illuminating the areas needed, without excess. Reduced quantity of bollard lighting will not only be economically cheaper but ensure minimum light spill onto surrounding habitat.
- Lighting will be required more throughout the dark corridor in the centre of the Site, but there is the opportunity for more staggered lighting in the north and south of the Site where moonlight and light spill from road lights will come into play.

7.6.3 Time of day and year

- The lighting scheme should adapt with the demand of traffic going to use the Site during the day and night. Lighting could be adjusted to turn on around the times at which Melksham Oak School opens and closes with an hour or two buffer either side to account for extracurricular activities (i.e. turn on 3pm – 6pm in the winter months).
- The lighting scheme should adapt to seasonal changes, i.e. daylight savings. The need for lighting will be increased during the winter months when sunset is earlier, which also is the time at which bats are (typically) in their hibernation stage. Lighting could stay on for longer during these periods to account for any changes in school routines and provide a safer environment during the darker hours of the day.

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8 CUMULATIVE EFFECTS

A search of the Wiltshire Council planning portal for the area within 1.5km of the Site for developments that could have a cumulative effect alongside the proposals was undertaken by Johns Associates Ltd in November 2022. Currently registered and previous planning applications within the last 3 years were considered to be predominantly small scale in nature and included domestic extensions, building alterations, tree works, signage/ lighting, small-scale developments (single dwellings) and change of use applications.

Due to the scale and nature of the proposed development, (including the integrated/ embedded mitigation and enhancement measures described in Table 6.1 that form part of the proposals), the associated localised Zone of Impact and low magnitude of predicted change, it is concluded that no additional in-combination effects will arise from the proposals when considered alongside other current and recent planning applications in the local area. The overall ecological enhancement of the Site (through the retention/ creation of habitats and the implementation of a LEMP) is likely to have a positive effect on the ecological status of protected species within the local area and the biodiversity value of habitats within the Site and immediately adjacent areas.

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9 IMPLEMENTATION OF BIODIVERSITY MEASURES AND MONITORING

Table 9.1 summarises the environmental measures mentioned within the proposed development and this report, and the means by which they will be implemented

Table 9.1: Summary of Environmental Measures to be Implemented

Environmental Measure	Responsibility for Implementation	Compliance Mechanism
Production and implementation of a Construction Ecological Management Plan (CEMP)	Contractor/Project Ecologist	Planning condition
Production and implementation of a Landscape and Ecology Management Plan (LEMP)	Sustrans/ Contractor/Project Ecologist	Planning condition
Ecological toolbox talk and register of attendance for all persons working within the construction area	Contractor/ Project Ecologiost	Planning condition
Suitably Qualified Ecologist / Ecological Clerk of Works/ Ecological Contractors to manage, monitor, supervise and implement all ecological aspects of the proposals	Contractor/Project Ecologist	Planning condition
Retention and protection of all hedgerows with suitable barriers	Contractor	Planning condition
Implementation of all on-Site landscape/ habitat measures in accordance with CEMP/ LEMP and the Integrated/ Embedded Mitigation Measures	Wiltshire Council/ Project Ecologist/ Contractor/ Operator	Planning condition

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10 CONCLUSIONS OF SIGNIFICANCE EVALUATION

Considering the ecological baseline, the integrated and embedded ecological mitigation and enhancement measures and the assessment of likely significant effects as set out in Section 7 of this EcIA, it is considered reasonable to conclude that no negative significant effects will occur to important biodiversity receptors, including legally protected species and designated sites, from either the construction or occupation stages of the proposed development. A range of positive effects on biodiversity are considered likely as a result of the proposals.

There are no known proposed developments within the wider landscape surrounding the Site that will have a cumulative effect with the proposed development.

Furthermore, the development proposals are considered to meet the requirements of local and national planning policy alongside best practice in relation to the construction and long-term management of the Site.

The use of the Defra Biodiversity Metric 3.1 has demonstrated that the proposals will also deliver a positive 13.96% Biodiversity Net Gain in line with national policy as well as best practice.

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APPENDIX A – PRELIMINARY ECOLOGICAL APPRAISAL REPORT

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APPENDIX B – UKHABITAT SURVEY MAP & TARGET NOTES



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- Site Boundary
- h2a - hedgerow (priority habitat)
- r1 - standing open water and canals
- u1e - built linear feature
- g4 - modified grassland
- r1 - standing open water and canals
- u1a - open mosaic habitats on previously developed land
- u1b5 - buildings
- u1c - artificial unvegetated unsealed surface
- w1h5 - other woodland, mixed, mainly broadleaved
- Secondary Codes and Target Notes

Point/Habitat Ref	Secondary Codes
A	96
B	710
C	511
D	10, 103, 119, 160
E	14, 119, 160, 4200
F	10, 119, 420
G	103, 199, 160, 420
P1	364
P2	162
P3	362
H1	35
H2	35
H3	70
H4	70
H5	70, 159, 190
H6	10
r1	199
u1c	17, 420

REV	NOTES	DATE
A	Amended site boundary	10/11/2022

CLIENT Sustrans

PROJECT Melksham School Link PEA

TITLE UKHab Classification Survey

SCALE @ A3	CREATED BY	CHECKED BY
1:2,500	CA	MS
REFERENCE	**ISSUE/REVISION**	**DATE**
J00990-002	A	27/10/2022

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APPENDIX C – POND LOCATIONS



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APPENDIX D – BAT TRANSECT ROUTE, STATIC DETECTOR LOCATIONS & SPECIES LOCATIONS



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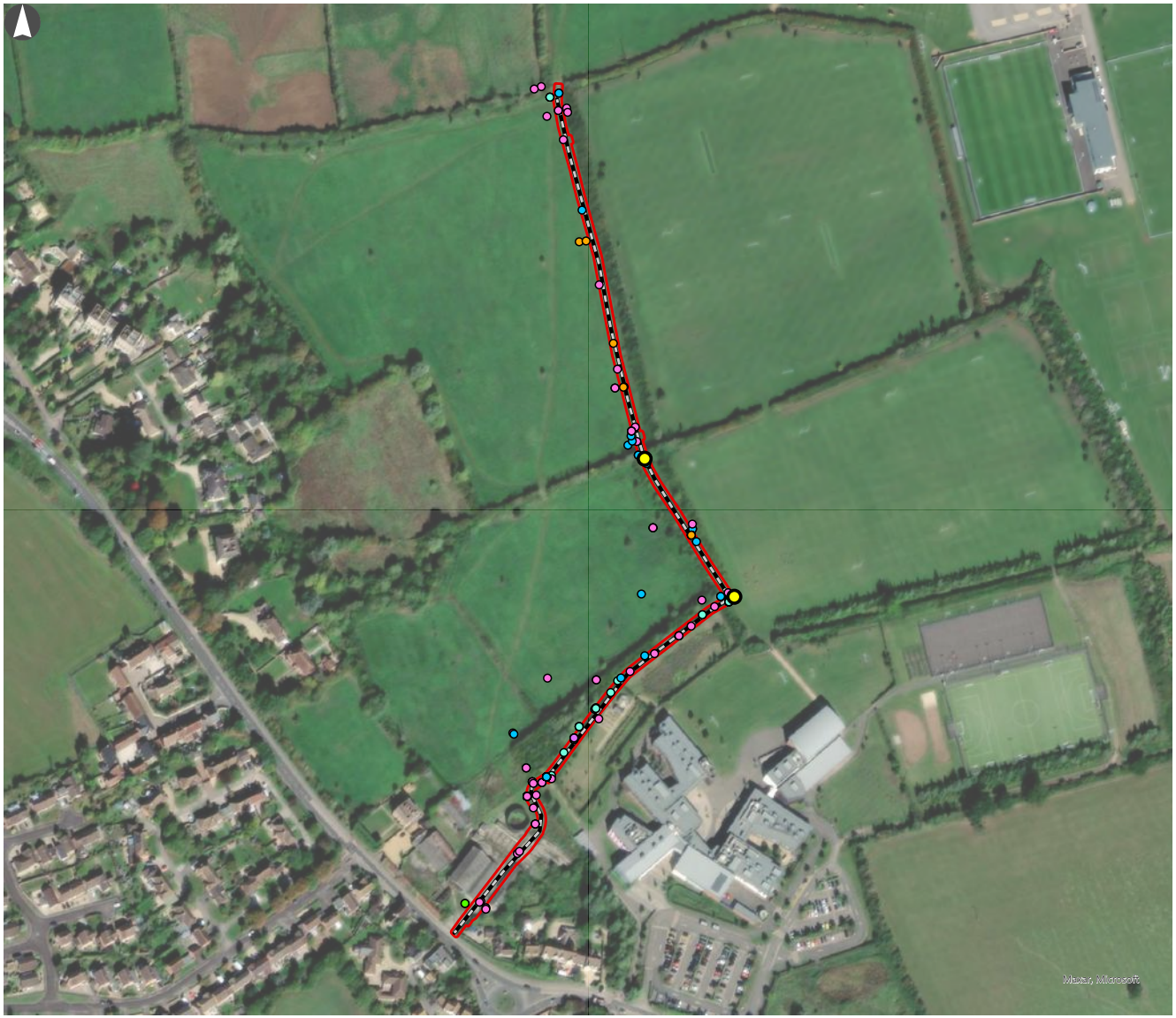

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- Site Boundary
- Transect route
- Rhinolophus hipposideros
- Myotis Species
- Nyctalus Species
- Nyctalus noctula
- Pipistrellus pipistrellus
- Pipistrellus pygmaeus
- Plecotus auritus

CLIENT Sustrans

PROJECT Melksham School Link PEA

TITLE Detected Bat Species

SCALE @ A3	CREATED BY	CHECKED BY
1:2,500	CA	MS
REFERENCE	**REVISION**	**DATE ISSUED**
J00990-007		22/11/2022

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APPENDIX E – DISUSED BADGER SETT LOCATION AND REPTILE SURVEY AREA



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Site Boundary
Reptile Survey
Badger Sett

REV	NOTES	DATE
A	Amended site boundary	10/11/2022

CLIENT Sustrans

PROJECT Melksham School Link PEA

TITLE Badger Setts and Reptile Surveys

SCALE @ A3	CREATED BY	CHECKED BY
1:2,500	CA	MS
REFERENCE	**REVISION**	**DATE ISSUED**
J00990-005	A	27/10/2022

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APPENDIX F – PROPOSED BNG ENHANCEMENT AREA AND SCHEME DESIGNS



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- Site Boundary
- g3c - other neutral grassland
- u1b - developed land, sealed surface
- g4 - modified grassland
- u1a - open mosaic habitats on previously developed land
- u1c - artificial unvegetated unsealed surface
- w1h5 - other woodland, mixed, mainly broadleaved

CLIENT Sustrans

PROJECT Melksham School Link Pathway

TITLE Proposed UKHab Classification

SCALE @ A3	CREATED BY	CHECKED BY
1:2,250	CA	MS
REFERENCE	**ISSUE/REVISION**	**DATE**
J01005-003		29/9/2023

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APPENDIX G – DEFRA METRIC 3.1 HEADLINE RESULTS AND CONDITION ASSESSMENT SHEET

On-site baseline	*Habitat units*	**1.50**
	Hedgerow units	**0.00**
	River units	**0.00**
On-site post-intervention (Including habitat retention, creation & enhancement)	*Habitat units*	**1.71**
	Hedgerow units	**0.00**
	River units	**0.00**
On-site net % change (Including habitat retention, creation & enhancement)	*Habitat units*	**13.96%**
	Hedgerow units	**0.00%**
	River units	**0.00%**
Off-site baseline	*Habitat units*	**0.00**
	Hedgerow units	**0.00**
	River units	**0.00**
Off-site post-intervention (Including habitat retention, creation & enhancement)	*Habitat units*	**0.00**
	Hedgerow units	**0.00**
	River units	**0.00**
Total net unit change (including all on-site & off-site habitat retention, creation & enhancement)	*Habitat units*	**0.21**
	Hedgerow units	**0.00**
	River units	**0.00**
Total on-site net % change plus off-site surplus (including all on-site & off-site habitat retention, creation & enhancement)	*Habitat units*	**13.96%**
	Hedgerow units	**0.00%**
	River units	**0.00%**
Trading rules Satisfied?		**Yes ✓**

The full Defra Metric 3.1 Biodiversity Net Gain Calculation Spreadsheet is submitted separately.

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Condition Assessment Sheet for Grassland

Condition Sheet: GRASSLAND Habitat Type (low distinctiveness)			
UKHab Habitat Type(s)			
Grassland - Modified grassland			
Site name/location	Melksham Oak School Link	**Onsite/offsite**	Onsite
Central grid reference of habitat		**Unique polygon reference**	
Limitations (if applicable)	The time of yar was suboptimal for grassland surveys.	**Metric 3.0 survey reference (if condition assessment of this polygon relates to a wider habitat survey)**	

Habitat Description

See UKHab

	Condition Assessment Criteria	Condition Achieved (Y/N)	Notes/Justification
1	There must be 6-8 species per m2. If a grassland has 9 or more species per m2 it should be classified as a medium distinctiveness grassland habitat type. **NB - this criterion is essential for achieving moderate condition.**	Y	<8 species, however, the time of year was suboptimal for grassland surveys, therefore may need updating in Spring/ Summer.
2	Sward height is varied (at least 20% of the sward is less than 7 cm and at least 20% is more than 7 cm) creating microclimates which provide opportunities for insects, birds and small mammals to live and breed.	N	Well-trodden path - has short sward
3	Some scattered scrub (including bramble) may be present, but scrub accounts for less than 20% of total grassland area. Note - patches of shrubs with continuous (more than 90%) cover should be classified as the relevant scrub habitat type.	Y	
4	Physical damage is evident in less than 5% of total grassland area. Examples of physical damage include excessive poaching, damage from machinery use or storage, erosion caused by high levels of access, or any other damaging management activities.	N	Damaged through access by vehicles and footfall from public and dogs
5	Cover of bare ground is between 1% and 10%, including localised areas (for example, a concentration of rabbit warrens).	Y	Bare ground exceeds 10% in places but overall, around 10% (wet muddy unvegetated patches)
6	Cover of bracken less than 20%.	Y	No bracken
7	There is an absence of invasive non-native species (as listed on Schedule 9 of WCA, 1981).	Y	No invasive species present
		Essential criterion 1 achieved (Y/N)	Y
		Number of criteria passed	5

Condition Assessment Result	Condition Assessment Score	Score Achieved ×/✓
Passes 6 or 7 of 7 criteria including passing essential criterion 1	Good (3)	
Passes 4 or 5 of 7 criteria; OR Passes 4 or 5 of 7 criteria including passing essential criterion 1	Moderate (2)	X
Passes 0, 1, 2 or 3 of 7 criteria; OR 4, 5 or 6 of criteria but failing criterion 1	Poor (1)	

Suggested enhancement interventions to improve condition score

Wildflower planting to encourage pollinators. Remove arisings when cut/managed to allow for species diversity and to reduce nutrient stores in the soil. Reduce areas at which people can walk to prevent trampling and areas of bare ground.

Notes

Redline area reduced from initial PEA survey so does not encompass the longer grassland areas in the north.

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APPENDIX H – BAT STATIC SURVEY R-REPORT

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Appendix G

Automated Bat Detector Survey

Data Analysis and Visualisation

1 INTRODUCTION

1.1 GENERAL INFORMATION ON BAT SPECIES OBSERVED

Below is a general introduction to the species observed on the survey. Further information can be found on the Bat Conservation Trust website https://www.bats.org.uk/about-bats/what-are-bats/uk-bats.

Barbastelle *Barbastella barbastellus*
The barbastelle is a distinctive looking medium-sized bat. It has a pug-shaped nose and broad ears which join across the top of the head, and its fur is very dark with "frosted" tips. It prefers woodland, roosting in trees and hunting both beneath the canopy and over tree-tops but can also be found over rough meadows, ponds and streams.

Common Pipistrelle *Pipistrellus pipistrellus*
Common pipistrelles are the most common and widespread of all British bat species. They are found in lots of places, including towns and cities, as well as in the countryside. They are small, and their flight is fast and jerky as they pursue small insects which they catch and eat whilst flying. A single pipistrelle can consume up to 3,000 insects in one night!

Greater horseshoe bat *Rhinolophus ferrumequinum*
Horseshoe bats can be distinguished from other British bats by the presence of a complex horseshoe-shaped nose which is needed for their particular type of echolocation. When roosting they hang free by their legs from a perch, with their wings more or less wrapped around their body. The greater horseshoe is one of our largest bat species, about the size of a small pear. It requires a network of cattle-grazed pasture, mature hedgerows, woodland edge and species-rich grassland to hunt its insect prey, which includes dung beetles. Horseshoe bats are known to avoid areas which are artificially lit, and are therefore vulnerable to increased light levels as they disrupt their commuting paths, roost flight-lines and foraging areas. This is one of the UK's rarest bat species, and Devon is one of their strong-holds in Northern Europe.

Leisler's or Noctule
These two bats belong to the same family, and are fairly large for a British bat. The noctule is generally one of the first bats to be seen of an evening, and they like to hunt over open ground, particularly pasture. Leisler's are more likely to be found in woodland, but they can also be found in the same places as noctules-making them hard to tell apart!

Lesser Horseshoe Bat *Rhinolophus hipposideros*
The lesser horseshoe bat is one of the smallest British species, being about plum - sized. It has a complex horseshoe shaped nose which is related to the way it echolocates. It rests by hanging upside - down with its wings wrapped around its body, and avoids flying and foraging in lit up areas. Lesser horseshoe bats mostly hunt close to their roost in sheltered valleys, woodland edge, pasture and wetlands.

Myotis Species
The Myotis are a group of bats which includes Alcathoe, Bechstein's, Brandt's, Daubenton's, Natterer's and Whiskered bats. They all make very similar sounds which mean that sometimes it is very hard to tell them apart from their recordings alone.

Nathusius' Pipistrelle *Pipistrellus nathusii*
This bat is quite rare in the UK, though records have increased in recent years. It is migratory (with one bat recorded travelling between Bristol and Holland!) and is most

commonly found in autumn, although there are now records of colonies remaining all year and breeding in the UK. It is similar in appearance to, but slightly larger than the common and soprano pipistrelles and the fur on its back is longer, sometimes giving a shaggy appearance. The Nathusius' is strongly associated with water and woodlands.

Serotine *Eptesicus serotinus* The serotine is one of Britain's largest bat species and usually one of the first to appear in the evening, often emerging in good light. It flies at about tree-top height (to about 10 m) often close to vegetation, and will sometimes flop, wings outstretched, on to the foliage to catch large insects. The serotine will feed around street lamps and even catch prey from the ground.

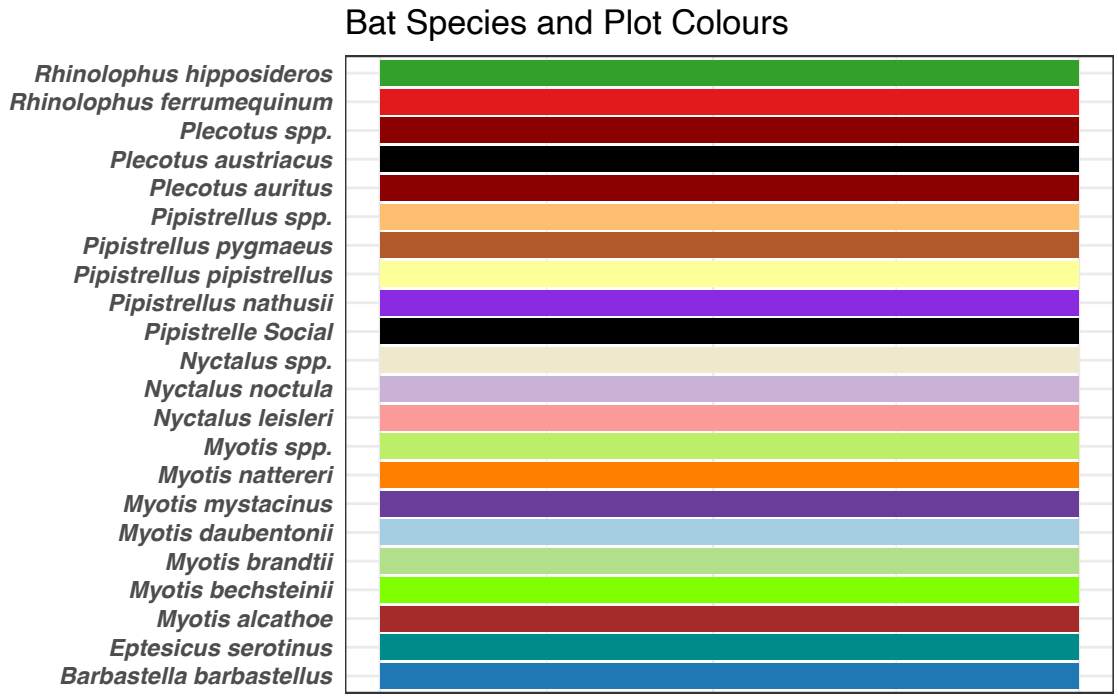
Serotines roost mainly in buildings with high gables and cavity walls. They can be found in much older buildings and churches, but are less often found in modern buildings.

Soprano Pipistrelle *Pipistrellus pygmaeus*
The soprano pipistrelle was discovered as a different species to the common pipistrelle in the 1990s - they are very similar but they use slightly different echolocation calls and there are subtle differences in how they look. They also tend to roost and hunt in slightly different places, with the soprano pipistrelle favouring river habitat and wetland areas.

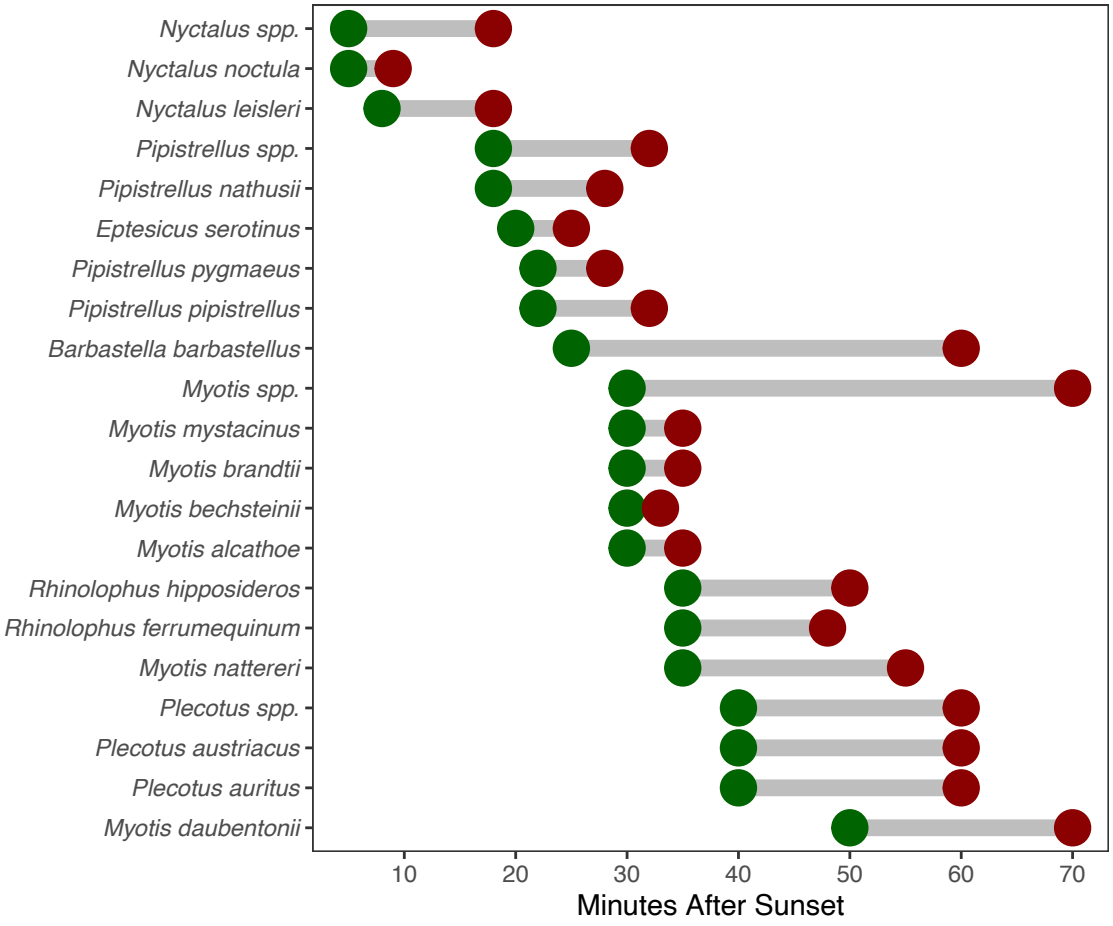
Soprano Pipistrelle *Pipistrellus pygmaeus*
The soprano pipistrelle was discovered as a different species to the common pipistrelle in the 1990s - they are very similar but they use slightly different echolocation calls and there are subtle differences in how they look. They also tend to roost and hunt in slightly different places, with the soprano pipistrelle favouring river habitat and wetland areas.

2 GRAPHS

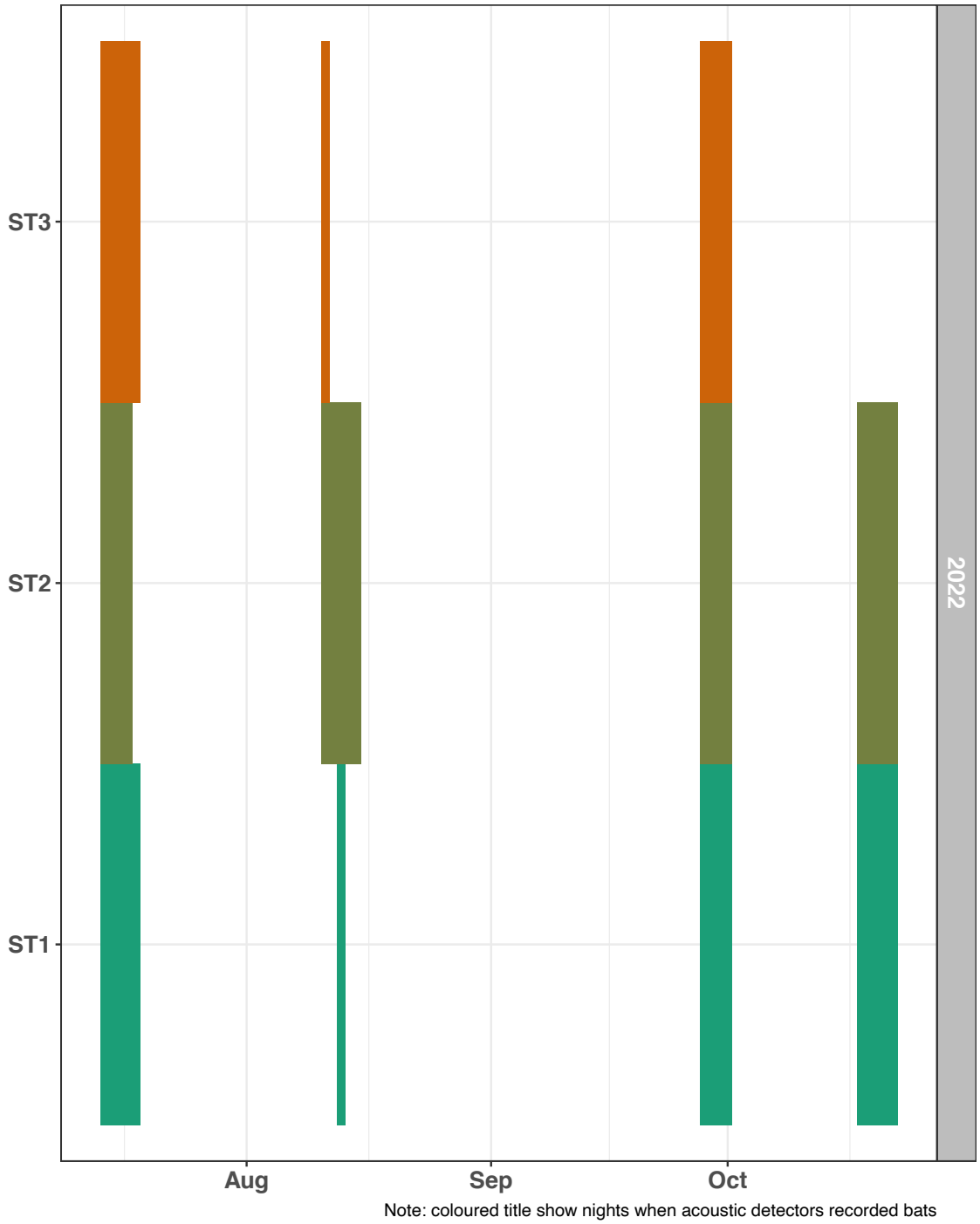
2.1 BAT COLOURS



2.2 ROOST EMERGENCE TIMES AFTER SUNSET

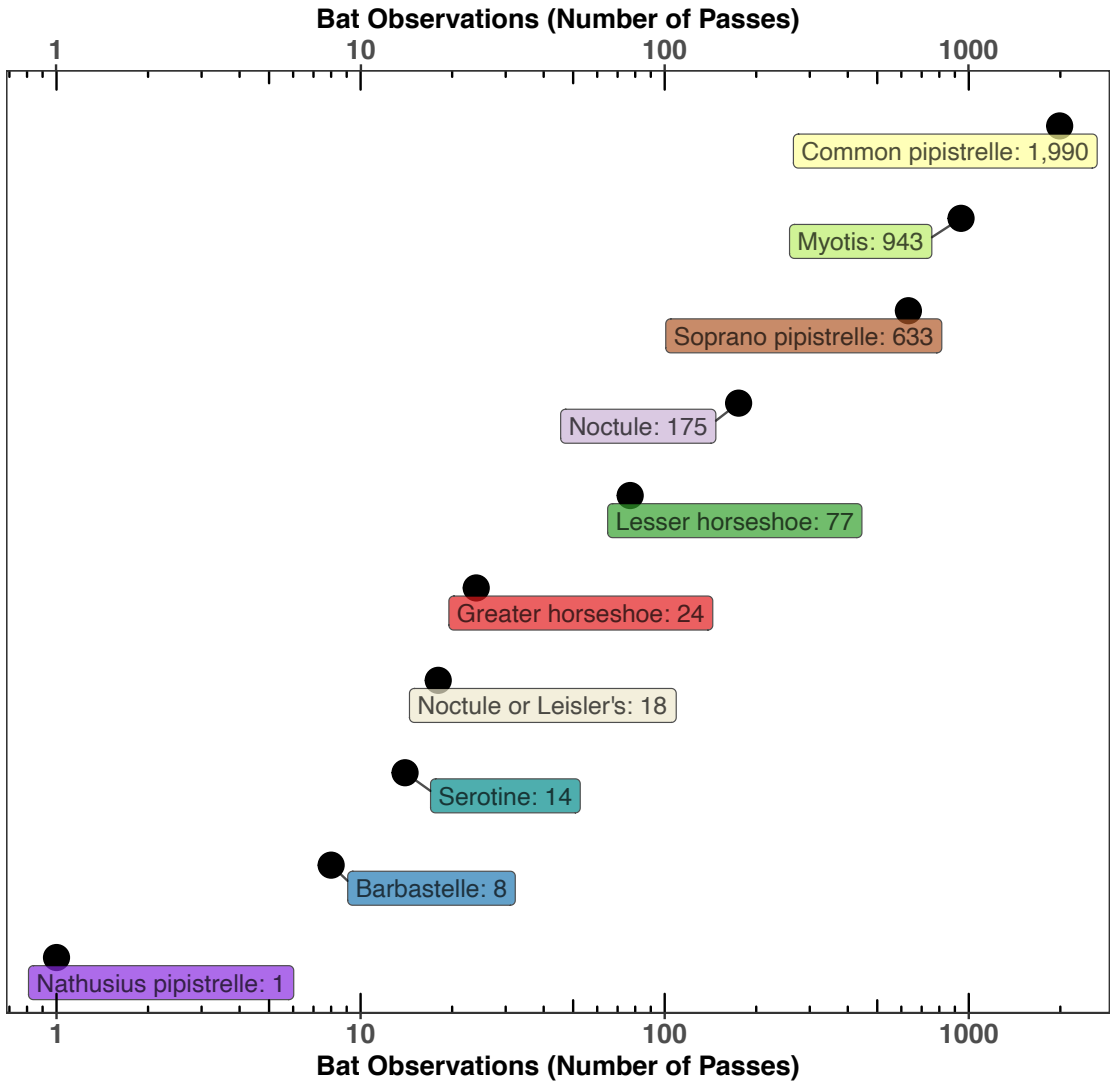


2.3 PERIOD OF DETECTOR RECORDED BATS



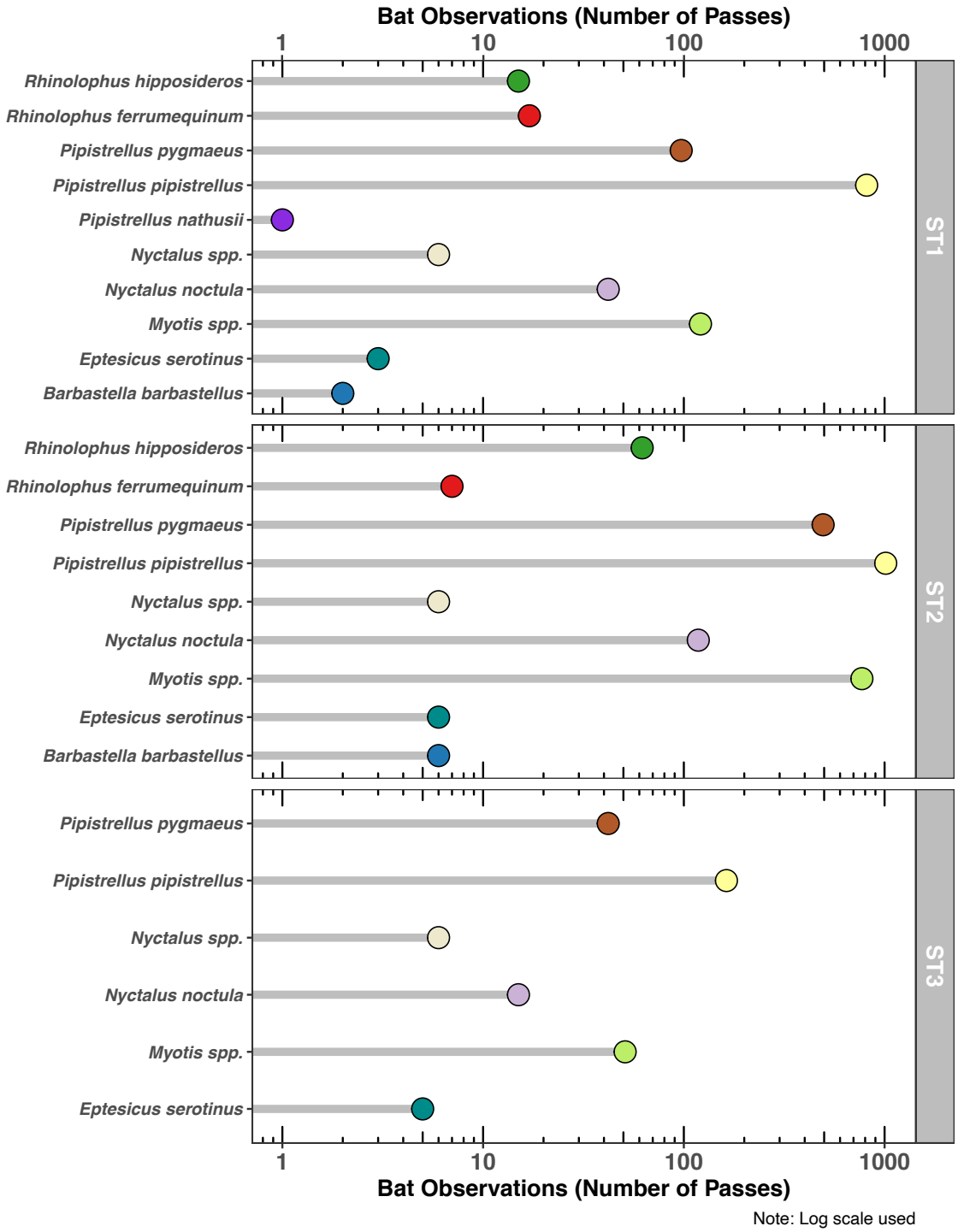
Note: coloured title show nights when acoustic detectors recorded bats

2.4 DOT CHART: COUNT OF ALL SPECIES OBSERVATIONS



Note: Log scale used

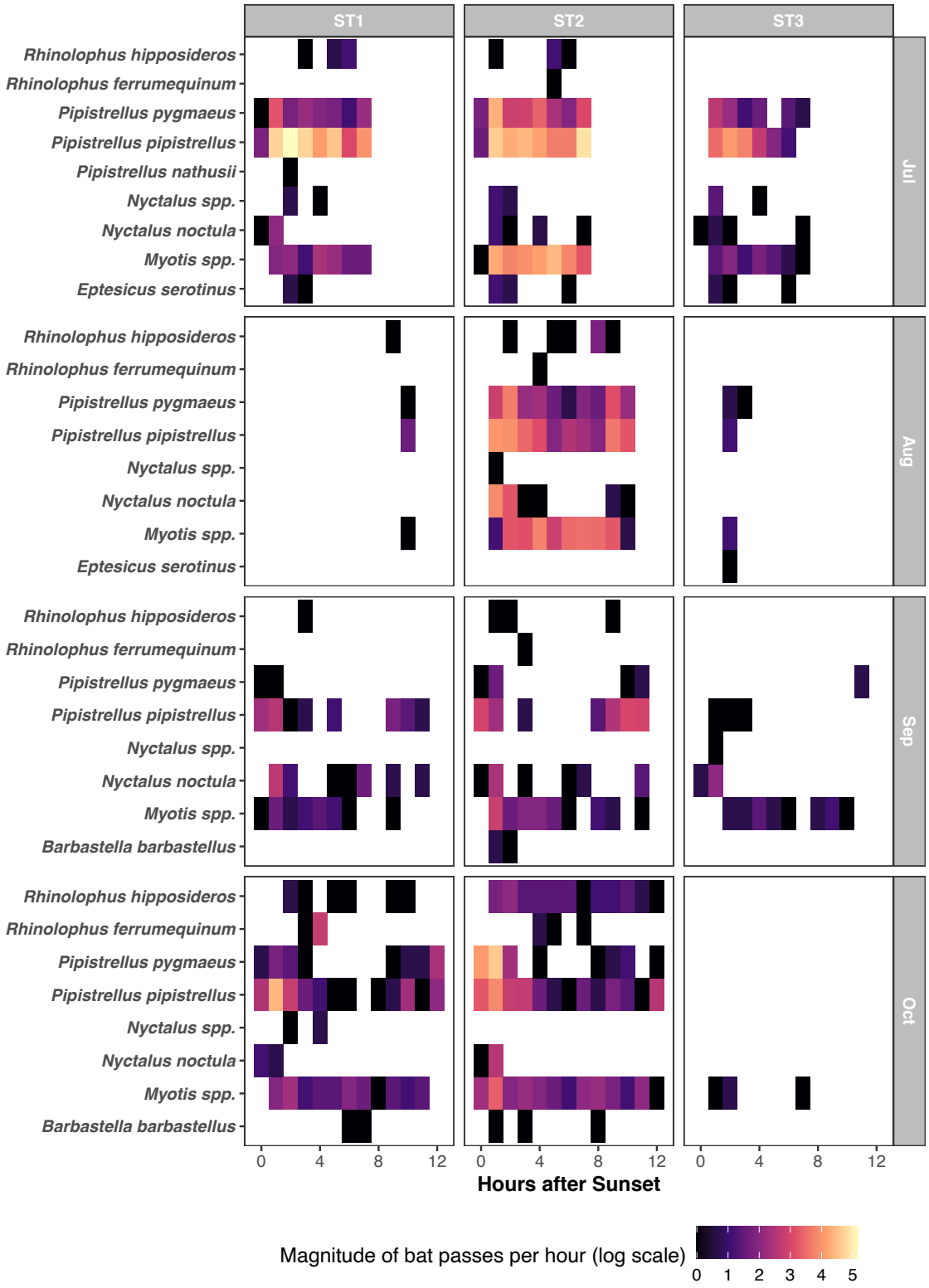
2.5 DOT CHART: COUNT OF SPECIES OBSERVATIONS BY LOCATION



2.11 TREEMAP OF LOCATION AND SPECIES (NO. OF PASSES)



2.12 HOURLY ACTIVITY BY LOCATION AND MONTH



3 STATISTICS

3.1 COMPARISON OF LOCATION ACTIVITY BY SPECIES

The average bat pass rate has been calculated for the night at each survey location; ST1, ST2, and ST3 using the formula:

$$\frac{Batpasses}{Nightlength}$$

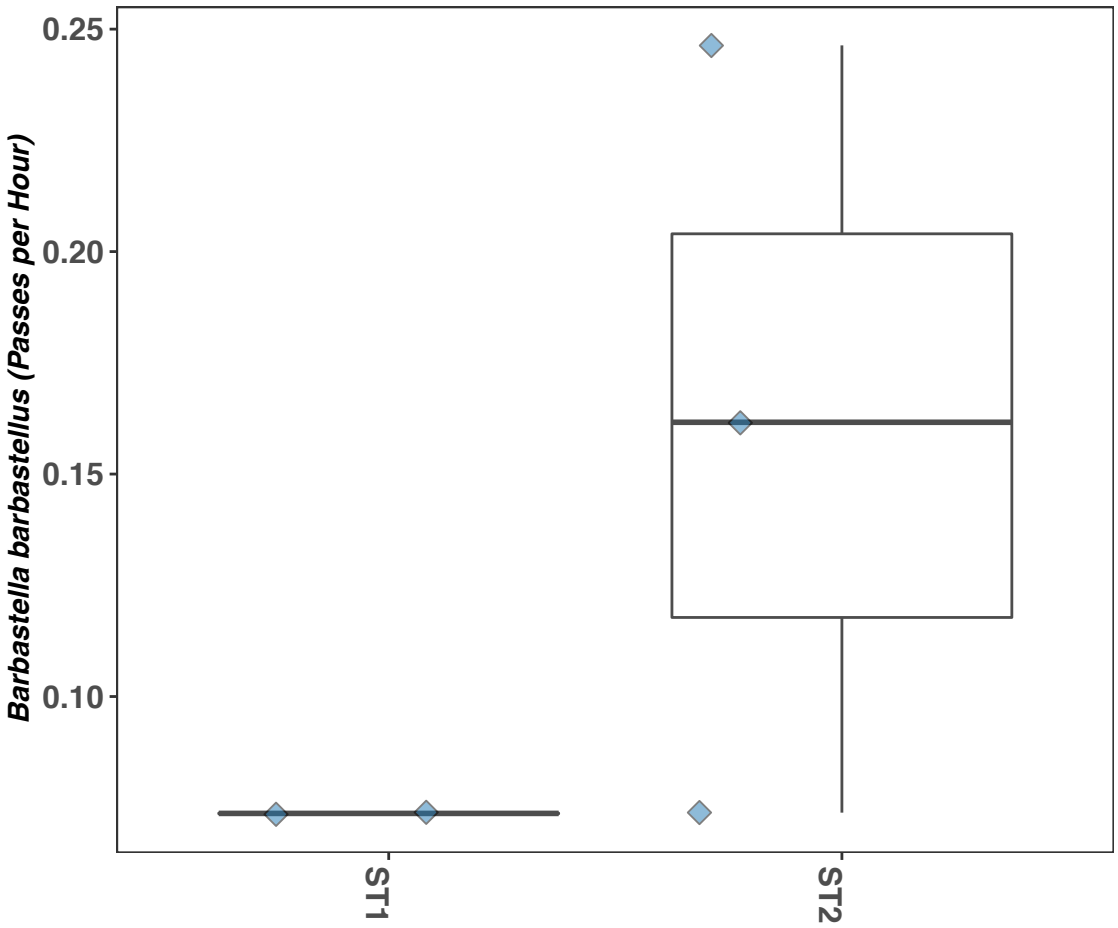
Where:

Batpasses = number of bat pass during the night at the location
Nightlength = Length of the night in decimal hours

The comparison of locations is undertaken with the Mann-Whitney-Wilcoxon or Kruskal-Wallis test. The Kruskal–Wallis test is a rank-based test that is similar to the Mann-Whitney-Wilcoxon test, but can be applied to one-way data with more than two groups. If there are just two locations the Mann-Whitney-Wilcoxon test is applied. The Kruskal–Wallis test *may* be used when there are only two samples, but the Mann-Whitney-Wilcoxon is more powerful for two samples and is preferred. Both tests assume that the observations are independent. The probability threshold for *statistical significance* used in the tests is: 0.05

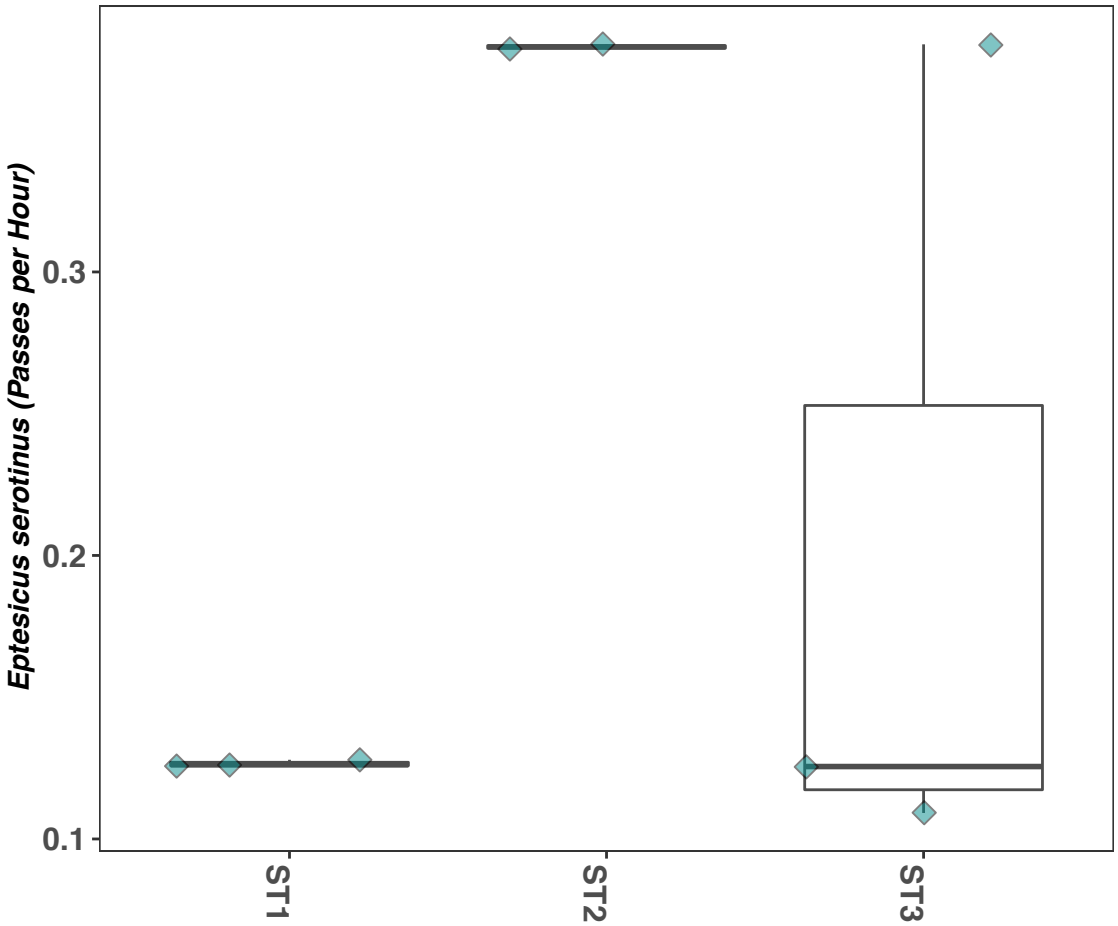
- **The Null Hypothesis:** *bat pass rates per hour* are from distributions with the same median.
- **The Alternative Hypothesis:** *bat pass rates per hour* are from distributions with a different median.

3.1.1 *Barbastella barbastellus*: Statistical Comparison of Activity Between Locations



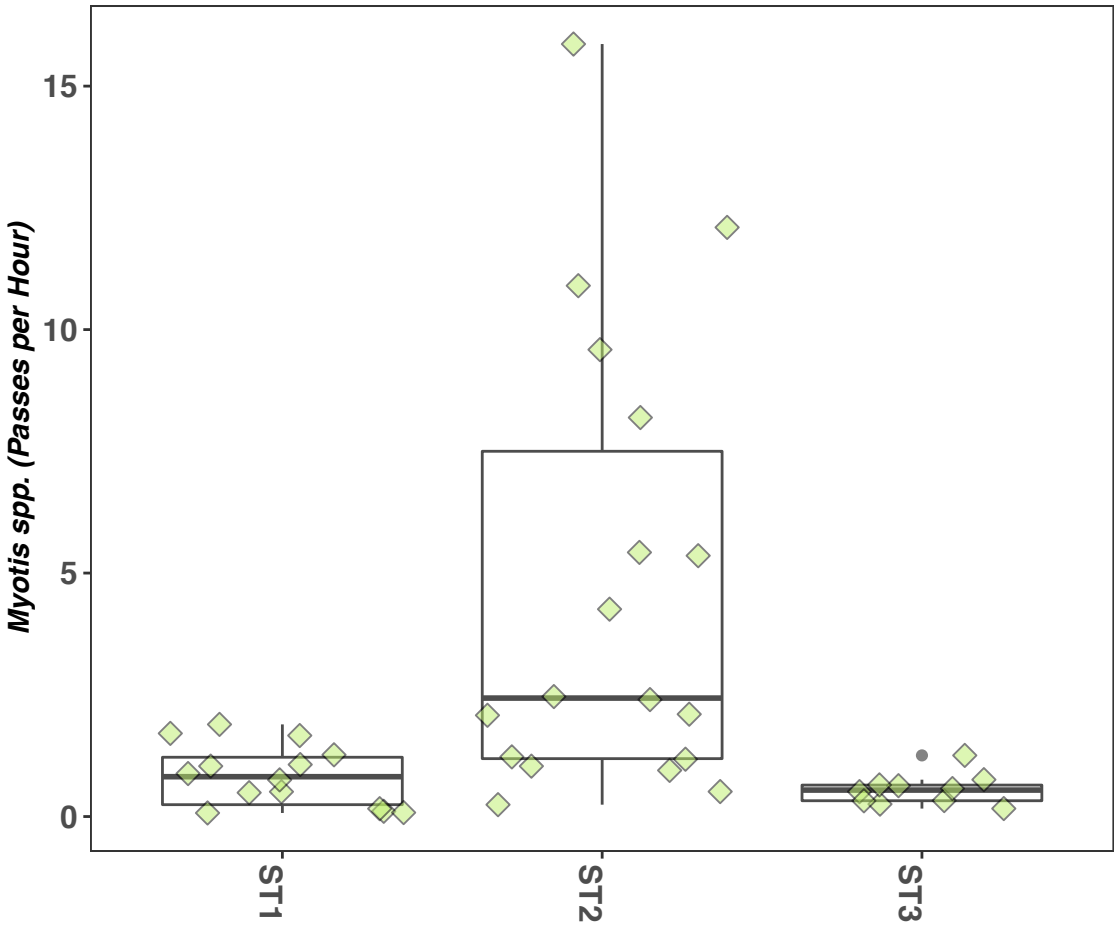
There is insufficient data to undertake the Kruskal-Wallis or Mann-Whitney-Wilcoxon test

3.1.2 *Eptesicus serotinus*: Statistical Comparison of Activity Between Locations



There is insufficient data to undertake the Kruskal-Wallis or Mann-Whitney-Wilcoxon test

3.1.3 *Myotis spp.*: Statistical Comparison of Activity Between Locations



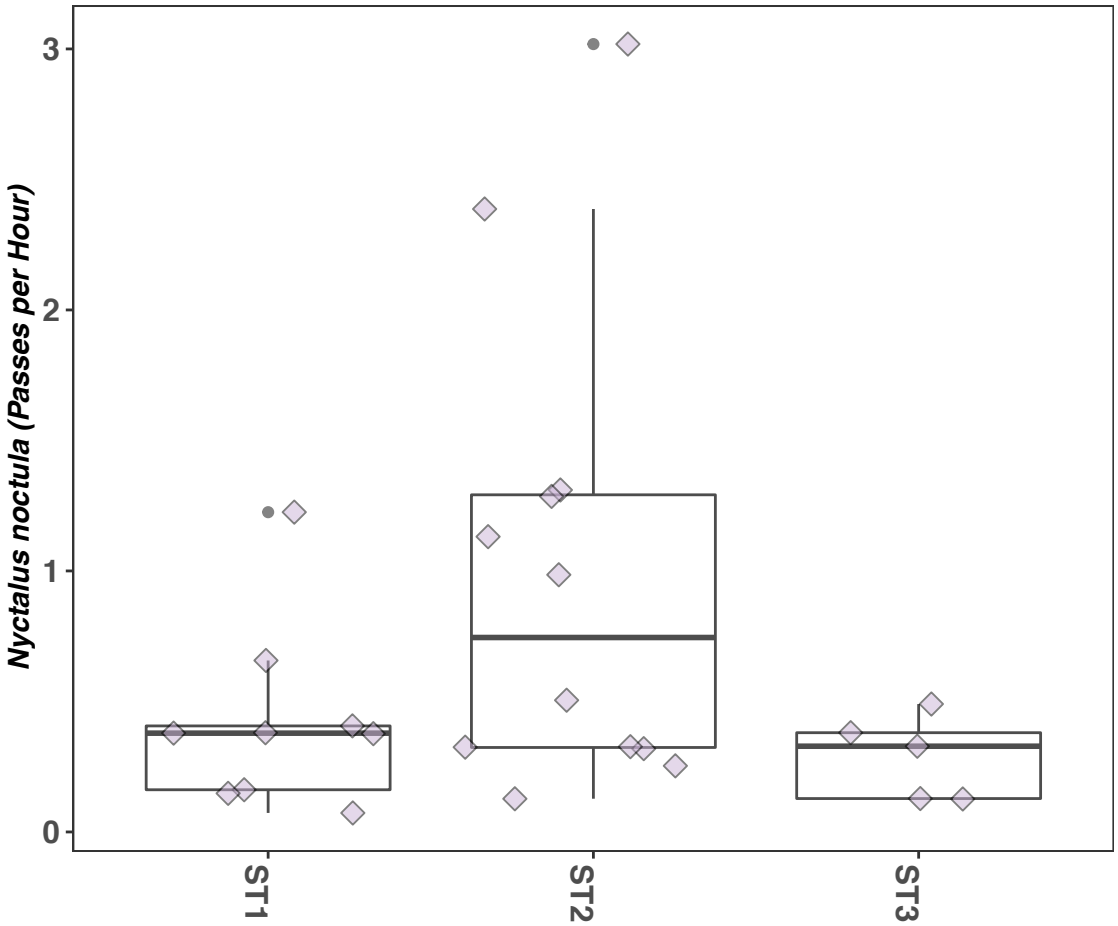
The Kruskal-Wallis test was undertaken for *Myotis spp.* between the following locations: ST1, ST2, and ST3.The null hypothesis is rejected at P<0.05. Activity between some locations is likely to be different. *Post hoc* testing with the Dunn's Test, has been applied to determine which locations are different; the results are shown below.

Table 1: Post hoc Test Results (Dunn's Test) for Myotis spp.

Locations with a significant difference	adjusted P
ST1 - ST2	0.0015939
ST2 - ST3	0.0004778

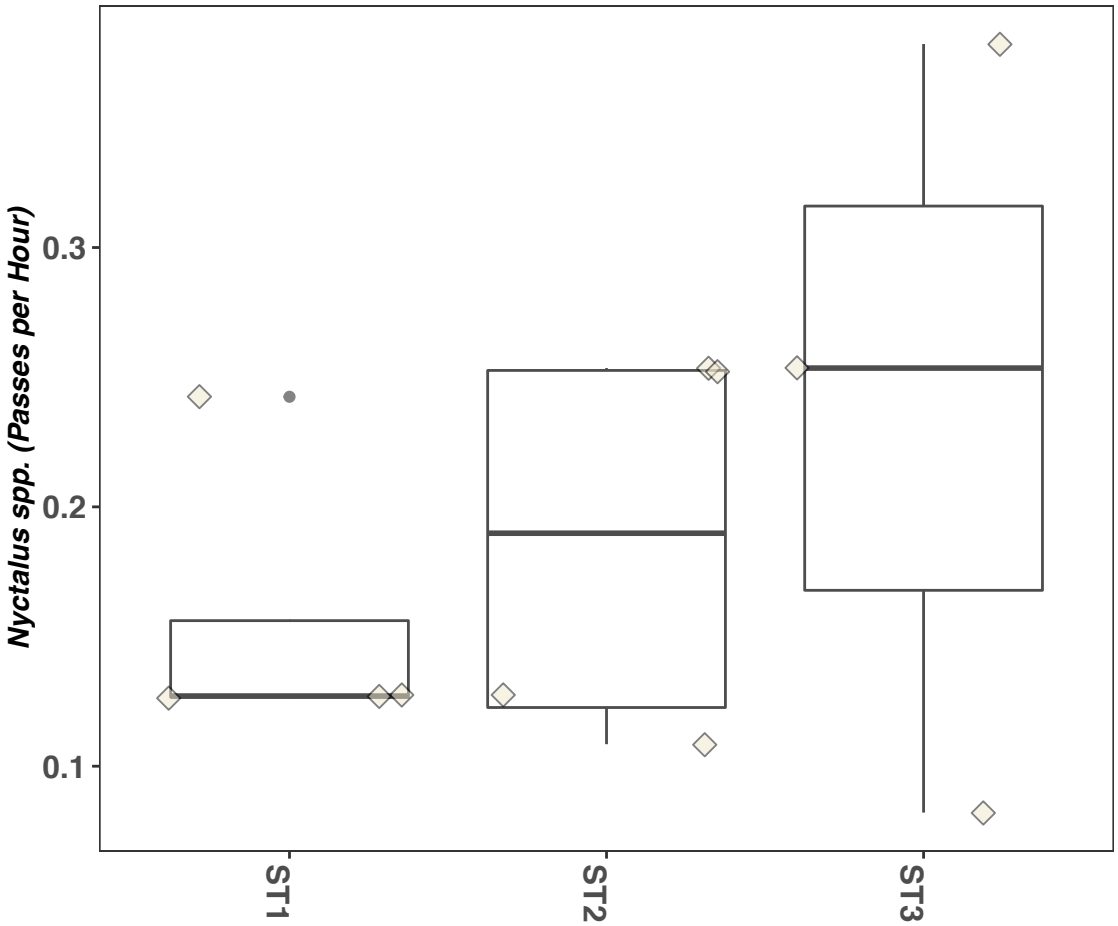
The P value adjustment has been made with the Bonferroni method. The Bonferroni method is a simple technique for controlling the overall probability of a false significant result when multiple comparisons are to be carried out.

3.1.4 *Nyctalus noctula*: Statistical Comparison of Activity Between Locations



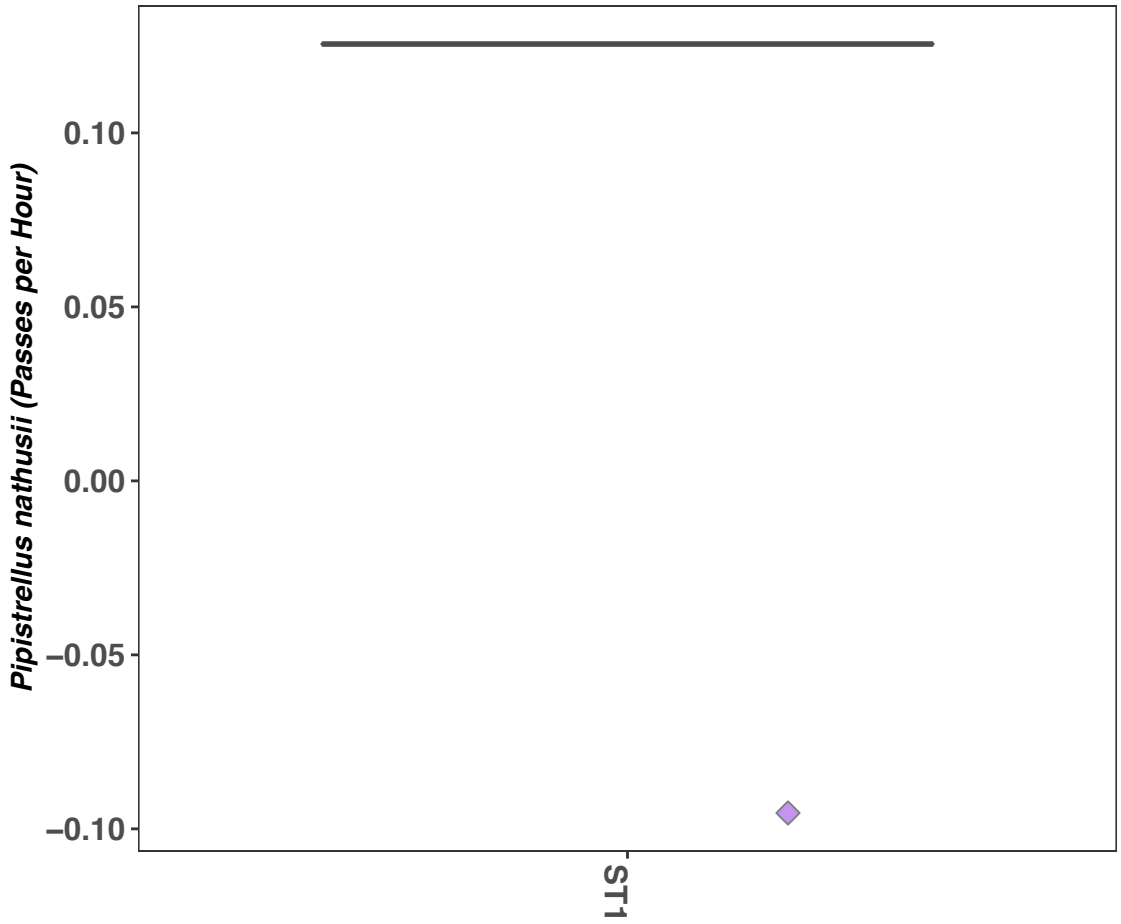
The Kruskal-Wallis test was undertaken for *Nyctalus noctula* between the following locations: ST1, ST2, and ST3.The null hypothesis is accepted at P<0.05. Activity between the locations is unlikely to be different.

3.1.5 *Nyctalus spp.*: Statistical Comparison of Activity Between Locations



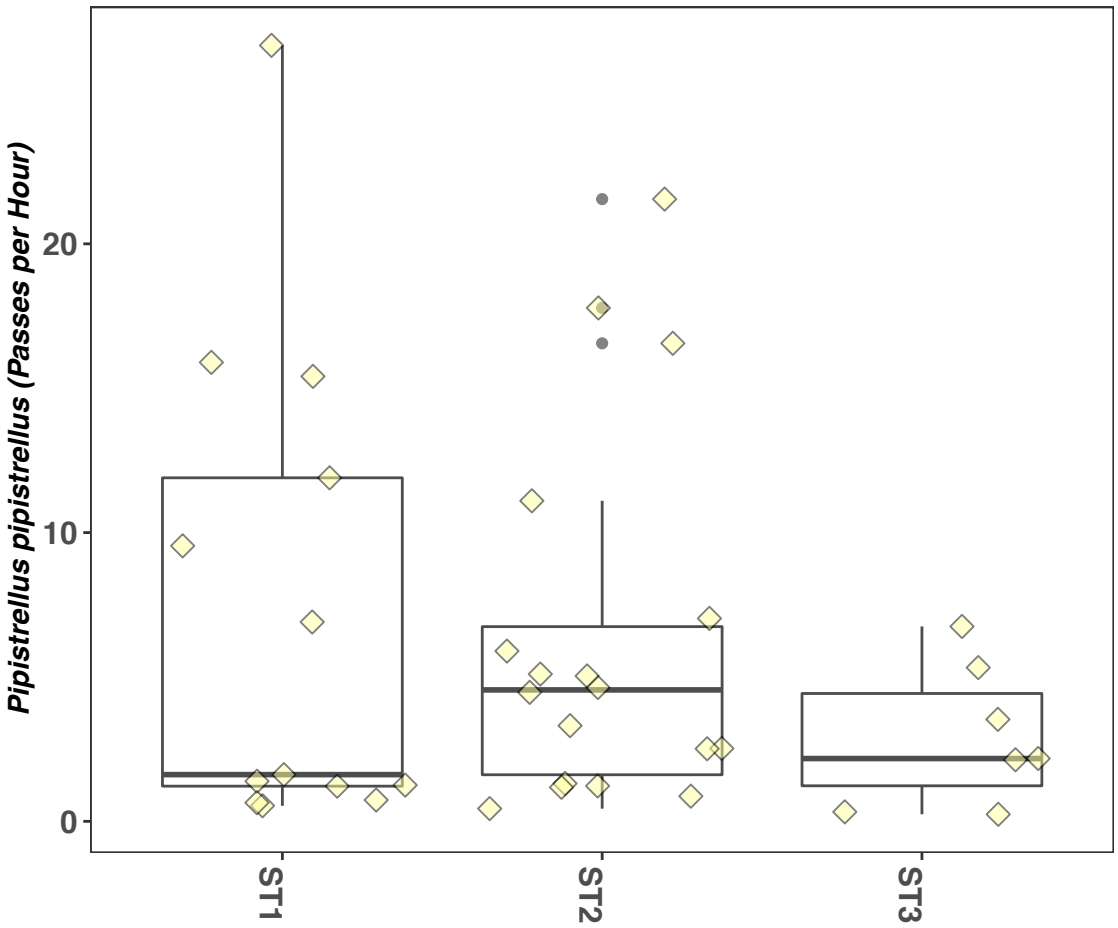
There is insufficient data to undertake the Kruskal-Wallis or Mann-Whitney-Wilcoxon test

3.1.6 *Pipistrellus nathusii*: Statistical Comparison of Activity Between Locations



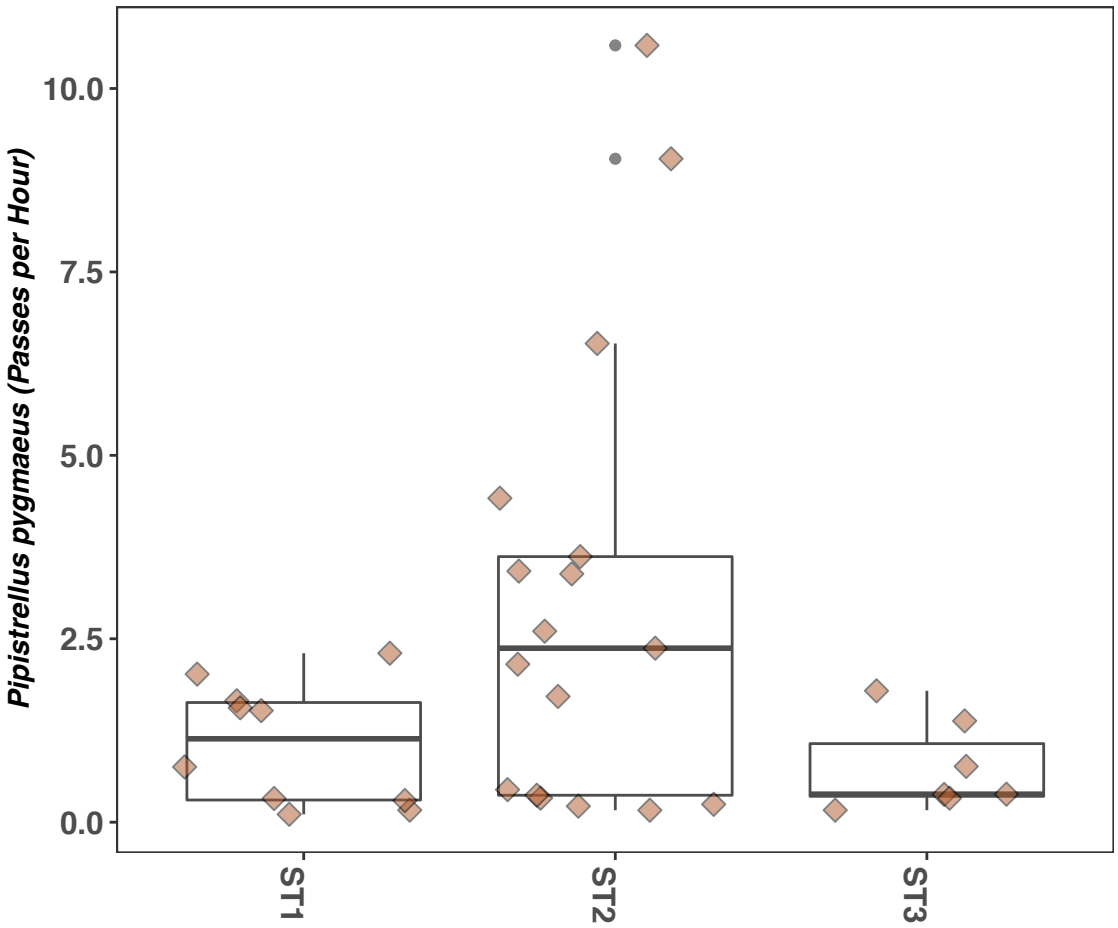
There is insufficient data to undertake the Kruskal-Wallis or Mann-Whitney-Wilcoxon test

3.1.7 *Pipistrellus pipistrellus*: Statistical Comparison of Activity Between Locations



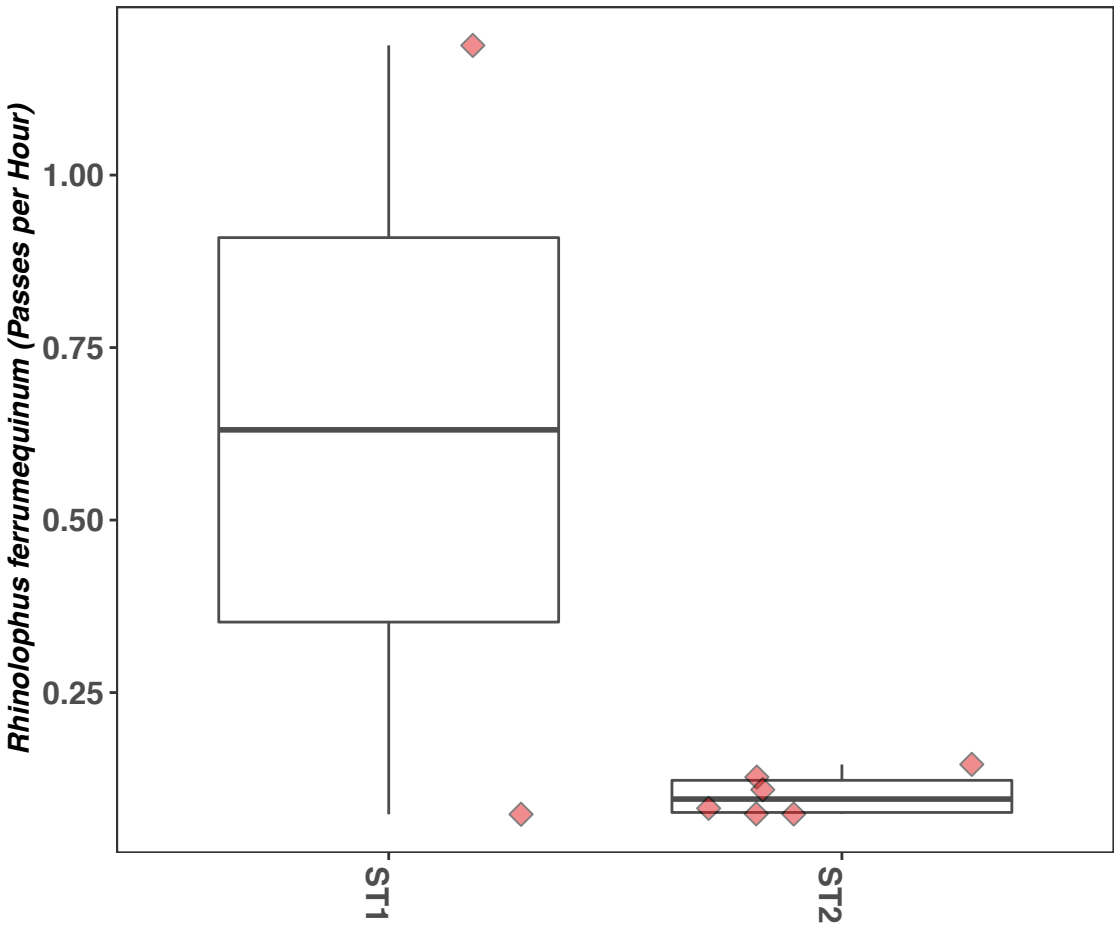
The Kruskal-Wallis test was undertaken for *Pipistrellus pipistrellus* between the following locations: ST1, ST2, and ST3.The null hypothesis is accepted at P<0.05. Activity between the locations is unlikely to be different.

3.1.8 *Pipistrellus pygmaeus*: Statistical Comparison of Activity Between Locations



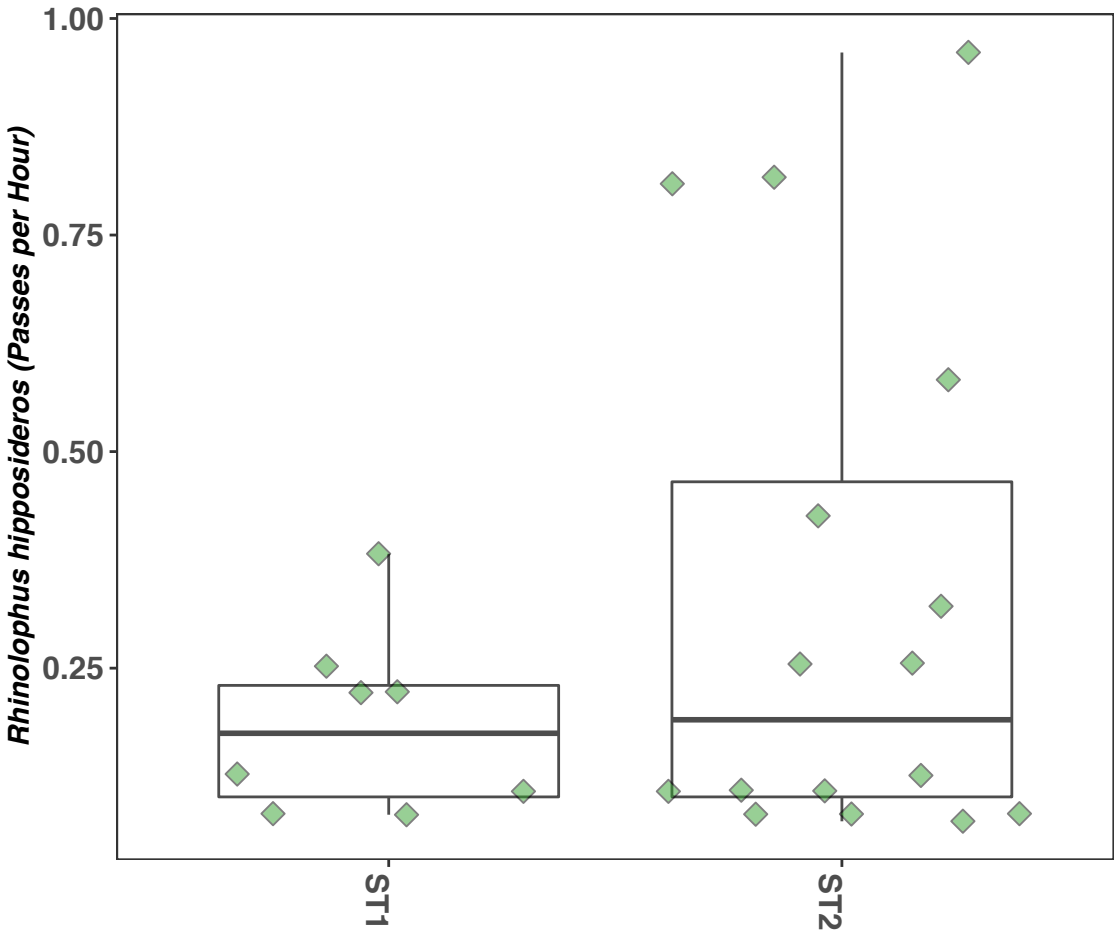
The Kruskal-Wallis test was undertaken for *Pipistrellus pygmaeus* between the following locations: ST1, ST2, and ST3.The null hypothesis is accepted at P<0.05. Activity between the locations is unlikely to be different.

3.1.9 *Rhinolophus ferrumequinum*: Statistical Comparison of Activity Between Locations



There is insufficient data to undertake the Kruskal-Wallis or Mann-Whitney-Wilcoxon test

3.1.10 *Rhinolophus hipposideros*: Statistical Comparison of Activity Between Locations



The Mann-Whitney-Wilcoxon test was undertaken for *Rhinolophus hipposideros* between the following locations: ST1 and ST2.The null hypothesis is accepted at P<0.05. Activity between the two locations is unlikely to be different.

4 TABLES

4.1 TABLE OF SUNTIMES

Bats are nocturnal, active at night rather than day; therefore the surveys are reported relative to the *night* which runs from the date at sunset to dawn the following day.

Table 2: Suntimes for each Survey Night

Night	Sunset (hh:mm)	Sunrise (hh:mm)	Night Length (hours)
14 July 2022	21:21	05:10	7.8
15 July 2022	21:20	05:11	7.9
16 July 2022	21:19	05:12	7.9
17 July 2022	21:18	05:14	7.9
18 July 2022	21:17	05:15	8.0
11 August 2022	20:41	05:50	9.2
12 August 2022	20:39	05:52	9.2
13 August 2022	20:37	05:53	9.3
14 August 2022	20:35	05:55	9.3
15 August 2022	20:33	05:57	9.4
28 September 2022	18:55	07:06	12.2
29 September 2022	18:53	07:08	12.2
30 September 2022	18:51	07:09	12.3
01 October 2022	18:49	07:11	12.4
18 October 2022	18:11	07:39	13.5
19 October 2022	18:09	07:41	13.5
20 October 2022	18:07	07:43	13.6
21 October 2022	18:05	07:44	13.7
22 October 2022	18:03	07:46	13.7

4.2 BAT PASSES PER SPECIES

The Table below shows total number of passes recorded for each species across all of the detectors. A total of 3,883 passes were recorded.

Table 3: Species and Number of Bat Passes

Scientific Name	Common Name	Count (No)	Percentage of total (%)
Pipistrellus pipistrellus	**Common pipistrelle**	1990	51.25
Myotis spp.	**Myotis**	943	24.29
Pipistrellus pygmaeus	**Soprano pipistrelle**	633	16.30
Nyctalus noctula	**Noctule**	175	4.51
Rhinolophus hipposideros	**Lesser horseshoe**	77	1.98
Rhinolophus ferrumequinum	**Greater horseshoe**	24	0.62
Nyctalus spp.	**Noctule or Leisler's**	18	0.46
Eptesicus serotinus	**Serotine**	14	0.36
Barbastella barbastellus	**Barbastelle**	8	0.21
Pipistrellus nathusii	**Nathusius pipistrelle**	1	0.03

4.3 LOCATION AND NUMBER OF BAT PASSES

Table 4: Number of Bat Passes and Location

Location	Barbastella barbastellus	Eptesicus serotinus	Myotis spp.	Nyctalus noctula	Nyctalus spp.	Pipistrellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	Rhinolophus ferrumequinum	Rhinolophus hipposideros
ST1	2	3	121	42	6	1	814	97	17	15
ST2	6	6	771	118	6		1,013	494	7	62
ST3		5	51	15	6		163	42		

4.4 MONTH AND NUMBER OF BAT PASSES

Table 5: Number of Bat Passes and Month

Month	Barbastella barbastellus	Eptesicus serotinus	Myotis spp.	Nyctalus noctula	Nyctalus spp.	Pipistrellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	Rhinolophus ferrumequinum	Rhinolophus hipposideros
Jul		13	456	21	13	1	1,312	286	1	11
Aug		1	242	77	1		265	131	1	11
Sep	3		85	58	1		130	13	1	4
Oct	5		160	19	3		283	203	21	51

4.5 MONTH/LOCATION AND NUMBER OF BAT PASSES

Table 6: Number of Bat Passes and Month and Location

Month	Location	*Barbastella barbastellus*	*Eptesicus serotinus*	*Myotis spp.*	*Nyctalus noctula*	*Nyctalus spp.*	*Pipistrellus nathusii*	*Pipistrellus pipistrellus*	*Pipistrellus pygmaeus*	*Rhinolophus ferrumequinum*	*Rhinolophus hipposideros*
	ST1		3	48	9	3	1	628	65		6
July	**ST2**		6	381	7	5		527	184	1	5
	ST3		4	27	5	5		157	37		
	ST1			1				5	1		1
August	**ST2**			238	77	1		257	127	1	10
	ST3		1	3				3	3		
	ST1			20	28			41	2		1
September	**ST2**	3		48	20			86	9	1	3
	ST3			17	10	1		3	2		
	ST1	2		52	5	3		140	29	17	7
October	**ST2**	3		104	14			143	174	4	44
	ST3			4							

4.6 MEDIAN BAT PASSES PER HOUR BY LOCATION

The median Nightly Pass Rate (bat passes per hour, per night) of each species.

Bat pass rates are often highly variable between nights, with some nights having few or no passes and other nights having high activity. In these circumstances, the median is likely to be a more useful summary of the 'average' activity than is the mean.

Table 7: Median Bat Passes per Hour by Location

Location	Barbastella barbastellus	Eptesicus serotinus	Myotis spp.	Nyctalus noctula	Nyctalus spp.	Pipistrellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	Rhinolophus ferrumequinum	Rhinolophus hipposideros
ST1	0.07	0.13	0.82	0.38	0.13	0.13	1.62	1.14	0.63	0.17
ST2	0.16	0.38	2.43	0.75	0.19		4.55	2.37	0.10	0.19
ST3		0.13	0.54	0.33	0.25		2.17	0.38		

4.7 MEDIAN BAT PASSES PER HOUR BY MONTH

The median Nightly Pass Rate (bat passes per hour, per night) of each species.

Bat pass rates are often highly variable between nights, with some nights having few or no passes and other nights having high activity. In these circumstances, the median is likely to be a more useful summary of the 'average' activity than is the mean.

Table 8: Median Bat Passes per Hour by Month

Month	Barbastella barbastellus	Eptesicus serotinus	Myotis spp.	Nyctalus noctula	Nyctalus spp.	Pipistrellus nathusii	Pipistrellus pipistrellus	Pipistrellus pygmaeus	Rhinolophus ferrumequinum	Rhinolophus hipposideros
Jul		0.38	12.80	0.38	0.63	0.13	31.86	6.81	0.13	0.38
Aug		0.11	5.36	1.31	0.11		5.17	2.60	0.11	0.22
Sep	0.25		1.88	1.97	0.08		2.86	0.24	0.08	0.08
Oct	0.15		2.06	0.15	0.24		3.28	0.74	0.11	0.70

4.8 SUMMARY STATISTICS: BAT PASSES PER HOUR GROUPED BY SPECIES/LOCATION

Table 9: Summary Statistics: Bat Pass Rate (per hour)

Species	Location	Minimum	Q1	Mean	Median	Q3	Maximum	SD
Barbastella barbastellus	ST1	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	ST2	0.07	0.12	0.16	0.16	0.20	0.25	0.07
Eptesicus serotinus	ST1	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	ST2	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	ST3	0.11	0.12	0.20	0.13	0.25	0.38	0.11
Myotis spp.	ST1	0.07	0.24	0.84	0.82	1.22	1.89	0.07
	ST2	0.24	1.19	4.77	2.43	7.50	15.86	0.24
	ST3	0.16	0.32	0.55	0.54	0.65	1.26	0.16
Nyctalus noctula	ST1	0.07	0.16	0.42	0.38	0.41	1.23	0.07
	ST2	0.13	0.32	1.00	0.75	1.29	3.02	0.13
	ST3	0.13	0.13	0.29	0.33	0.38	0.49	0.13
Nyctalus spp.	ST1	0.13	0.13	0.16	0.13	0.16	0.24	0.13
	ST2	0.11	0.12	0.19	0.19	0.25	0.25	0.11
	ST3	0.08	0.17	0.24	0.25	0.32	0.38	0.08
Pipistrellus nathusii	ST1	0.13	0.13	0.13	0.13	0.13	0.13	0.13
		0.54	1.22	7.23	1.62	11.90	26.87	0.54
Pipistrellus pipistrellus	ST2	0.44	1.61	6.25	4.55	6.74	21.55	0.44
	ST3	0.25	1.23	2.93	2.17	4.43	6.75	0.25
Pipistrellus pygmaeus	ST1	0.11	0.30	1.07	1.14	1.63	2.30	0.11
	ST2	0.16	0.37	3.04	2.37	3.62	10.59	0.16
	ST3	0.16	0.35	0.74	0.38	1.07	1.79	0.16
Rhinolophus ferrumequinum	ST1	0.07	0.35	0.63	0.63	0.91	1.19	0.07
	ST2	0.07	0.08	0.10	0.10	0.12	0.15	0.07
Rhinolophus hipposideros	ST1	0.08	0.10	0.18	0.17	0.23	0.38	0.08
	ST2	0.07	0.10	0.32	0.19	0.47	0.96	0.07

4.9 SUMMARY STATISTICS: BAT PASSES PER HOUR GROUPED BY SPECIES/MONTH

Table 10: Summary Statistics: Bat Pass Rate (per hour)

Species	Month	Minimum	Q1	Mean	Median	Q3	Maximum	SD
Barbastella barbastellus	Sep	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	Oct	0.07	0.11	0.13	0.15	0.15	0.16	0.07
Eptesicus serotinus	Jul	0.13	0.22	0.41	0.38	0.57	0.76	0.13
	Aug	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Myotis spp.	Jul	2.01	12.24	11.59	12.80	12.86	18.04	2.01
	Aug	2.73	4.26	5.21	5.36	5.42	8.30	2.73
	Sep	0.97	1.43	2.32	1.88	2.99	4.11	0.97
	Oct	0.59	1.23	2.01	2.06	2.46	3.79	0.59
Nyctalus noctula	Jul	0.13	0.13	0.53	0.38	1.01	1.01	0.13
	Aug	0.32	1.29	1.66	1.31	2.39	3.02	0.32
	Sep	0.73	1.35	1.58	1.97	2.01	2.04	0.73
	Oct	0.07	0.11	0.50	0.15	0.72	1.29	0.07
Nyctalus spp.	Jul	0.25	0.44	0.55	0.63	0.70	0.76	0.25
	Aug	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Sep	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Oct	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Pipistrellus nathusii	Jul	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Pipistrellus pipistrellus	Jul	11.68	30.53	33.30	31.86	38.72	53.75	11.68
	Aug	5.04	5.10	5.71	5.17	6.22	7.03	5.04
	Sep	2.05	2.46	3.53	2.86	4.27	5.69	2.05
	Oct	0.44	1.35	3.54	3.28	3.91	9.43	0.44
Pipistrellus pygmaeus	Jul	2.13	5.70	7.27	6.81	10.62	11.08	2.13
	Aug	1.71	2.48	2.83	2.60	3.62	3.71	1.71
	Sep	0.16	0.20	0.35	0.24	0.45	0.66	0.16
	Oct	0.22	0.37	3.19	0.74	3.71	10.91	0.22
Rhinolophus ferrumequinum	Jul	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	Aug	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Sep	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Oct	0.07	0.07	0.39	0.11	0.42	1.26	0.07
Rhinolophus hipposideros	Jul	0.38	0.38	0.47	0.38	0.51	0.64	0.38
	Aug	0.11	0.11	0.24	0.22	0.32	0.43	0.11
	Sep	0.08	0.08	0.11	0.08	0.12	0.16	0.08
	Oct	0.07	0.21	0.63	0.70	0.98	1.18	0.07

4.10 SUMMARY STATISTICS: BAT PASSES PER HOUR GROUPED BY LOCATION

Table 11: Summary Statistics: Bat Pass Rate (per hour)

Location	*Species*	Minimum	Q1	Mean	Median	Q3	Maximum	SD
ST1	*Barbastella barbastellus*	0.07	0.07	0.07	0.07	0.07	0.07	0.07
	Eptesicus serotinus	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	Myotis spp.	0.07	0.24	0.84	0.82	1.22	1.89	0.07
	Nyctalus noctula	0.07	0.16	0.42	0.38	0.41	1.23	0.07
	Nyctalus spp.	0.13	0.13	0.16	0.13	0.16	0.24	0.13
	Pipistrellus nathusii	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	Pipistrellus pipistrellus	0.54	1.22	7.23	1.62	11.90	26.87	0.54
	Pipistrellus pygmaeus	0.11	0.30	1.07	1.14	1.63	2.30	0.11
	Rhinolophus ferrumequinum	0.07	0.35	0.63	0.63	0.91	1.19	0.07
	Rhinolophus hipposideros	0.08	0.10	0.18	0.17	0.23	0.38	0.08
ST2	*Barbastella barbastellus*	0.07	0.12	0.16	0.16	0.20	0.25	0.07
	Eptesicus serotinus	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	Myotis spp.	0.24	1.19	4.77	2.43	7.50	15.86	0.24
	Nyctalus noctula	0.13	0.32	1.00	0.75	1.29	3.02	0.13
	Nyctalus spp.	0.11	0.12	0.19	0.19	0.25	0.25	0.11
	Pipistrellus pipistrellus	0.44	1.61	6.25	4.55	6.74	21.55	0.44
	Pipistrellus pygmaeus	0.16	0.37	3.04	2.37	3.62	10.59	0.16
	Rhinolophus ferrumequinum	0.07	0.08	0.10	0.10	0.12	0.15	0.07
	Rhinolophus hipposideros	0.07	0.10	0.32	0.19	0.47	0.96	0.07
ST3	*Eptesicus serotinus*	0.11	0.12	0.20	0.13	0.25	0.38	0.11
	Myotis spp.	0.16	0.32	0.55	0.54	0.65	1.26	0.16
	Nyctalus noctula	0.13	0.13	0.29	0.33	0.38	0.49	0.13
	Nyctalus spp.	0.08	0.17	0.24	0.25	0.32	0.38	0.08
	Pipistrellus pipistrellus	0.25	1.23	2.93	2.17	4.43	6.75	0.25
	Pipistrellus pygmaeus	0.16	0.35	0.74	0.38	1.07	1.79	0.16

4.11 SUMMARY STATISTICS: BAT PASSES PER HOUR GROUPED BY MONTH

Table 12: Summary Statistics: Bat Pass Rate (per hour)

Month	*Species*	Minimum	Q1	Mean	Median	Q3	Maximum	SD
Jul	*Eptesicus serotinus*	0.13	0.22	0.41	0.38	0.57	0.76	0.13
	Myotis spp.	2.01	12.24	11.59	12.80	12.86	18.04	2.01
	Nyctalus noctula	0.13	0.13	0.53	0.38	1.01	1.01	0.13
	Nyctalus spp.	0.25	0.44	0.55	0.63	0.70	0.76	0.25
	Pipistrellus nathusii	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	Pipistrellus pipistrellus	11.68	30.53	33.30	31.86	38.72	53.75	11.68
	Pipistrellus pygmaeus	2.13	5.70	7.27	6.81	10.62	11.08	2.13
	Rhinolophus ferrumequinum	0.13	0.13	0.13	0.13	0.13	0.13	0.13
	Rhinolophus hipposideros	0.38	0.38	0.47	0.38	0.51	0.64	0.38
Aug	*Eptesicus serotinus*	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Myotis spp.	2.73	4.26	5.21	5.36	5.42	8.30	2.73
	Nyctalus noctula	0.32	1.29	1.66	1.31	2.39	3.02	0.32
	Nyctalus spp.	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Pipistrellus pipistrellus	5.04	5.10	5.71	5.17	6.22	7.03	5.04
	Pipistrellus pygmaeus	1.71	2.48	2.83	2.60	3.62	3.71	1.71
	Rhinolophus ferrumequinum	0.11	0.11	0.11	0.11	0.11	0.11	0.11
	Rhinolophus hipposideros	0.11	0.11	0.24	0.22	0.32	0.43	0.11
Sep	*Barbastella barbastellus*	0.25	0.25	0.25	0.25	0.25	0.25	0.25
	Myotis spp.	0.97	1.43	2.32	1.88	2.99	4.11	0.97
	Nyctalus noctula	0.73	1.35	1.58	1.97	2.01	2.04	0.73
	Nyctalus spp.	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Pipistrellus pipistrellus	2.05	2.46	3.53	2.86	4.27	5.69	2.05
	Pipistrellus pygmaeus	0.16	0.20	0.35	0.24	0.45	0.66	0.16
	Rhinolophus ferrumequinum	0.08	0.08	0.08	0.08	0.08	0.08	0.08
	Rhinolophus hipposideros	0.08	0.08	0.11	0.08	0.12	0.16	0.08
Oct	*Barbastella barbastellus*	0.07	0.11	0.13	0.15	0.15	0.16	0.07
	Myotis spp.	0.59	1.23	2.01	2.06	2.46	3.79	0.59
	Nyctalus noctula	0.07	0.11	0.50	0.15	0.72	1.29	0.07
	Nyctalus spp.	0.24	0.24	0.24	0.24	0.24	0.24	0.24
	Pipistrellus pipistrellus	0.44	1.35	3.54	3.28	3.91	9.43	0.44
	Pipistrellus pygmaeus	0.22	0.37	3.19	0.74	3.71	10.91	0.22
	Rhinolophus ferrumequinum	0.07	0.07	0.39	0.11	0.42	1.26	0.07
	Rhinolophus hipposideros	0.07	0.21	0.63	0.70	0.98	1.18	0.07

4.14 BAT PASSES EACH HOUR AFTER SUNSET BY LOCATION

Table 16: Bat Passes Each Hour after Sunset

Location	*Species*	0	1	2	3	4	5	6	7	8	9	10	11	12
ST1	*Barbastella barbastellus*							1	1					
	Eptesicus serotinus			2	1									
	Myotis spp.	1	19	20	9	19	16	13	10	1	5	4	4	
	Nyctalus noctula	4	24	3			1	1	5		2		2	
	Nyctalus spp.			3		3								
	Pipistrellus nathusii			1										
	Pipistrellus pipistrellus	28	202	191	119	62	98	22	53	1	8	19	3	8
	Pipistrellus pygmaeus	4	31	10	10	7	6	3	9		1	3	2	11
	Rhinolophus ferrumequinum				1	16								
	Rhinolophus hipposideros			2	3		3	4			2	1		
ST2	*Barbastella barbastellus*		3	1	1					1				
	Eptesicus serotinus		3	2				1						
	Myotis spp.	11	118	81	90	119	110	81	67	45	34	5	9	1
	Nyctalus noctula	2	74	26	2	3		1	3		2	1	4	
	Nyctalus spp.		4	2										
	Pipistrellus pipistrellus	50	213	139	127	91	49	53	141	13	55	49	20	13
	Pipistrellus pygmaeus	65	195	67	27	40	16	9	28	6	25	13	2	1
	Rhinolophus ferrumequinum				1	3	2		1					
	Rhinolophus hipposideros		8	10	4	4	8	6	1	9	5	4	2	1
ST3	*Eptesicus serotinus*		2	2				1						
	Myotis spp.		5	14	5	10	6	3	2	2	3	1		
	Nyctalus noctula	3	10	1					1					
	Nyctalus spp.		5			1								
	Pipistrellus pipistrellus		33	61	44	15	7	3						
	Pipistrellus pygmaeus		14	11	4	5		4	2				2	

5 REFERENCES

The visualisation and analysis has been undertaken in R (R Core Team 2018) using R version 3.6.1 (2019-07-05); R is an open-source statistical programming language. This document has been produced dynamically using `knitr` (Xie 2015) and `rmarkdown` (Allaire et al. 2019), integrating the data, analysis and reporting. For clarity the R script that generates the analysis is not shown. The graphics have been produced using the R package `ggplot2` (Wickham, Chang, et al. 2019). The wrangling of data was undertaken with `dplyr` (Wickham, François, et al. 2019) and `tidyr` (Wickham and Henry 2019) packages. The data in *csv* and *Excel* files has been imported with `readr` (Wickham, Hester, and Francois 2018) and `readxl` (Wickham and Bryan 2019) packages respectivily. The computation with dates and times has been accomplished with `lubridate` (Spinu, Grolemund, and Wickham 2018) package. Suntimes have been obtained with the `suncalcs` (Thieurmel and Elmarhraoui 2019) package. The manipulation of text was through the `stringr` (Wickham 2019) package. Summary statistics have been produced with the `mosaic` (Pruim, Kaplan, and Horton 2019) package. Tables have been enhanced and made more readable with the `kableExtra` (Zhu 2019) package. The `broman` (Broman and Aimee Teo Broman 2018) package provided some useful R functions. The `scales` (Wickham 2018) package improves the clarity of scales on `ggplot` graphics.

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