Bracklyn Wind Farm

Annex 5.5: Bat Survey Report

Bracklyn Wind Farm Limited

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BAT SURVEY REPORT TO INFORM THE PROPOSED BRACKLYN WIND FARM, CO. WESTMEATH

Results of the 2020 active bat season and habitat suitability assessments

Report prepared by Woodrow Sustainable Solutions Ltd.

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STATEMENT OF AUTHORITY

Bat surveys conducted at the proposed Bracklyn Wind Farm Site over 2020 and 2021 were undertaken by staff from Woodrow Sustainable Solutions Ltd (Woodrow), including: Rachel Irwin, Kristi Leydon, Aoife Moroney, Nicole Fleming, Róisín NigFhloinn, Oisín O'Sullivan, Declan Manley, Daelyn Purcell and Mike Trewby. Manual verification of bat sonograms, data analysis using Ecobat and reporting, was undertaken by Oisín O'Sullivan, Aoife Moroney and Rachel Irwin; with input and supervision from Will Woodrow. The report was compiled by Oisín O'Sullivan, Aoife Moroney and Rachel Irwin, with final review and approval undertaken by Will Woodrow.

Will is a Director and Principal Ecologist at Woodrow Sustainable Solutions Ltd. and is an experienced ecologist with over 30 years of experience in ecological surveys and impact assessment. He has an authoritative understanding of bat ecology in relation to wind farm proposals. Will's qualifications include M.Sc. – European Environmental Policy and Regulation, Lancaster University, 1994, and M.Sc. (Arch) – Advanced Environmental and Energy Studies. University of East London, 2006. Will is a Chartered Ecologist and a full member of the Chartered Institute of Ecology and Environmental Management (CIEEM). As such, he is required to abide by a strict code of professional conduct in all aspects of his work.

Rachel Irwin, is a graduate ecologist at Woodrow and has spent two seasons coordinating the company's bat surveys under the direction of Will Woodrow. Over this time she has developed considerable experience in Potential Roost Feature (PRF) surveys for bats, emergence/re-entry roost surveys, activity transects and deployment of static bat detectors for numerous large wind farms sites in both the Republic of Ireland and Northern Ireland; as well as other developments including quarries and smaller residential projects. Rachel has also developed expertise in conducting roost searches of buildings, bridges and trees under the supervision of licenced members of Woodrow staff - Róisín NigFhloinn and Will Woodrow. During her time at Woodrow, Rachel has become accomplished at manual identification of bat sonograms utilising Kaleidoscope and BatExplorer. Towards the end of each active bat season, she was responsible for compiling bat reports. She also assists senior members of staff with reporting for Ecological Impact Assessment (EcIA), Biodiversity Chapters for Environmental Impact Assessment Reports (EIAR) and to inform the Appropriate Assessment (AA) process. She is a Qualifying member of the CIEEM.

Oisín O'Sullivan is a graduate ecologist with Woodrow. Oisín has completed a B.Sc. in Ecology and Environmental Biology at University College Cork. His final year thesis involved bat surveys of urban habitats in Cork City. His work as a graduate ecologist with Woodrow is focused on bat data analysis including bat call identification and bat roost/habitat suitability surveys. Oisín has developed a high level of proficiency with Kaleidoscope, Ecobat and BatExplorer, the analysis software used to assess bat calls and activity. Oisín also possess marine and freshwater habitat survey skills from his time studying at UCC. Since joining Woodrow, Oisín has contributed to the writing of multiple bat activity reports. Oisín is a Qualifying member of CIEEM.

Aoife Moroney is a Graduate Ecologist with Woodrow. She has completed a B.Sc. in Engineering at University College Dublin and M.Sc. in Environmental Engineering (specialising in Environmental Management) at the Technical University of Denmark and the Royal Institute of Technology, Sweden. She is currently undertaking a Post-graduate Certificate in Ecological Survey Techniques at the University of Oxford. She has also been involved with multiple conservation and research projects in southern Africa. Aoife has developed a high level of proficiency with Kaleidoscope, Ecobat and BatExplorer, the analysis software used to assess bat calls and activity. She is the process of applying for membership of the CIEEM.

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1 INTRODUCTION

1.1 Protected status of bats in Ireland

Bats are protected by law in the Republic of Ireland under the Wildlife Act 1976 and subsequent amendments (2000 and 2010). Under the Wildlife Act, it is an offence to intentionally disturb, injure or kill a bat or disturb its resting place. Under this legislation it is unlawful to destroy, alter or disturb known bat roosts without an appropriate derogation licence, as issued by the National Parks and Wildlife Service (NPWS).

All bat species fall under Annex IV of the EU Habitats Directive (1992), whereby member states have a burden of responsibility to protect bats and their resting places wherever they occur. The EU Habitats Directive has been transposed into Irish law with the European Communities (Birds and Natural Habitats) Regulations 2011. The lesser horseshoe bat (*Rhinolophus hipposideros*), which occurs only in Counties Cork, Kerry, Limerick, Clare, Mayo and Galway in the Republic of Ireland, is listed in Annex II of the EU Habitats Directive 1992. The level of protection offered to the lesser horseshoe bat effectively means that areas important for this species are designated as Special Areas of Conservation (SACs). For remaining bats, the EU requires that they are strictly protected. Among Ireland's obligations under the Habitats Directive, is the obligation to 'maintain favourable conservation status' of Annex-listed species.

Ireland has ratified two international conventions, which afford protection to bats amongst other fauna. These are known as the 'Bern' and 'Bonn' Conventions. The Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention 1982) exists to conserve all species and their habitats, including bats. The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979, enacted 1983) was instigated to protect migrant species across all European boundaries, which covers certain species of bat.

1.2 Requirements for impact assessment

In order to comply with the requirements of the EU Habitats Directive 1992 and the EC Habitats Regulations 2011, wind farm applications in Ireland need to be assessed as to their potential impact on bat populations. To inform the impact assessment at the proposed Bracklyn Wind Farm Site ('the proposed development site') a range of bat surveys were undertaken including a desk-based study and field surveys. As of 2019, the appropriate methodological approach for assessing bat population on proposed Wind Farm Sites is *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (SNH *et al*., 2019) [1].

1.3 Outline of the scope of works

This report considers the proposed Bracklyn Wind Farm ('the proposed development'), providing details on the methodologies and results of bat surveys undertaken to investigate the bat usage and habitat suitability of the Wind Farm Site (including substation) and grid connection route. For the purpose of this report, the term 'Wind Farm Site' will be used to refer to the turbine array, substation and associated access tracks; while the term 'grid connection route' will be used to refer to the proposed route of the underground electricity line and proposed end masts.

The Wind Farm Site consists of a nine-turbine proposal located within the townland of Bracklin, Co. Westmeath. The Wind Farm Site lies 4 to 5 km (depending on proposed turbine location) south of

1 Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, University of Exeter & Bat Conservation Trust (2019). *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation*.

Devlin village, and *c*. 14 km north-east from the nearest point of Mullingar. **Figure 1** shows the locations of the proposed turbines with a 300 m buffer applied to illustrate the potential Zone of Influence for bats, where survey effort was focused. The electricity substation and other infrastructure associated with the Wind Farm Site is buffered by 30 m to illustrate the potential Zone of Influence for bats. **Figure 2** shows the proposed grid connection route with a 30m buffer applied to depict the potential Zone of Influence, which was assessed for potential bat habitat suitability. The grid connection route, exits the Wind Farm Site at T10 and will be laid underground, running east, initially through Bracklin before entering the townland of Coolronan in Co. Meath, where it will be connected to the proposed end masts and the Mullingar-Corduff 110kV overhead transmission line.

In compliance with SNH *et al*. (2019) guidelines, static bat recording equipment was deployed on three occasions in 2020 at selected locations representative of the proposed turbine layout for the Wind Farm Site. The three deployments, each lasting a minimum of 10 nights, covered the spring, summer and autumn active season for bats and were undertaken in conjunction with continuous monitoring of climatic conditions on the site to ensure recording windows were inline within compliant weather parameters. A continuously recording static bat detector was deployed on the on-site temporary meteorological mast, with 2 microphones, for the duration of the 2020 season and provided comparative data on bat activity at height (50 m) and at ground level (2 m). To supplement data collected from static bat detectors, manual roost emergence/re-entry surveys and bat activity transects were undertaken and observations provide context to inform how bats utilise the Wind Farm Site. In addition, an assessment of potential bat roost features within the Wind Farm Site and grid connection route was completed, along with roost emergence/re-entry surveys and bat activity transects.

At the time of the conducting this assessment the following information regarding turbine specification was provided:

- Turbine make-model: Vestas V162
- Turbine tip heights: 185 m
- Rotor diameter: 162 m (blade length of 81 m)
- Hub height: 104 m (rotor swept height = 23 m)

Please note that although turbine make and model are specified here, the bat data collected and can be adjusted for alternative turbine dimensions, as well as changes to site layout such as micro-siting of turbines. The impact assessment outlined in the following sections has been conducted by applying a range of turbine set-ups, including the most extreme (worst-case) scenario in turbine specifications, i.e. largest, lowest to ground level rotor swept areas; and as such will be consistent with a precautionary approach.

1.4 Layout of report

This report was written to be included as a technical appendix to Chapter 5 – Biodiversity of the EIAR and provides details of methodologies and survey effort for the suite of bat surveys conducted for the proposed development, including tabulated results, maps and charts, as well as reports from roost suitability surveys, bat activity surveys and seasonal static bat detector surveys. These surveys allow for the baseline bat populations and habitat suitability of the proposed development to be described and to allow fora robust impact assessment to be conducted.

Figure 1 – Bracklyn Wind Farm showing potential Zone of Influence (ZoI) on bats

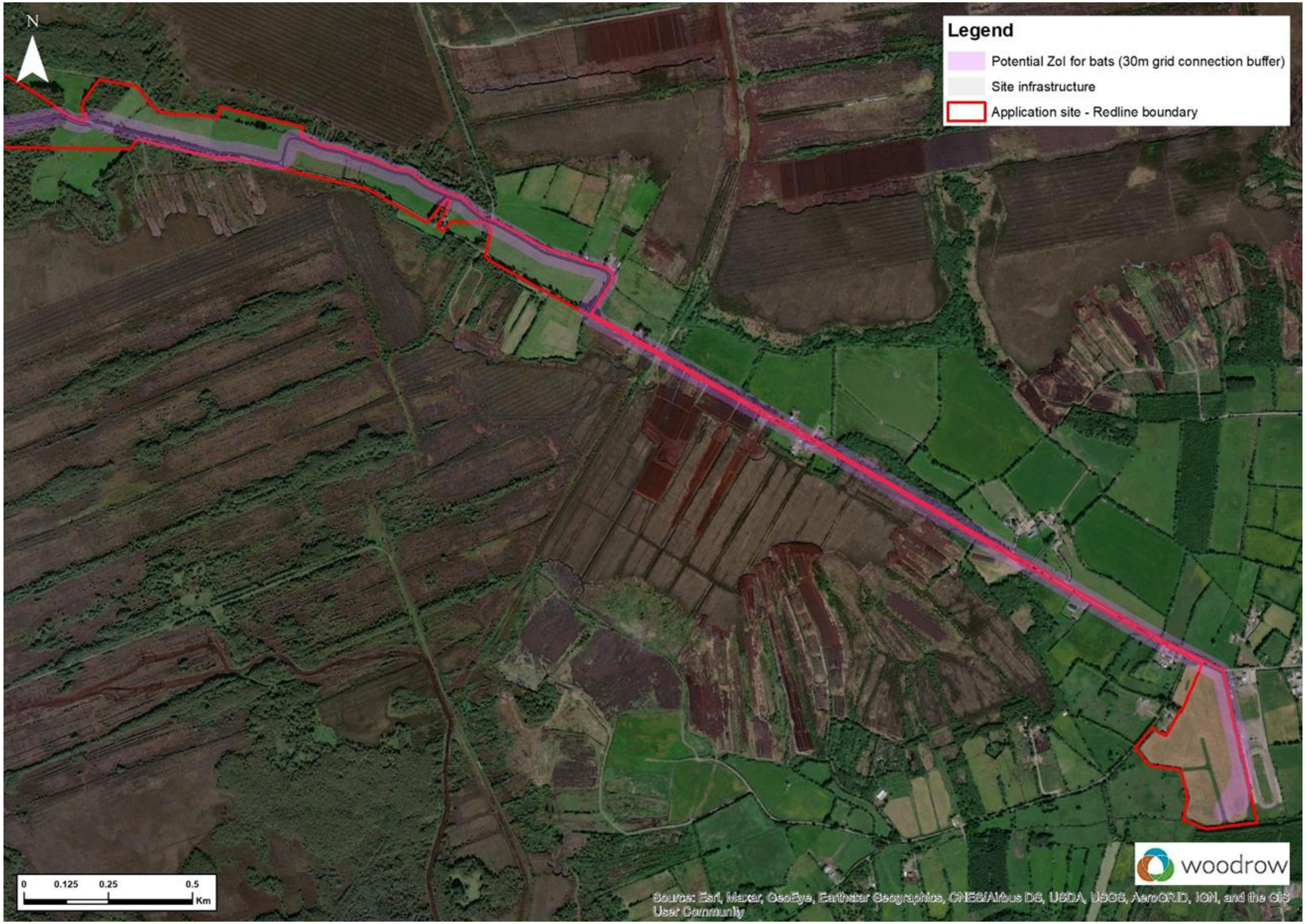


Figure 2 – Proposed grid connection and end masts with 30m potential ZoI for bats

1.5 Limitations and issues pertinent to interpretation of bat survey results

In the case of bat surveys, survey limitations often relate to weather conditions at the time of the surveying and equipment failing in the field, for example microphones can be damaged by livestock or can lose sensitivity when exposed to prolonged episodes of heavy rainfall.

The sections below provide details for any potential limitations to the bat surveys. Overall, it is considered that the combined survey approach and coverage over the 2020 survey season, with additional surveying conducted in 2021 to cover the route to the grid connection, provides robust data from which a full insight into the use of the proposed development site by bats can be obtained. As such, this information can be used to assess any potential impacts of the proposed development on the local bat population. Given the survey methodologies used to ensure full coverage of proposed development site across the bat activity season 2020, it is considered that the data obtained complies, in full, with the recommend guidelines set out within *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation* (SNH *et al*., 2019).

1.5.1 Coverage

It is considered that static bat detector coverage of the Wind Farm Site for bat activity in 2020 was in line with the SNH *et al*. (2019) guidelines. Due to reasons relating to access and habitat structure, bat equipment could not always be setup at exact proposed turbine locations, e.g. when proposed turbine locations are in dense conifer plantations. While this was not considered to limit the robustness of the data set, it is important to acknowledge the deployment locations in relation to the turbines, as this has implications for interpretation of bat activity. For instance, deploying units away from proposed turbine locations within plantations and along the edge of habitat features is likely to lead to more bats being registered, which may not be a true reflection of activity at a given turbine location.

Appendix 2 provides a series of aerial images, one for each proposed turbine location, and illustrates the deployment locations relative to the turbines. To distinguish between locations where bat recording equipment was deployed and the proposed turbine locations, different numbering systems have been used for these features throughout this report, numbers preceded by ‘T’ refer to turbine locations and those with a ‘D’ refer to static bat detector deployment locations.

For clarity, the relationship between turbine and deployment locations is reviewed in the following points. In summary, the majority of deployment locations (those covering T4, T5, T6, T7, and T11) were positioned within 81m of the turbine tower and as such are considered to be monitoring airspace within the rotor swept area. The deployment locations covering T1 was just beyond the 81m mark (c. 90m). For T2, T3 and T10 the separation distance was slightly wider (c. 120m, 300m and c.130m respectively).

Units at T4, T5, T6, T7, T10 and T11 were all deployed within or on the edge of commercial plantation as a result of the turbine location or other issues, such as livestock interference. Units at T2 and T3 was also placed along linear features. It is important to note that these deployments are unlikely to be representative of habitat conditions once turbines are built and vegetation clearance around the turbines is likely to alter how bats utilise the area. The placement of these detectors along high quality foraging interfaces results in very high levels of activity being recorded. It is very important to note that the levels of bat activity recorded by static bat detectors deployed at proposed turbine locations are not representative of the actual number of bats. Bat activity generally considered as the number of bat pass over time, with a bat pass defined as a species presence within a 15 second sound file. For example, a small number of bats (1 or 2 bats) consistently foraging at a given location will register high levels activity.

During the design phase of the proposed development, two turbines were omitted (T8 and T9) as embedded mitigation in order to avoid impacts on ecological constraints, among other reasons. – D.09 was originally set up to cover the proposed T9 which was subsequently omitted and this unit now provides useful context of activity levels at other locations adjacent to the proposed development. D.08 was positioned in the open field adjacent to D.11 to provide context data from a more open environment lacking linear features. The use of the D.08 context detector helps to provide a clearer insight into the level of activity at turbine locations for which detectors could not be deployed at the precisely proposed turbine location. The additional data gathered by these context detectors is considered to have also ensured the data is compliant with SNH *et al.* (2019) guidelines, notably offsetting any equipment failures that are a normal aspect of bat surveys involving the deployment of high specification electrical equipment in the field.

1.5.2 Equipment

Deployments of static bat detectors covering involved the use of two types of Wildlife Acoustic Song Meters (SMs), including SM2s and SM4s. **Table 2** lists the types of models of static detectors used for each deployment. In summary, during the spring survey, five locations were covered by Wildlife Acoustics Song Meters 2s (SM2s), D.01, D.02, D.08, D.11, D.06; while the remaining six locations were covered by Wildlife Acoustics Song Meter 4sSM4s. For the summer deployment, only two SM4s were used, at D.02 and D.06, while all other deployments comprised SM2s. During the autumn, six SM2s were deployed at D.02, D.05, D.06, D.07, D.09 and D.11 with the other five locations covered by SM4s.

Equipment failure/technical issues over the course of the three deployments in 2020 was experienced by four static detectors, comprising:

- The spring deployment at D.01, where the data recorded was corrupted and bat calls were unable to be identified.
- The spring deployment at D.03, where only two calls were recorded over 18 nights. This is considered likely to be as a result of an equipment failure due to the higher levels of activity observed in the summer and autumn seasons at this deployment location.
- The spring deployment at D.07 where the static bat detectors suffered a microphone failure and failed to record any bat passes. However, D.07 has been sufficiently covered during the summer and autumn deployments.
- The autumn deployment at D.06, where the static bat detectors suffered a software failure on the fifth night of recording, during a 10-night deployment.

It is considered that these four deployment locations were sufficiently covered during the other deployments (including continually recording bat detector at the meteorological mast), and patterns in bat activity were well documented. As such, these surveys robustly inform any conclusions being made regarding levels of bat activity at the Wind Farm Site and this limitation is not considered to affect the overall results. Detectors with less than 10 night's data were still included in the analysis as a measure of bat passes per hour is used, rather than total bat passes. This means that data can be compared irrespective of number of nights they record for.

A continuously recording static detector was deployed on a temporary meteorological mast from 23 June 2020 onwards to record bat activity at ground level (2 m) and at height (*c*. 50 m). This static detector recorded until 05 October 2020. Battery failure resulted in no data being recorded for five nights (04 September 2020 to 08 September 2020); however, this does not affect the robustness of this data set.

Despite equipment failures at three deployment location in the spring and one deployment locations in autumn it is considered that both seasonal deployments provide sufficient baseline data to facilitate a robust assessment of potential impacts of the proposed development. This is achieved through the supplementary data collected with context detectors. For the other remaining detectors, recording was achieved throughout deployment (which included recording up to 18 nights per deployment).

1.5.3 Weather

In Ireland, good survey conditions for static monitoring sessions are difficult to guarantee; as weather forecasts and conditions can change dramatically over the nights that static detectors are left out. However, deployment periods can be considered as capturing data that is representative of the real situation and provide useful insight into the sporadic and opportunistic use of more open sites by bats; for instance, foraging bats may be less inclined to venture onto open bog on nights when prevailing weather conditions, e.g., higher wind speeds, make flying more energetically costly or supresses activity levels of flying invertebrates upon which bats prey. A primary value of static detectors deployed in conjunction with a weather station is the ability to compare relative density of use across a site at a time when all variables (such as weather) are the same, rather than just recording during optimal weather conditions for bats.

To comply with SNH *et al*. (2019) guidelines, the duration of each deployment period should last a minimum of 10 nights within compliant weather parameters. Compliant weather conditions are defined as: temperatures at ≥ 8°C at dusk, maximum ground level wind speed of 5 m/s (11 mph) and no, or only very light, periodic overnight rainfall. A Davis Vantage Vue weather station was deployed to provide real time data transfer, allowing the weather station to be fully monitored throughout the deployment periods, and to avoid the need for deployment of a second (back-up) weather station.

During the summer period, D.07 recorded the shortest number of nights (11), three of which were non-compliant as a result of heavy rainfall. As a result, D.07 was not in compliance with the SNH guidelines. However, as a further precaution to capture 10-nights of records within compliant weather conditions, deployment periods were generally extended beyond 10 nights, unless recorded weather conditions demonstrated compliance. The non-compliance of D.07 in this period is offset by the additional data provided by other detectors recording in excess of 10 nights during this period. **Table 2** provides deployment dates and the durations for recording. Weather data (temperature, wind speed and rainfall) are summarised for each seasonal deployment in **Figure 14**, **Figure 17** and **Figure 20**.

Aside from the four units which experienced technical limitations and the single unit that experienced weather limitations during a single season, it is considered that a minimum of 10 nights within compliant weather parameters was collected by all the remaining units, with many recording for significantly longer than 10 nights. It is also considered that with many units recording for a period of longer than 10 compliant nights in similar habitats, along with the presence of the unit continuously recording at the met station and supplementary context units, that this still allows for the robust analysis of baseline bat activity for the site as a whole, despite the non-compliance of D.07 in Summer.

1.5.4 Data analysis

When sound files are processed through the Kaleidoscope software, many bat calls are identified as ‘noise’ files for a variety of reasons such as nearby sound interference or a call being distant and therefore faint. The manual verification of bat call identifications on these data logs included the examining of noise files and identifying bat calls where possible. This results in a higher number of bat passes being identified during this approach compared to approaches that may be undertaken at other sites (i.e. those that that declare bat calls within ‘noise’ files to be sub-optimal and therefore excluded from analysis or those that use the Kaleidoscope setting to delete ‘noise’ files as part of the analysis settings). For this Wind Farm Site in particular, a large amount of bat call data was generated from noise files. This methodology could be a distorting factor in the use of the Ecobat software analysis tool, as the methods used by other independent contributors to their database cannot be ascertained. There is therefore potential for an inflation of the median activity results from Ecobat which is based on the comparison of this site to other datasets originating from other operators.

The software analysis provided by Ecobat gives several options for the definition of a bat pass for datasets. The pass definition most suited to the data generated at the Wind Farm Site was a “Registration” which defines a bat pass as a species presence within a 15 second sound file. This means that, unlike the use of bat passes per hour and Kepel *et al.* (2011) for analysis, Ecobat does not take into account multiple individuals of the same species within the same 15 second sound file.

It is also important to consider Ecobat median percentiles in the context of nights to which data was compared to. In the data presented in this report, for each recorded species at each detector there is a figure given for “reference range” (**Table 11**). The reference range refers to the number of nights of similar geographic location, equipment used and time of year to which this data was compared. The level of accuracy is therefore liable to vary between species. This difference in accuracy between species and location can be seen in the 95% confidence intervals presented in **Table 8** and **Table 11**. It is important to note that species which are often detected less frequently, for example brown-long eared bats and Nathusius’ pipistrelles, are given larger 95% confidence intervals having been compared to less datasets. Ecobat also does not use zero data nights of recording, meaning only nights on which bats are recorded are compared to the Ecobat database. These two factors could result in an inflated level of bat activity being produced with analysis through Ecobat.

One limitation that exists with the use of Kepel *et al.* (2011) categorisations is that the outputs are less scalable than that of Ecobat. While Ecobat works off median percentiles, the use of Kepel *et al.* examines activity band ranges classifying the bat passes per hour. Once a level of activity passes the threshold for ‘High’ activity, it is possible to lose a sense of scale for the activity level. For example, both 10 and 150+ bat passes per hour are considered to be the same level of activity.

For this reason, both of these methods of analysis are used in this report in order to mitigate the limitations posed by each system. While Kepel *et al.* (2011) classifications lack scalability, the results are uninfluenced by the results of third-party surveys and take into account zero data nights. While Ecobat can be influenced by third party surveys and zero data nights, through the use of median percentiles, the results are much more contextual in terms of scale and the potential wealth of data gathered in surveys external to this study.

The particular value of Ecobat is that it is intended to put the recorded bat activity levels at a given site into a wider context of other sites that have been surveyed. This allows a comparative analysis of activity across different sites, thus putting the surveyed site in a wider, regional, context. However, the level of information within Ecobat is limited for Ireland (it currently stands at equivalent to around 11 times the amount of data collected for this proposal in entirety), and the proportion of open upland sites (likely to have lower activity levels) and forested lowland sites (likely to have higher activity levels) is unknown. For this reason, interpretation of the Ecobat percentiles should be undertaken under caution and in full understanding of this limitation.

1.5.5 Other considerations

Walked or driven transects are no longer always a requirement under the SNH *et al*. (2019) guidelines. Transects were undertaken by Woodrow for the Wind Farm Site, which covered the summer and autumn survey seasons in 2020 and spring in 2021, when the grid connection route was surveyed. It is considered that manual bat activity surveys, such as these, provide valuable contextual data in addition to the information that is recorded on static bat detectors. A total of four dusk transects combined with roost emergence surveys were conducted, as well as two dawn transects combined with roost re-entry survey, to enhance the understanding of the general bat activity across the Wind Farm Site. Further roost emergence were undertaken in spring 2021, which were combined with transect surveys covering the grid connection route

2 METHODOLOGY

Pre-planning surveys for bats at proposed Wind Farm Sites aim to identify the species occurring within the proposed development site and provide an understanding of how local bat populations utilise the area in terms of density of use for foraging, roosting (maternity and hibernation) and social interactions. This information allows for the identification and assessment of the potential impacts the proposed development is likely to have and for appropriate avoidance and/or mitigation measures to be implemented as part of the design phase of the project

Bat surveys were conducted by Woodrow Sustainable Solutions Ltd. at Bracklyn over the 2020 active bat season, with additional coverage undertaken in spring 2021, to ensure compliance with the most recently published guidelines pertaining to surveying, impact assessment and mitigation for bats at onshore wind turbines (SNH *et al*. 2019). This guidance document supersedes previous guidelines (Collins, 2016[2] updating Hundt, 2012[3] & BCI, 2012[4]) and requires a site-by-site approach to survey design, with the only prescriptive element being the positioning, number and duration of static bat detector deployments, as well as the strongly recommended continual monitoring of site-specific weather data on rainfall, temperature and wind speeds.

The guidelines require as a minimum, three deployments of static detectors aimed at covering spring (April to May), summer (June to mid-August) and autumn (mid-August to October), each with a minimum deployment period of 10 nights (within compliant weather parameters). Seasonal deployments of static detectors are set out at all potential turbine locations for proposals comprising ten or less turbines, with a third of any additional locations also covered up to a maximum of 40 detectors. Compliant weather conditions are defined as: temperatures at $\geq$ 8°C at dusk, maximum ground level wind speed of 5 m/s (11 miles/hr) and no, or only very light, periodic rainfall.

Additional requirements of the SNH *et al*. (2019) guidelines include swarming surveys and winter roost inspections if potential hibernation roosts are identified. Transect and/or vantage point surveys are seen as methods used to complement the static detector surveys, with applicability being discretionary and site-specific.

2.1 Desk study and site investigation

A desk-based review of habitat availability in the environs of the proposed development, and the available bat data was used to inform the scope of the bat surveys required. As recommended by both BCI (2012)[5] and SNH *et al*. (2019) the area covered by the desk-based review was extended to 10 km surrounding the Wind Farm Site. The desk-based study included:

- Reviewing distances from closest Natura 2000 sites designated for bats (only bat SACs in Ireland are for lesser horseshoe bat *Rhinolophus hipposideros*) - the area of interest (in Co. Westmeath/ Meath) is outside the range for lesser horseshoe bat in Ireland.
- Examining aerial imagery and 6-inch maps to identify potential bat foraging and roosting habitats
- Lundy *et al*. (2011) [6] provides a high-level assessment of potential habitat suitability for different species of bat occurring in Ireland.

2 Collins, J. (ed.) (2016) *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd edition). The Bat Conservation Trust, London.

3 Hundt, L. (2012). *Bat Surveys: Good Practice Guidelines*. 2nd Edition. BCT – Bat Conservation Trust, London.

4 Bat Conservation Ireland (2012) *Wind Turbine/Wind Farm Development Bat Survey Guidelines*, Version 2.8, December 2012. Bat Conservation Ireland

5 Bat Conservation Ireland (2012) Wind Turbine/Wind Farm Development Bat Survey Guidelines, Version 2.8, December 2012.

6 Lundy, M.G., Aughney, T., Montgomery, W.I., & Roche, N., (2011) Landscape conservation for Irish bats & species specific roosting characteristics. Bat Conservation Ireland.

- Review of data received from BCI within 10 km of the Wind Farm Site and the results of Biodiversity Maps report for the 10-km squares covering the site [N55 & N65], including species recorded and known roosting sites.

2.2 Roost assessment surveys

The most recent guidelines (SNH *et al*., 2019) recommend that "*features that could support maternity roosts and significant hibernation and/or swarming sites (both of which may attract bats from numerous colonies from a large catchment) within 200 m plus rotor radius of the boundary of the proposed development should be subject to further investigation*".

Turbine specification, as well as locations, are regularly altered during the design phase of projects and as a precaution Woodrow always conduct roost assessment surveys within 300 m of the potential build area. Sections of the access tracks falling beyond the 300m zone of influence around turbines and the grid connection route have been assessed out to 30 m, to account for the maximum extent of potential disturbance from construction works. Wide reaching roost and foraging habitat assessment of the Wind Farm Site were undertaken during March 2020, as part of a site scoping exercise. These assessments were refined over subsequent site visits and the final assessments were conducted over May 2021, which re-assessed the finalised site layout, including the on-site substation and grid connection route.

Surveyors utilised the assessment criteria described in Collins (2016) – see Page 35, Table 4.1, which provides guidelines for assessing potential suitability of habitat features as bat roosts and for foraging bats. This allows surveyors to assign features, a 'negligible', 'low', 'moderate' or 'high' status in terms of their potential for bats, i.e., the presence of Potential Roost Features (PRFs). Based on the features present and the location of the trees or other structure, the potential use of the feature can also be considered, and classified (as in Hundt, 2012):

- Maternity (breeding roost)
- Summer / transitional (to include transitional, occasional, satellite, night and day roosts)
- Hibernation roost

Surveyors initially employed non-invasive external and internal inspection techniques for any building encountered, and trees were assessed from the ground. All turbine locations were evaluated and an area of 300 m around turbines was assessed for bat roost potential - see **Figure 1**. Based on the young age of trees, a lack of suitable Potential Roost Features (PRFs), and species composition (mostly Sitka spruce), it can be safely assumed that the trees within most of the plantations covering the Wind Farm Site did not have the capacity to support roosting bats.

If deemed appropriate, full building/tree inspections can be undertaken under licence from NPWS and would include inspecting any potential hibernation roosts. Only one full building inspection was required at a derelict cottage adjacent to the access track entering the Wind Farm Site to the north. No potential winter (hibernation) roosts were identified in the Zone of Influence and therefore no further inspections were required.

Based on the findings of the roost assessment surveys, features classed as having moderate to high suitability for bats and/ or demonstrating likely occupancy, (e.g. bat dropping found), were targeted for further bat activity surveys, including dusk emergence/dawn re-entry surveys.

2.3 Bat activity surveys – roost emergence/re-entry surveys

As summarised in **Table 1**, several dusk emergence/dawn re-entry surveys were completed, typically prior to or after undertaking walkover (transect) surveys of the site. Transect and dusk emergence/dawn re-entry surveys undertaken using professional Elekon Batlogger M bat detectors to collect geo-referenced records of bat activity, which were then analysed using BatExplorer.

Four emergence surveys at potential roost sites were conducted on 05-Aug-2020 and 02-Sep-2020 (considered to have 'Low' to 'High' PRF suitability based on Collins, 2016 guidelines) prior to undertaking dusk transects, while another emergence survey was conducted on 24-Aug-2020 and a further two locations were covered on the 10-May-2021, covering the following locations highlighted in **Figure 3a**:

- 05-Aug-2020 (21:00 to 21:51) – derelict cottage in the northern section of the Wind Farm Site, located at 1,113m from the closest turbine [53.581583, -7.095333]
- 05-Aug-2020 (21:00 to 21:50) – mature beech in the southern section of the Wind Farm Site, located at *c*. 387m from the closest turbine [53.565833, -7.083167
- 24-Aug-2020 (20:12 to 22:10) – crypt in the north – western section of the Wind Farm Site, located *c*. 392m from the closest proposed turbine [53.575971, -7.087565
- 02-Sept-2020 (20:00 to 21:00) – 'T' shaped treeline with occasional 'moderate' to 'low' PRF suitability in the middle section of the Wind Farm Site, located *c*. 213mfrom the closest proposed turbine [53.576148, -7.080718 through to 53.574039, -7.076673]
- 02-Sept-2020 (20:00 to 21:00) – semi-mature woodland located in the eastern section of the Wind Farm Site, located *c*. 268m from closest proposed turbine [53.570121, -7.072124 through to 53.569904, -7.069152]
- 10-May-2021 (21:00 to 22:44) – treeline SW of T4 [53.564755, -7.077551]
- 10-May-2021 (20:54 to 22:30) – treeline SW of T5 [53.562488, -7.084000]

Four re-entry surveys at potential roost sites (considered to have 'Low' to 'Moderate' PRF suitability based on Collins, 2016 guidelines) were conducted during the 2020 active season, covering the following locations which are highlighted in **Figure 3a**:

- 06-Aug-2020 (04:30 to 05:30) – derelict cottage in the northern section of the Wind Farm Site, located at 1,113m from the closest turbine [53.581583, -7.095333]
- 06-Aug-2020 (04:30 to 05:30) – semi-mature birch in the northern section of the Wind Farm Site south-west of derelict cottage, located at *c*. 387m from the closest turbine [53.581578, -7.095522] – see **Figure 5a**
- 03-Sept-2020 (05:40 to 06:55) – 'T' shaped treeline with occasional 'moderate' to 'low' PRF suitability in the middle section of the Wind Farm Site, located *c*. 213m from the closest proposed turbine [53.576148, -7.080718 through to 53.574039, -7.076673]
- 03-Sept-2020 (05:40 to 06:55) – semi-mature woodland located in the eastern section of the Wind Farm Site, located *c*. 268m from closest proposed turbine [53.570121, -7.072124 through to 53.569904, -7.069152]

2.4 Bat activity surveys – walked/driven transects

Under SNH *et al*. (2019), the application of transect surveys is discretionary, with survey requirements designed on a site-by-site basis. Transects are complementary to data collected from static bat detectors; and are important for identifying flight lines and for gaining understanding of bat abundance within the survey area. Driven transects can provide useful information on the wider landscape in the vicinity of the proposed development site. If driven transects are undertaken, it is important that appropriate microphones are used and are directed above the vehicle. It is also important to remain at a constant low speed (< 10 km/h). Point counts (of a fixed duration) can be incorporated into transects to survey specific features to provide information on comparative density of use.

Transects were completed on four dates in 2020, including dawn surveys, with the latter three transects split into two to allow survey teams to cover various sections of the site robustly. Survey dates and weather conditions for transects conducted are provided in **Table 1** and **Figure 3a** illustrates the transect routes undertaken within the wind farm site. The grid connection route was covered during an additional transect on 10-May-2021 - see **Figure 3b**.

Field records were made of bat species encountered, number of bat passes, activity (where known: e.g. foraging, commuting, advertising), travelling direction and approximate height (where known).

Temperature and wind speed were measured at intervals throughout the survey. Batloggers recorded temperature throughout the surveys.

Table 1 – Dusk transect survey dates, timing & weather conditions for 2020

Date	**Start time**	**End time**	**Survey type - coverage** (surveyors)	**Weather Conditions**	**Distance from nearest Turbine**
08-Jun-2020 Sunset 21:56	21:30	00:00	Dusk transect - Walked transect covering T1 to T8 (R. Irwin, plus-one)	Wind: Force 1 NW Cloud: 7 oktas Dry Temp: 15°C	n/a
05-Aug-2020 Sunset 21:17	21:00	21:50	Emergence survey - At a derelict cottage in the north of the site. One surveyor facing the south side of the cottage and one facing the east side. (R. NigFhloinn & A. Moroney)	Wind: Force 1 SW Cloud: 7 oktas Dry Temp: 19°C	1,113m from T1
	21:00	21:50	Emergence survey - At a mature beech tree in the south of the site, close to T4 (J. Kohlstruck & N. Fleming)	Wind: Force 1 SW Cloud: 7 oktas Dry Temp: 19°C	387m from T3
	21:50	23:35	Dusk transect - Driven transect from derelict cottage along road to farm entrance. Walked transect east of site, covering T3, T7, T9 and T10. (R. NigFhloinn & A. Moroney)	Wind: Force 1 SW Cloud: 7 oktas Dry Temp: 19°C	n/a
	21:50	23:50	Dusk transect - Walked transect in west of site, covering T2 - T5 (J. Kohlstruck & N. Fleming)	Wind: Force 1 SW Cloud: 7 oktas Dry Temp: 19°C	n/a
06-Aug-2020 Sunrise 05:53	04:20	06:13	Re-entry survey - At derelict cottage in the north of the site. Surveyors facing south, east and north sides of the cottage (R. NigFhloinn, A. Moroney, J. Kohlstruck & Nicole Fleming)	Wind: Force 1 SE Cloud: 1 oktas Dry Temp: 11°C	1,113m from T1
25-Aug-2020 Sunset 20:32	20:12	22:10	Emergence survey - At a crypt located in the north of the site within a small cluster of yew, beech and elder trees (R. Irwin)	Wind: Force 3 SW Cloud: 8 oktas Dry Temp: 13°C	392m from T2
02-Sep-2020 Sunset 20:17	20:00	21:00	Emergence survey - In a clearing between conifer plantation and broadleaved woodland located next to T7. One surveyor facing west and one east (A. Moroney & D. Manley)	Wind: Force 3 SW Cloud: 8 oktas Drizzle Temp: 20°C	268m from T7
	20:00	21:00	Emergence survey - At a mature treeline close to T6 and T7. One surveyor facing the south-east of the treeline and one surveyor the north-west (N. Fleming & D. Purcell)	Wind: Force 3 SW Cloud: 8 oktas Drizzle Temp: 20°C	285m from T1
	21:00	22:30	Dusk transect – Walked transect around east of site, covering T3, T4, T7, T8 and T10. (A. Moroney & D. Manley)	Wind: Force 3 SW Cloud: 8 oktas Light rain Temp: 18°C	n/a
	21:00	22:00	Dusk transect – Walked/driven transect in east and north-east of site covering T1 – T6 (N. Fleming & D. Purcell)	Wind: Force 3 SW Cloud: 8 oktas Light rain Temp: 18°C	n/a
03-Sep-2020 Sunrise 06:42	04:45	05:45	Dawn transect - Walked transect around east of site, covering T3, T4, T7, T8 and T10. (A. Moroney & D. Manley)	Wind: Force 3 SW Cloud: 7 oktas Dry Temp: 14°C	n/a
	04:45	05:45	Dawn transect - Walked/driven transect in east and north-east of site covering T1 – T6 (N. Fleming & D. Purcell)	Wind: Force 3 SW Cloud: 7 oktas Dry Temp: 14°C	n/a
	05:45	07:00	Re-entry survey - In a clearing between conifer plantation and broadleaved woodland located next to T7. One surveyor facing west and one east (A. Moroney & D. Manley)	Wind: Force 3 SW Cloud: 7 oktas Dry Temp: 14°C	268m from T7
	05:45	07:00	Re-entry survey - At a mature treeline close to T6 and T7. One surveyor facing the south-east of the treeline and one surveyor the north-west (N. Fleming & D. Purcell)	Wind: Force 3 SW Cloud: 7 oktas Dry Temp: 14°C	354m from T6
10-May-2021 Sunset 21:15	21:00	22:48	Emergence survey – At tree SW of T5 (A. Moroney)	Wind: Force 1 SW Cloud: 8 oktas Occ. light drizzle Temp: 11-10°C	43m from T5
	20:54	22:33	Emergence survey – At treeline SW of T4 (O. O'Sullivan)		123m from T4
	23:34	00:08	Dusk transect – driven transect of grid connection route (O. O'Sullivan & A. Moroney)	Wind: Force 1-2 W Cloud: 8 oktas Occ. drizzle Temp: 10-9°C	n/a

2.5 Static bat detector surveys

Static detector surveys were undertaken using Wildlife Acoustic Song Meters (SM2 and SM4) across three deployments covering spring, summer and autumn. Static bat detectors were deployed to record the types of bat species present and to provide an overview of how bat activity is broadly distributed over the site and specifically at selected turbine locations.

Dates, distance from associated turbine and positions of static detectors are provided in **Table 2**. The location of all static detectors for each month is shown in **Figure 4**. Two of the detectors deployed, D.08 and D.09, were done so in order to give further context to other deployments. D.08 was paired with D.011 in a position approximately 100 metres away but unlike D.11, D.08 was not deployed adjacent to a linear feature. D.09 was deployed along a treeline in a bog woodland which leads to a bog pool (Bracklin Lough). This approach was followed to give context for bat activity on the site in the presence of these features, which are positively associated with bats. The same locations were used for all three seasonal deployments.

2.5.1 Permanent static at height

In addition to three seasonal deployments of static bat detectors, a continuously recording static was setup on the temporary meteorological mast from 23-Jun-2020 to the end of the active bat season (October 2020). A microphone was erected at height (c. 50m) and was paired with a microphone at 2m to provide a comparative analysis of activity at both of these levels, which is shown in **Plate A**.

2.6 Monitoring climatic of conditions

Monitoring of climatic conditions was undertaken through the deployment of an on-site fully automated weather station with 3G connectivity (Davis Vantage Vue wireless integrated sensor suite weather station). The deployment location of the weather station is shown in **Figure 4**, and **Plate B** provides a picture of the equipment used. The weather station generates data on a real-time basis, allowing functionality to be checked on a daily basis during the survey season and for action to be taken if the station failed, or there were concerns regarding the data. This obviated the need for a second (backup) weather station. The weather station collected the full range of weather data, including temperature, wind speed and rainfall, which allows surveyors to determine whether deployment nights were compliant with the prescribed weather parameters (≥ 8°C at dusk, max. ground level wind speed of 5m/s and minimal rainfall).

Deployment periods can then be adjusted to ensure 10 nights of compliant data are captured. In addition, site specific weather data can be useful for investigating the recorded patterns of site usage by bats.

Plate A – Recording at height

Plate B – Weather station

2.7 Calibration and testing of recording equipment

Calibration and testing of recording equipment is required by the SNH *et al*. (2019) guidelines. As a standard operating procedure Woodrow have a stringent schedule of testing all bat recording equipment prior to and during deployment in the field. Checks are logged in excel, providing an audit trail to ensure that all data can be relied upon to form a robust data set. Unique numbering of static detectors, SD cards and microphones allows for reverse checking, if any issues arise, e.g. following a microphone failure. Checks undertaken include pre-deployment device setting and battery checks, and post- and pre- deployment microphone sensitivity checks.

As detailed in the section on survey limitations, failure of bat recording equipment was limited to D.01, D.03, D.07 in spring and D.06 failed during the fifth night of the summer deployment.

2.8 Analysis

For data collected using SM2s and SM4s, analysis of sound recordings was undertaken using Kaleidoscope software to confirm species (or genus for *Myotis* species[7]) and exact number of bat passes for each deployment. For data collected using the Batloggers, analysis of sound recordings was undertaken using BatExplorer software. Russ (2012)[8] and Middleton *et al*. (2014)[9] were used to aid in identification of bat calls during data analysis.

All sounds files were run through auto-identification and then manual verification was undertaken by Woodrow operatives. Any sound files identified as noise were manually checked, as these can hide bats calls, especially if calls are faint, e.g. if there are high levels of other background noise such as rustling leaves during windy conditions or during periods of light rainfall. Recordings where more than one bat or more than one species was registered were split into separate passes. The number of passes generated were considered synonymous with Registrations, as defined by Ecobat, which is considered to be species presence within a 15 second sound file. SNH *et al*. (2019) guidelines recommend using the online tool Ecobat (managed by the UK Mammal Society) to allow for a measure of relative bat activity using a ranking system by comparing the data collected with bat survey information collected from similar areas during similar times of year. Through correspondence with the UK Mammal Society, it was discovered that Ecobat creates an aggregate of pass rates for pipistrelles classified to genus level, which results in a consistently high activity rate for the genus. In order to avoid confusion by showing duplicate information with inflated median levels of pipistrelle activity, the proportionally small number of calls which could only be classified to a genus level for pipistrelles were not included in the presentation of Ecobat analysis results.

Up until recently, the reference system used by Ecobat was strongly oriented on UK bat populations and it was not clear whether reference data sets were relevant to Ireland. Comparative Irish data sets are now considered to have surpassed thresholds to allow for more robust assessments. Ecobat allows users to upload activity data and compare it to results within a reference range filtered by geographic location, time of year and the make of bat detector used. This generates robust reports tailored for a dataset's specific location, timeframe and equipment. The continued use of Ecobat improves its future accuracy, as the data from each survey uploaded adds to their reference database (Lintott *et al.* 2017[10]).

The activity levels were also examined in terms of bat passes per hour (bp/h). This is effectively bat contacts per hour and is worked out on the basis of the time that the static bat detectors operated during the deployment period (set to record from half an hour before sunset to half an hour after

7 Bats should be identified to species, or where these cannot be separated with confidence, to species group e.g. Myotis spp. (SNH 2019)

8 Russ, J. (2012) British Bat Calls: A Guide to Species Identification.

9 Middleton N., Fround A. & French K (2014) Social Calls of the Bats of Britain and Ireland.

10 Lintott, P.R., Davison, S., van Breda, J., Kubasiewicz, L., Dowse, D., Daisley, J., Haddy, E. & Mathews, F. (2018). Ecobat: An online resource to facilitate transparent, evidence-based interpretation of bat activity data. Ecology and evolution, 8(2), pp.935-941

sunrise). In order to provide additional context for what constitutes significant levels of activity the bp/h data has been presented taking account of a Polish study by Kepel *et al*. (2011)[11] (sourced from *'A Review of the Impacts of Wind Energy Developments on Biodiversity'*). The study sought to attribute significance levels to bat activity recorded during wind farm surveys.

[11] Kepel, A., Ciechanowski, M., Jaros, R. (2011). How to assess the potential impact of wind turbines on bats using bat activity surveys? A case study from Poland, XII European Bat Research Symposium, August 22-26, 2011, Vilinusm Lithuania.

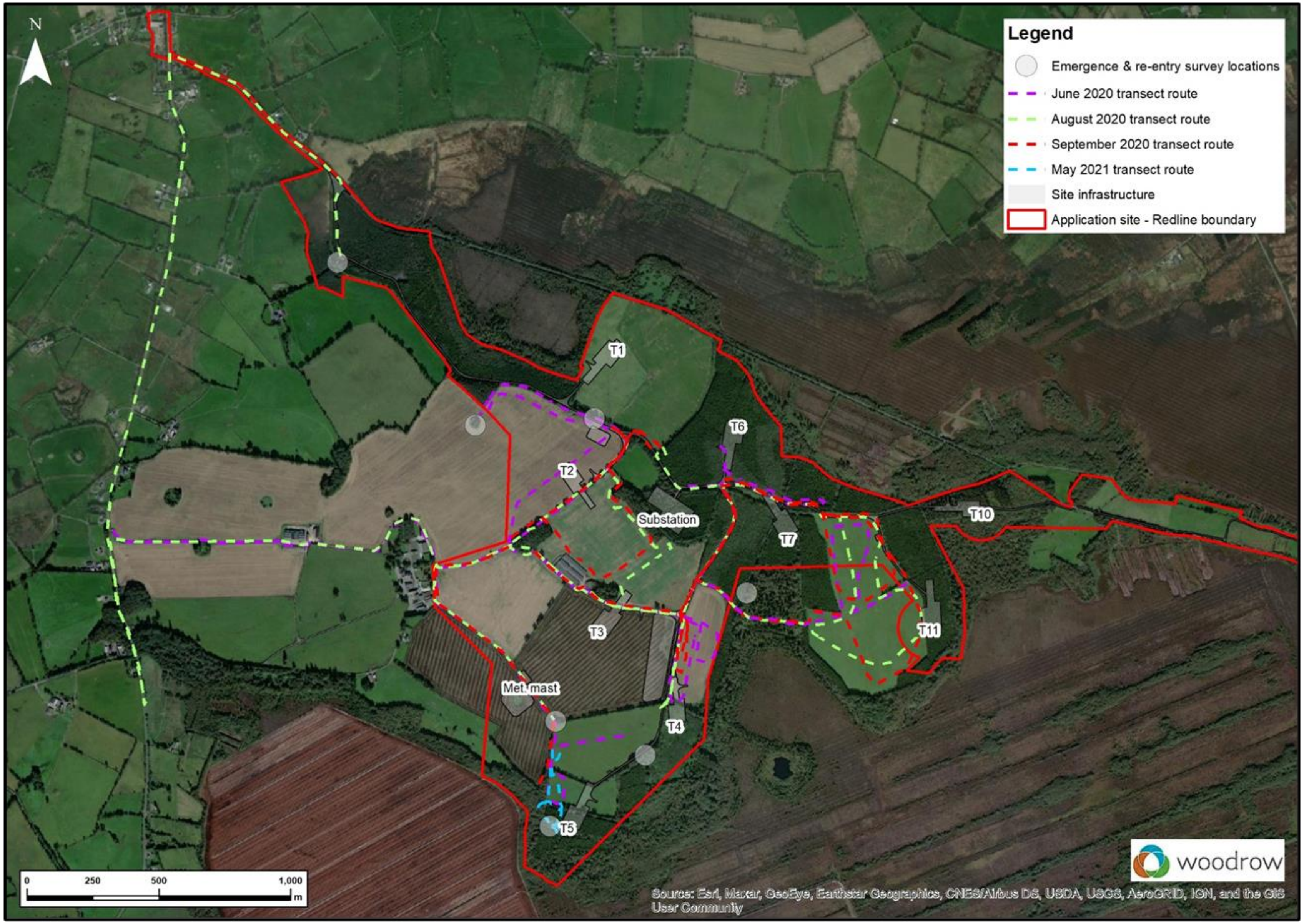


Figure 3a – Transect routes and emergence/re-entry survey locations

Figure 3b – Transect route surveyed along grid connection route

Figure 4 – Deployment locations for all static bat detectors and weather station in 2020

Table 2 – Static bat detector deployment dates, locations & features covered during 2020

Map ID	Associated turbine	Unit location (Lat.-Long.)	Associate feature / habitats	Spring deployment date: 21-May-2020		Summer deployment date: 23-Jun-2020		Autumn deployment date: 25-Aug-2020	
				Unit code	Running time (mins)	Unit code	Running time (mins)	Unit code	Running time (mins)
D.01	T1	53.577931 -7.078460	Open: In cattle grazed field of improved grassland, c. 190m away from closest habitat feature	WSS-001	Unit Fail	WSS-025	15 nights (7,754)	WSS-038	15 nights (10,149)
D.02	T2	53.573443 -7.081799	Feature: Along earth bank with low elder hedgerow and mature beech trees, which divides two arable fields	WSS-019	14 Nights (7,113)	WSS-016	14 nights (7,183)	WSS-011	11 nights (7,553)
D.03	T3	53.568278 -7.084910	Feature: Within arable fields at end of hedgerow/ treeline dominated by bramble, elder scrub and young ash trees	WSS-024	18 Nights (9,058)	WSS-023	15 nights (7,754)	WSS-034	15 nights (10149)
D.04	T4	53.565561 -7.077094	Feature: Along treeline/ hedgerow with drain, which divides young ash plantation from improved grassland	WSS-032	18 Nights (9,058)	WSS-286	15 nights (7,754)	WSS-051	15 nights (10,149)
D.05	T5	53.562787 -7.082454	Feature: Along treeline/ hedgerow, which divides conifer plantation from improved grassland	WSS-029	18 Nights (9,058)	WSS-031	15 nights (7,754)	WSS-016	11 nights (7,863)
D.06	T6	53.575515 -7.073446	Feature: In forestry ride/ access track through conifer plantation - track being extended during spring deployment	WSS-022	11 Nights (5,651)	WSS-020	14 nights (7,298)	WSS-019	4.5 nights (2,745)
D.07	T7	53.571794 -7.06914	Feature: In forestry ride with broadleaves and drain between two blocks of conifer plantation	WSS-009	18 Nights (9,058)	WSS-037	11 nights (5,520)	WSS-010	11 nights (7,692)
D.10	T10	53.573686 -7.057399	Feature: In small clearing (3 x 5m) at edge of commercial plantation where semi-natural woodland starts	WSS-026	18 Nights (9,058)	WSS-028	15 nights (7,754)	WSS-060	11 nights (7,790)
D.11	T11	53.568657 -7.061872	Feature: Along edge of conifer plantation adjacent to field of improved grassland	WSS-011	14 Nights (7,602)	WSS-039	15 nights (7,754)	WSS-006	9 nights (6,798)
D.08	T11 - context	53.568776 -7.063344	Open: In field of improved grassland surrounded by plantation, located c. 90m from edge of plantation and paired with D.11 for context	WSS-014	16 Nights (8,284)	WSS-036	15 nights (7,754)	WSS-032	15 nights (10,149)
D.09	Bog pool	53.564728 -7.071805	Feature: Along treeline of bog woodland leading to bog pool within area of remnant raised bog	WSS-033	18 Nights (9,058)	WSS-027	15 nights (7,754)	WSS-007	13 nights (9,028)
D.12	Temporary met. mast	53.569886 -7.076360	Deployment at height Open: Two microphones. One was deployed at ground level and the other at height (c. 50m), the closest features being c. 50m away	WSS-017	Continuous deployment 23-Jun-2020 to 05-Oct-2020				

3 SURVEY RESULTS

This section, provides the detailed results for bat surveys conducted during the 2020 survey period, as well as additional habitat assessment surveys, roost inspection and transects conducted in February 2021 and May 2021. These survey results are summarised in **Section 4**.

Appendix 1, **Appendix 2** and **Appendix 4** provide additional context with plates illustrating deployment locations, locations at which emergence and re-entry surveys were conducted and bat detectors in situ.

3.1 Desk based study

A data request was submitted to Bat Conservation Ireland (BCI) for known roost records in the general area. A total of 13 bat records were provided, including four roosts records, none of which are located within the proposed development site. The closest previously document bat roost is a brown long-eared bat roost located *c.* 5 km from the proposed development site. This bat roost data is list in **Table 4** with distances from site provided, and **Table 4** also indicates that six species have been recorded in the environs of the proposed development site, including:

- Common pipistrelle *Pipistrellus pipistrellus*
- Soprano pipistrelle Pipistrellus pygmaeus
- Leisler's bat *Nyctalus leisleri*
- Brown long-eared bat *Plecotus auritus*
- Daubenton's bat *Myotis daubentonii*
- Natterer's bat *Myotis nattereri*

The only Natura 2000 sites designated for bats in Ireland are for lesser horseshoe bats (*Rhinolophus hipposideros*). The area of interest in Co. Westmeath/Co. Meath is outside the range for this species; and with the closest Special Areas of Conservation (SACs) being in Co. Mayo, there are no designated sites within the 15 km Zone of Influence of the proposed development.

3.2 Bat habitat suitability assessment

Based on Lundy *et al.*, (2011), the overall suitability for the 5x5 km square encompassing the Wind Farm Site has been scored as holding moderate suitability for all bat species combined. For individual species it was ranked as high for common and soprano pipistrelles, moderate to high for Leisler's bat and brown long-eared bats; and moderate for *Myotis* species, with the exception of whiskered bat which was ranked as low. Suitability for Nathusius' pipistrelle was also ranked as low.

The habitat within the Wind Farm Site is comprised of relatively distinct blocks of tillage, improved grassland, conifer/ash plantation, semi-natural broadleaf woodland and bog woodland. The proposed turbine location for T1 is located in improved grassland, while T2 and T3 are located in fields of arable crop. The rest of the proposed turbines; T4, T5, T6, T7, T10, and T11 are located in commercial forestry plantations. Sheltered foraging opportunities for bats are provided within the forestry rides, between blocks of plantations and along forestry tracks. The plantations surrounding the proposed turbine locations for are bordered by semi-natural woodland, including bog woodland and mature broadleaf woodland, with some of the woodland adjacent to the plantation surrounding T5 considered to be long-established woodland. The edge effects created by differing ages of woodland is likely to create foraging opportunities. There are also treelines and hedgerows in relatively close proximity to proposed turbine locations at T4, T5 and T7, which provided potential connectivity through the mosaic of habitats within the site. Many of these treelines consist of semi-mature to mature broadleaf trees. A summary of foraging features is presented in **Table 3**.

Two structures were identified as having 'moderate' to 'high' PRF suitability, which included a crypt (c. 350m from T2) and a derelict cottage (adjacent to the entrance track); however, both structures fall beyond the 300m Zone of Influence (ZoI) of proposed turbine locations and no PRFs classified as 'high' suitability were identified within the ZoI. Various trees and treelines were identified as having 'low' to 'moderate' PRF suitability within the 300m ZoI.Error! Reference source not found. **Figure 5a** shows the following potential roost features classified as 'low' to 'moderate' and 'moderate' suitability which lie within the ZoI of proposed turbine locations;

- Broadleaf 'T' shaped treeline [running from 53.576420, -7.081712 to 53.573974, -7.076562 and 53.575479, -7.078370 to 53.574613, -7.079647] with ivy clad, mature trees containing some features such as knot holes and broken limbs. This treeline was assessed as having 'low' to 'moderate' potential roost potential and is within the ZoI of both the proposed turbines T01 and T02 (North of T02 and South of T01).
- Broadleaf treeline [running from 53.573719, -7.078923 to 53.572190, -7.076906] containing several mature ivy clad trees. This treeline was assessed as having 'low' to 'moderate' roost potential a small portion of this treeline lies within the eastern side of the ZoI of T02.
- Mixed scattered group of semi-mature to mature broadleaf trees along field margin. This scattered treeline runs from [53.564264, -7.078872 to 53.564914, -7.077349]. This was assessed as having a 'low' to 'moderate' roost potential and lies within the ZoI of the proposed turbines T05 and T04.
- Three mature beech trees with knot and rot holes in close proximity to each other, to the southwest of T05 at [53.561817, -7.084478]. These trees were assessed to have 'moderate' roost potential.
- Semi-mature broadleaf trees with dense ivy coverage running from [53.562550, -7.083995 to 53.561635, -7.080380]. This treeline lies to the south of T05 and is also within the turbine swept area of the proposed turbine and was assessed to have 'low' to 'moderate' roost potential.
- Semi-mature ash and hawthorn treeline with dense ivy cover to the north of T05, running from [53.562992, -7.083727 to 53.562425, -7.079892]. This treeline was classified as having 'low' to 'moderate' roost potential and lies within the ZoI and rotor swept area of T05.
- Semi-mature beech plantation with some other native species present to the north-west of T05 with its approximate centre at [53.563164, -7.084724]. Trees in the plantation had many rot holes, rotten limbs and dense ivy cover. This plantation was determined to be of 'low' to 'moderate' roost suitability.
- Standing dead trees at [53.574555, -7.067328], to the east of T06 were determined to be of 'low' to 'moderate' roost suitability.
- Treeline of semi-mature ash trees with dense ivy cover running from [53.572843, -7.069157 to 53.573082, -7.062627]. This treeline has some of its length in the Northeastern sector of the ZoI of T07 and the western sector of the ZoI for T10 and was assessed to have 'low' to 'moderate' roost potential.
- Mature birch treeline with dense ivy [running from 53.567178, -7.061913 to 53.567178, -7.061913]. This treeline is assessed as having 'low' to 'moderate' roost potential and lies within the ZoI of proposed turbine T11

Figure 5b shows the locations of PRFs along the grid connection route, including several mature trees with deadwood that were class as having moderate to high PRFs, and a bridge that was classed as supporting high PRFs.

Table 4 details the BCI roosts that have been recorded within 10 km of this site. Specific BCI roost locations are confidential to afford protection to bat roosts, and as such are not shown within this report – however, these can be made available on request.

Table 3 – Summary of bat habitat and roost suitability

Turbine	Foraging features and assessment of vegetation removal required for turbine buffer (c.100m)	Roost potential within c. 300m of turbines of low to moderate or higher suitability
T1	In an open improved grassland with low foraging potential. There is no vegetation requiring removal within 100m. There is however, a strong linear feature in the form of bog woodland a little over 100m to the West of T1	Within 300m to the south of T1 is the 'T' shaped treeline of mature broadleaf trees classed as being of low to moderate roost potential
T2	Located in an open arable crop field. The nearest feature is a treeline to its southeast of potential commuting value to bats commuting between areas of woodland in this habitat mosaic. However, this feature is 120m from the proposed turbine location and would not need to be removed to achieve a 100m buffer.	Within 300m to the northeast of T2 is the 'T' shaped treeline of mature broadleaf trees. Within 300m to the east of T2 is a broadleaf treeline with several mature trees with dense ivy. This treeline was classed as having low to moderate roost potential.
T3	In an open arable crop field. The nearest feature is a weak linear feature in the form of a semi-mature treeline to the north.	There were no potential roost features found classed as low to moderate or higher within 300m of the proposed location for T3.
T4	Located in commercial ash plantation with three strong linear features in the form of mature broadleaf treelines. These tree lines have a strong level of connectivity to the mosaic of bog, semi-natural and broadleaf woodland to the East, South and Southwest of the proposed location of T4	There was a scattered treeline of semi-mature to mature broadleaf trees along a field margin assessed as having low to moderate roost potential within 300m of the proposed turbine location.
T5	Located in a conifer plantation, with semi-mature broadleaf treelines of good foraging potential within the plantation to the north and south of the proposed turbine location.	The two semi-mature treelines to the north and south and within *c.* 80m of the proposed location for T5 were assessed to be of low to moderate roost potential. Three mature beech trees to the southwest of T5 within 300m of the proposed location and assessed as being of moderate potential
T6	Located in a forestry ride of a conifer plantation. The forestry ride provides a strong linear feature for foraging bats.	Standing dead trees within 300m to the east of T6 were determined to be of low to moderate roost potential.
T7	Located in a forestry ride of a conifer plantation. The forestry ride provides a strong linear feature for foraging bats. There is a drainage feature to the north of the proposed location. To the south of the proposed location for T7 was bog woodland. The border between bog woodland and conifer plantation provides a linear feature of strong foraging potential.	Within 300m, to the northeast of T7 was a semi-mature ash treeline assessed as having low to moderate roost potential.
T10	Located in an area of ongoing felling of conifer plantation T10 is bordered in all directions within 100m by bog woodland except to the west southwest. The ongoing felling creates strong linear features of bog woodland to clear fell which has high foraging potential for bats.	A very small portion of semi-mature treeline, assessed as being of low to moderate roost potential lies within 300m of T10.
T11	Located along a conifer plantation bordering improved grassland, which provides a strong foraging linear feature.	Within 300, to the South of T11 is a mature beech treeline with dense ivy cover assessed as being of low to moderate roost potential.
Substation	The majority of footprint is within conifer plantation with small sections impinging into older woodland and a treeline offering strong linear features above the plantation	The footprint impinges on a broadleaf treeline and small woodland with several mature trees with dense ivy - classed as having mainly low with the occasional moderate PRFs
Grid connection	Route passes through a range of different habitats, largely following strong linear features along the road and occasionally along the stream/drain.	Along route several mature trees with deadwood that were class as having moderate to high PRFs. There were several structures including buildings and bridges that supported moderate to high PRFs.

Table 4 – BCI Roost Data within 10 km of the Site

BCI roost data within 10km of the proposed Wind Farm Site			
Roost Data - Roost Surveys			
Name	***Distance from Site***	***Species observed***	
Private	c. 6.9km	*Plecotus auritus*	
Private	c. 10.7km	*Pipistrellus pygmaeus*	
Private	c. 7.8km	*Plecotus auritus*	
Private	c. 5km	*Plecotus auritus*	
Roost Data - Transect Surveys			
Name	***Distance from Site***	***Species***	
DArcys Bridge Transect	c. 3.7km	*Myotis daubentonii; Nyctalus leisleri*; Unidentified bat	
DArcys Bridge Transect	c. 7.5km	*Myotis daubentonii*; Unidentified bat	
Ad-hoc Observations			
Survey	***Distance from Site***	***Species***	***Date***
BATLAS 2010	c. 8.9km	*Myotis daubentonii*	11/10/2009
Unid Survey	c. 8.9km	*Plecotus auritus*	17/07/2005
Unid Survey	c. 6.9km	*Nyctalus leisleri; Pipistrellus pipistrellus* (45kHz)	27/06/2007
Unid Survey	c. 8.5km	*Pipistrellus pipistrellus* (45kHz); *Pipistrellus pygmaeus; Plecotus auritus*	20/05/2003
Unid Survey	c. 8.6km	*Myotis natterreri; Nyctalus leisleri; Pipistrellus pipistrellus* (45kHz); *Pipistrellus pygmaeus*	26/03/2012
Unid Survey	c. 7.3km	*Nyctalus leisleri; Pipistrellus pipistrellus* (45kHz); *Pipistrellus pygmaeus; Plecotus auritus*	06/09/2007
EIS Survey	c. 9km	*Myotis daubentonii; Pipistrellus pipistrellus* (45kHz); *Pipistrellus pygmaeus*	23/06/2002

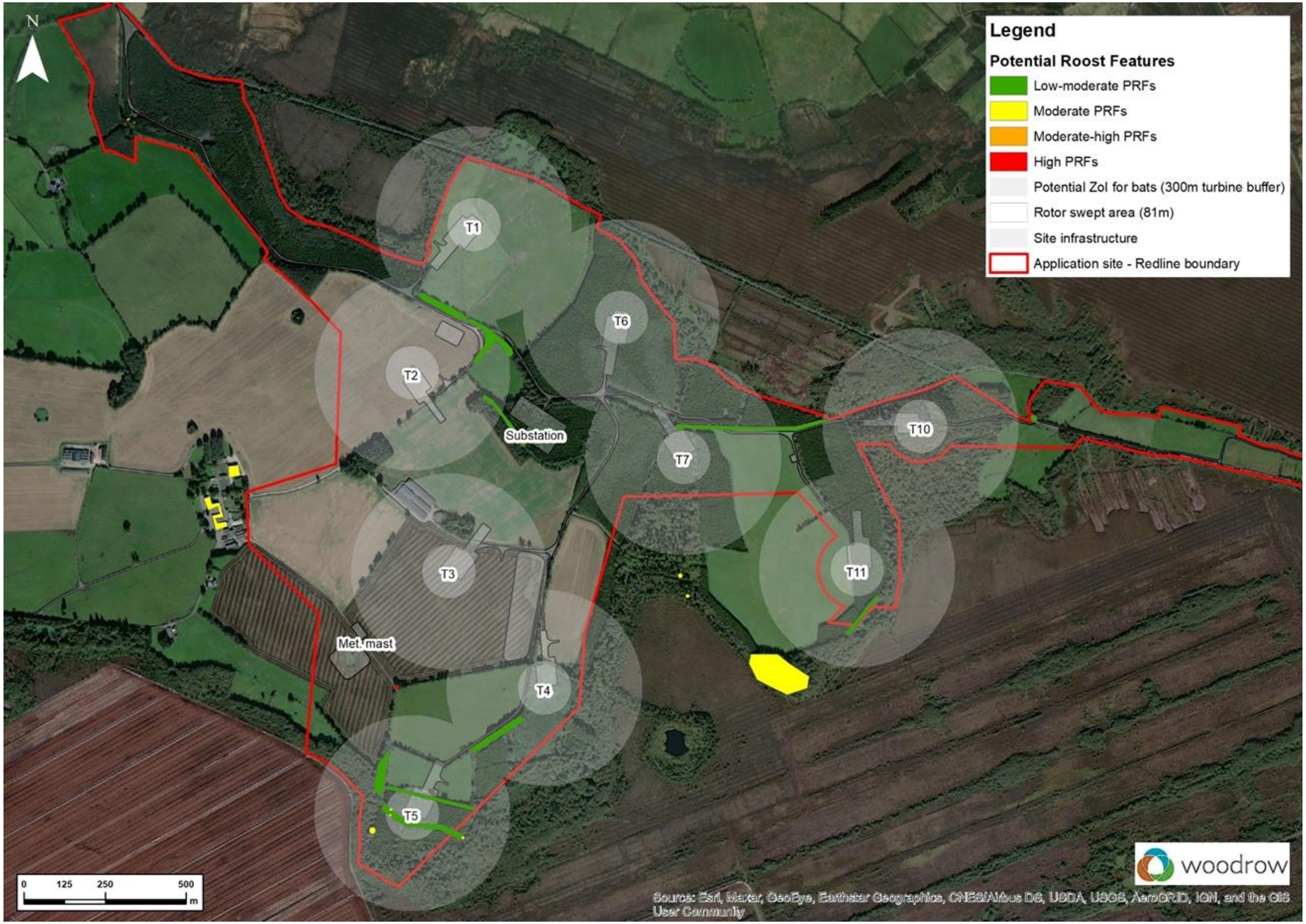


Figure 5a – Roost suitability assessment within the Wind Farm Site

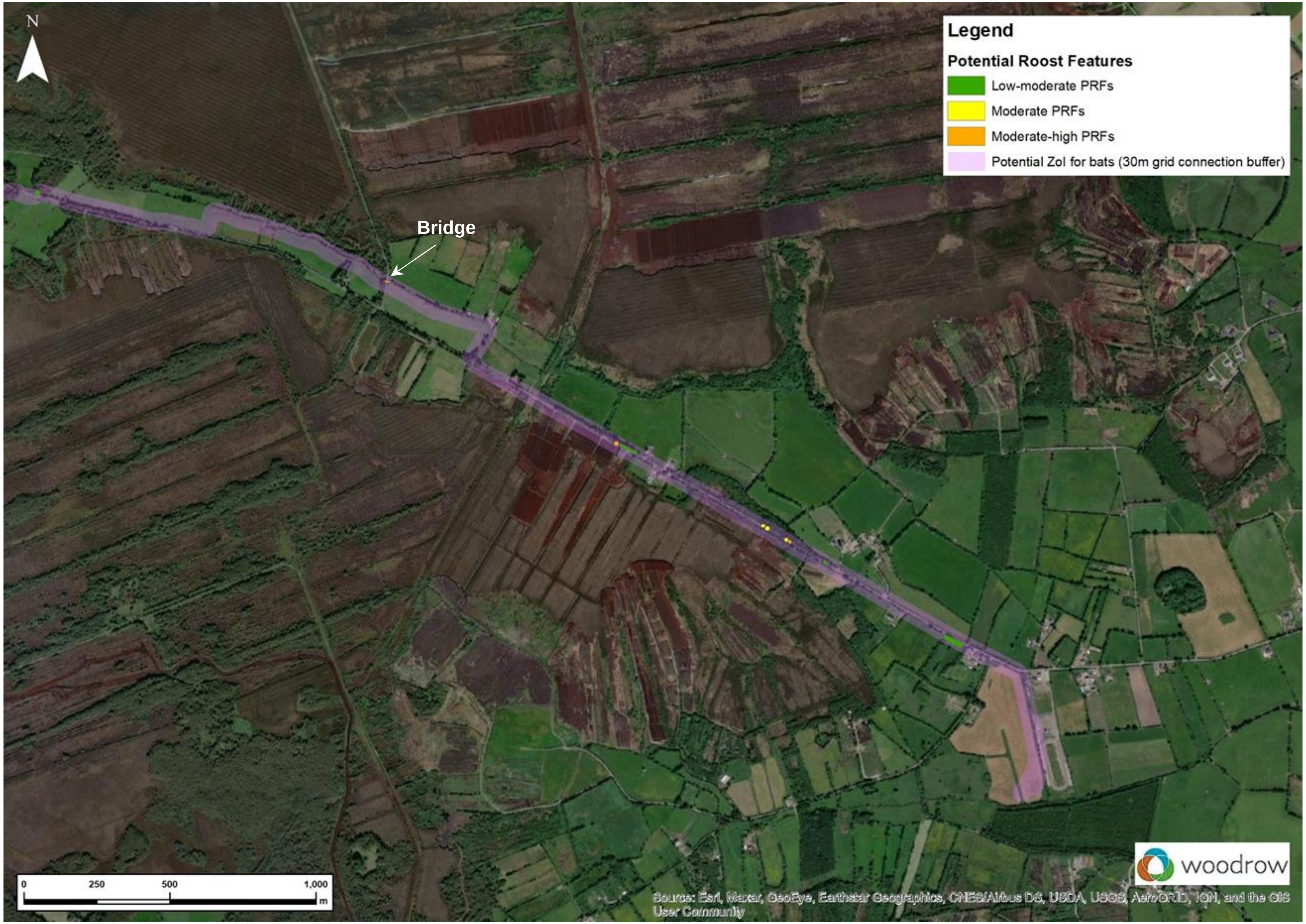


Figure 5b – Roost suitability assessment along the grid connection route

3.2.1 Emergence and re-entry surveys

Throughout the duration of the 2020 active bat season, three visits were made to the Wind Farm Site to carry out dusk/dawn transects and emergence/re-entry surveys. Five emergence surveys were conducted on 05-Aug-2020, 24-Aug-2020 and 02-Sept-2020 and three re-entry surveys were conducted on 06-Aug-2020 and 03-Sept-2020. A further two emergence surveys were undertaken in spring 2021, on 10-May-2021

Sample pictures of these locations can be found in **Appendix 4**

Visit 1:

A dusk emergence was conducted on the 05-Aug-2020 followed by a dawn re-entry on the 06-Aug-2020 at a mature beech [53.5658212, -7.0847226], derelict cottage [53.5815833, -7.0953263] and semi-mature tree directly south-west of the cottage. Both locations were covered by two surveyors. The mature beech lies approximately 387m and 398m away from T3 and T5, respectively, as seen in **Figure 3a**. The derelict cottage is located over a kilometre away from T1, which was closest proposed turbine location. This structure lies adjacent to the proposed entrance track for the proposed wind farm.

Date: 05-Aug-2020 *Sunset:* 21:17 *Start:* 21:00 *Duration:* 50 mins

At mature beech: No bats were recorded or observed throughout the duration of the emergence survey.

At derelict cottage: No bats were observed emerging from the cottage itself. The first bat, a Leisler’s bat, was recorded at 21:18 foraging above the cottage. It appeared to have come from east of the surveyors’ location. Four Leisler’s bats in total were observed foraging above the house, often simultaneously, throughout the duration of the emergence survey. At 21:38, the first soprano pipistrelle was observed to have commuted into the area through a forestry ride adjacent to the cottage. It was estimated that more than 20 soprano pipistrelles were commuting through the surrounding woodland. It is possible that these movements and numbers were indicative of dispersal from a roost in the wider area.

Date: 06-Aug-20 *Sunrise:* 05:53 *Start:* 04:20 *Duration:* 2 hours

A re-entry survey was conducted at the derelict cottage on 06-Aug-20020 to investigate a potential soprano pipistrelle tree roost nearby, as speculated by the surveyors on the previous night’s survey. While no bats were observed using roosting features on the surrounding trees, one soprano pipistrelle was observed entering the west side of the derelict cottage through a crack between the roof tiles and wall at 05:24. This confirmed the building as being a small soprano pipistrelle roost. Two common pipistrelles were also seen foraging at 04:36 and 04:40.

The roost activity survey was followed up with a building inspection, conducted by a licenced operative from Woodrow. However, this proved inconclusive in giving an indication of the level of occupation, as the whole structure could not be accessed (the roof space in particular). For the parts of the building examined fully there was limited evidence of bat activity (e.g. droppings).

Visit 2:

Date: 24-Aug-2020 *Sunset:* 20:32 *Start:* 20:12 *Duration:* 2 hours

A dusk emergence was conducted on the 24-Aug-2020 at the crypt located within a small woodland [53.576017, -7.087546]. No bats were observed emerging; however, bats were observed to forage within and around the small woodland in limited numbers. The first bat recorded was a common pipistrelle at 21:52. This bat was observed to come from a westerly direction, and continued to forage in and around the woodland until approximately 22:01 when it flew west again. The surveyors noted high winds during the survey, which may have influenced the low activity levels observed.

Visit 3:

A dusk emergence was conducted by four surveyors on the 02-Sept-2020 followed by a dawn re-entry on 03-Sept-2020. Two surveyors covered opposite sides of the treeline running west to south-east located at [53.575438, -7.078272], while two surveyors covered the broadleaf woodland and conifer plantation at [53.569987, -7.072285]. The woodland is 268m from the nearest proposed turbine location, at T7, while the treeline lies approximately 300m south-east and south-west of T1 and T5 respectively.

Date: 02-Sept-2020 *Sunset:* 21:17 *Start:* 21:00 *Duration:* 1 hour

At woodland: No bats were observed exiting or entering any roosting features within the trees targeted for the roost watch. The first bat recorded was a soprano pipistrelle at 20:39. The surveyors noted two potential bats commuting at 20:46, which correspond to two soprano pipistrelles recorded on the detector around this time. Only two further passes were detected during the survey, both soprano pipistrelles, at 20:56.

At treeline: Though a total of 325 bat passes were recorded throughout the survey, no definitive roost was identified as an active roost. The first bat recorded was a soprano pipistrelle at 20:22. This included soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle, brown long-eared bat and Leisler's bat. Soprano pipistrelle was the most frequently recorded species with almost 90% of the passes and is strongly suggestive of a soprano pipistrelle roost in the wider area.

Date: 03-Sept-2020 *Sunrise:* 06:42 *Start:* 05:40 *Duration:* 1.25 hours

At woodland: No bats were observed foraging, commuting or entering any roosting features during the dawn re-entry survey between the broadleaf woodland and conifer plantation. Only one bat, a soprano pipistrelle, was recorded throughout the duration of the survey. This occurred at 06:04.

At treeline: As in the dusk survey, a high level of bat activity was observed along the treeline. Multiple soprano pipistrelle bats were noted by the surveyors to be foraging within the area. The detector also recorded passes from common pipistrelle, Nathusius' pipistrelle, brown long-eared bat and Leisler's bat.

Visit 4:

Date: 10-May-2021 *Sunset:* 21:15 *Start:* 21:00/20:53 *Duration:* 1.8/1.6 hours

A dusk emergence was conducted by two surveyors on the 10-May-2021, with one surveyor covering three trees at the northeastern tip of a treeline 123m from T4 and the other covering a tree within a treeline 43m from T5.

T4 treeline: The first bat recorded at this survey location was recorded at 21:38 but was not seen emerging from a tree. Between 21:38 and 21:42 another soprano pipistrelle and an unidentified bat (emitted no call, potentially a brown long-eared bat) were seen and recorded commuting from south to north and south to north east through the treeline. Between 21:45 and 22:00, 8 common pipistrelles, 2 soprano pipistrelles and a Leisler's bat calls were recorded but the bats were not seen emerging from the trees. Visual confirmation of these bats entering or leaving the area as conditions could not be made as it had become very dark under the foliage of the treeline and visibility past the immediate roosts was poor. Faint common pipistrelle calls were recorded between 22:00 and 22:03. Another common pipistrelle commuting from south to north was recorded at 22:05. Between 22:09 and 22:18 between 3 and 4 common and soprano pipistrelles were recorded foraging in the treeline. No bats were seen emerging from the features on the three north most trees of the treeline.

T5 treeline: The first bat recorded during this emergence survey passed at 21:41 and was a soprano pipistrelle noted to be faint and therefore distant. A Leisler's bat was heard but not seen at 21:42. Two pipistrelles of unidentified species were recorded commuting west to east at 21:51 and 21:57 along the treeline.

A Leisler's bat was recorded without visual confirmation again at 22:02 and 22:06 noted to be faint and likely a distant bat. Further faint common pipistrelle calls were recorded at 22:15 and 22:13. A soprano pipistrelle was recorded commuting west to east along the treeline at 22:24. Between 22:26 and 22:37 faint soprano pipistrelle, common pipistrelle and Leisler's bat calls were recorded. At 22:44 a common pipistrelle was recorded foraging along the nearby conifer plantation edge.

3.2.2 Winter Roost Inspection Surveys

New SNH Guidelines (SNH, 2019) recommend that winter roost surveys should also be carried out for any potential hibernation roost within 200 m plus rotor radius of developable area.

However, no potentially suitable significant hibernation roosts were identified within the 200 m plus rotor radius of the turbine layout, as such, no winter roost inspections were required on Wind Farm Site. Likewise, no suitable features were identified within the potential Zone of Influence of the proposed grid connection route and substation location.

3.3 Transect survey reports 2020 & 2021

For the 2020 active bat season, four transects, three dusk and one dawn transect were undertaken on four dates including 08-Jun-2020, 05-Aug-2020, 02-Sept-2020 and 03-Sept-2020, with the aim of covering the site during the summer and autumn periods. The following sections provide transect survey reports for the four transects conducted. The distribution of bats recorded along transects are displayed in **Figure 6**, **Figure 7**, **Figure 8**, **Figure 9a** and **Figure 9b**.

A single transect was conducted in 2021 on the 10-May-2021. This transect covered the proposed grid connection route for the Wind Farm Site. This consisted a driven transect along the grid connection route The results for all transects, obtained using Elekon Batlogger M bat detectors, are presented in **Table 5**.

Visit 1:

Date: 08-Jun-2020 *Sunset:* 21:56 *Start:* 21:40 *Duration:* 1.25 hours

During the first transect visit, two surveyors simultaneously recorded activity at different locations throughout the site, using a Batlogger.

A total of 51 bat passes were recorded during the transect conducted by Surveyor 1; while total of 27 bat passes were recorded during the transect conducted by Surveyor 2 (see **Table 5**). During this summer visit, two bat species were recorded by both surveyors, common pipistrelle and soprano pipistrelle. Similar to the static results, common pipistrelle and soprano pipistrelle bats were the most active species across the Wind Farm Site, with the most dominant species being common pipistrelle.

Figure 6 shows the distribution of bat records across the Wind Farm Site recorded during the June transect. This illustrates that bat activity was strongly associated with habitat features, including treelines and hedgerows along field boundaries and at the edge of the bog, as well as conifer/broadleaf forestry plantations. Higher activity was noted in the southern section of the site during the June transect; however, it was noted during the survey that smoke from a nearby forest fire was quite thick in parts of the site. Thus, the apparent higher levels of activity in the southern part of the site may be as a result of decreased smoke in this section of the site.

Visit 2:

Date: 05-Aug-2020 *Sunset:* 21:17 *Start:* 21:50 *Duration:* 1.75/2 hours

During the second transect visit, four surveyors covered the site in pairs using Batloggers. An emergence survey was conducted prior to walking the transect routes – recording time and bat passes were excluded in the analysis of the transect and reported on within the results section for roost emergence survey in **Section 3.2.1**.

A total of 288 bat passes were recorded during the August transect survey conducted by Surveyor 1 and 2 within the Northern and Eastern sections of the Site (see **Table 5**). During this visit common pipistrelle (236 passes) and soprano pipistrelle (46 passes) were the most active across the site. A small number of Leisler's bat (2 passes), *Myotis* species (2 passes), Nathusius' pipistrelle (1 pass) and brown long-eared bat (1 pass) were also recorded. A total of 232 bat passes were recorded during the August transect conducted by Surveyor 3 and 4 within the southern and western sections of the Wind Farm Site. Common pipistrelle activity dominated the records with 152 passes recorded. Soprano pipistrelle bat activity was also high at 76 passes. Again, only small numbers of Leisler's bat (1 pass), *Myotis* species (1 pass) and brown long-eared bat (2 passes) were recorded.

Like the June transect, high levels of activity were recorded along treelines and within the plantations and broadleaf woodland. As can be seen in **Figure 7**, little to no activity was recorded in open fields or along roads with no features, such as hedgerows or treelines.

Visit 3:

Dawn and dusk transect surveys were carried out during the third visit. For both transects, four surveyors covered the site in pairs. As such, data is displayed from only two prominent Batloggers to avoid multiplication. Emergence surveys were conducted prior to walking the dusk transect routes and re-entry surveys were conducted following the dawn transects. Recording time and bat passes were excluded in the analysis of the transect and reported on within the results section for roost emergence survey in **Section 3.2.1**.

Activity in the September transect, like the August transect, was associated with treelines, hedgerows and plantations. High numbers of common pipistrelle were recorded along the treeline 'T' shaped treeline near D.02 which was determined a valuable commuting and foraging corridor for bats. Furthermore, higher levels of activity were recorded along the plantation at the edge of the agricultural field to the east of the Site, where large numbers of common and soprano pipistrelles were recorded foraging during both the dusk and dawn surveys.

Date: 02-Sept-2020 *Sunset:* 20:17 *Start:* 21:00 *Duration:* 1.5 hours

As shown in **Table 5**, a total of 162 bat passes were recorded during 95 minutes of survey time for the September dusk transect conducted by Surveyor 1 and 2 within the northern and eastern sections of the Wind Farm Site. A total of 28 bat passes were recorded during 94 minutes of survey time for the September dusk transect conducted by Surveyor 3 and 4 within the southern and western section of the Wind Farm Site. During the autumn dusk visit, three bat species were recorded by Surveyor 1 and 2, with common pipistrelle dominating the records (100 passes) followed by soprano pipistrelle (47 passes). Leisler's bats were also recorded foraging in three separate locations along the transect route. Within the southern and western section of the Site, soprano pipistrelle passes were highest (17 passes) followed by common pipistrelle (11).

Date: 03-Sept-2020 *Sunrise:* 06:42 *Start:* 04:45 *Duration:* 1 hour

As shown in **Table 5**, a total of 92 bat passes were recorded during the dawn transect conducted by Surveyor 1 and 2, while a total of 120 bat passes were recorded by Surveyor 3 and 4. As in the dusk transect, common pipistrelle bat passes dominated the registrations during the transect conducted by Surveyor 1 and 2 with 51 passes, while soprano pipistrelle bat passes also remained high with 32 passes. 4 Leisler's bat passes and 5 brown long-eared bat passes were also recorded. Surveyors 3 and 4 recorded a total of 71 soprano pipistrelle passes and 45 common pipistrelle passes. One Nathusius' pipistrelle was also recorded in this section of the Wind Farm Site. Leisler's bat and brown long-eared bats were present in very small numbers along the transect route, 2 and 1 passes respectively.

<u>Visit 4</u>

A driven transect with the user of a single detector was conducted along the grid connection route. This was undertaken to provide a species list assess the use of habitat features along the grid connection route by bats.

Date: 10-May-2020 *Sunset:* 21:15 *Start*: 23:34 *Duration*: 0.5 hour

Displayed in **Table 5**,. only 13 bats were recorded during the transect all of which were common pipistrelles. None of the calls recorded contained feeding buzzes making it more likely the linear features along this road are used for commuting by a small number of bats and are not used intensively for foraging.

Table 5 – Number of bat passes recorded throughout transect surveys

Species	Transect 1 – Dusk 08-Jun-2020		Transect 2 – Dusk 05-Aug-2020		Transect 3 – Dusk 02-Sep-2020		Transect 3 – Dawn 03-Sep-2020		Transect 4 – Dusk Substation Route 10-May-2021
	Surveyor 1	Surveyor 2	Surveyor 1 & 2	Surveyor 3 & 4	Surveyor 1 & 2	Surveyor 3 & 4	Surveyor 1 & 2	Surveyor 3 & 4	Surveyor 1
Common pipistrelle	45	24	236	152	100	11	51	45	13
Soprano pipistrelle	6	3	46	76	47	17	32	71	0
Nathusius' pipistrelle	0	0	1	0	0	0	0	1	0
Leisler's bat	0	0	2	1	15	0	4	2	0
Myotis species	0	0	2	1	0	0	0	0	0
Brown long-eared bat	0	0	1	2	0	0	5	1	0
Total	**51**	**27**	**288**	**232**	**162**	**28**	**92**	**120**	**13**

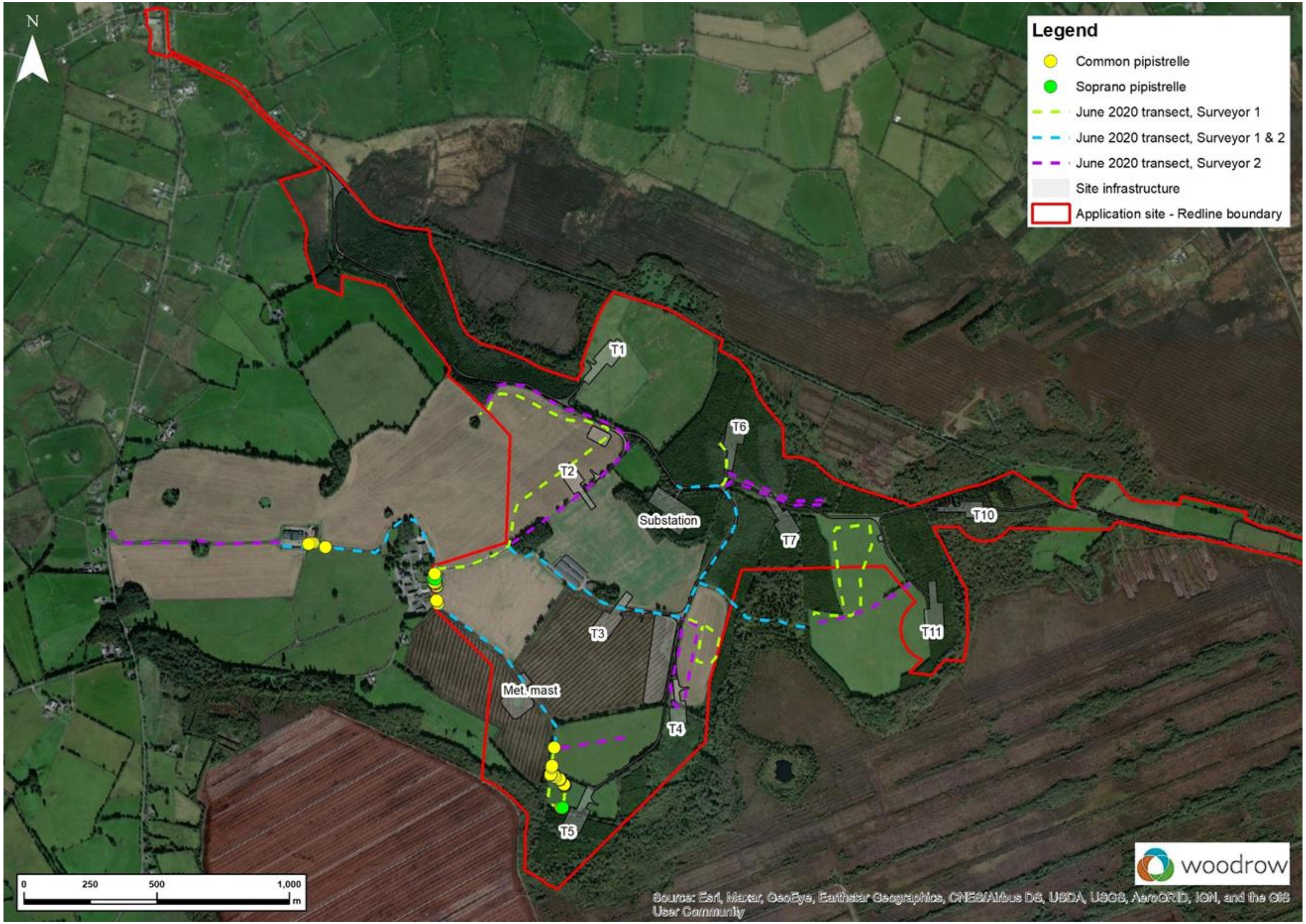


Figure 6 – Coverage and bat registrations for dusk transect: 08-Jun-2020

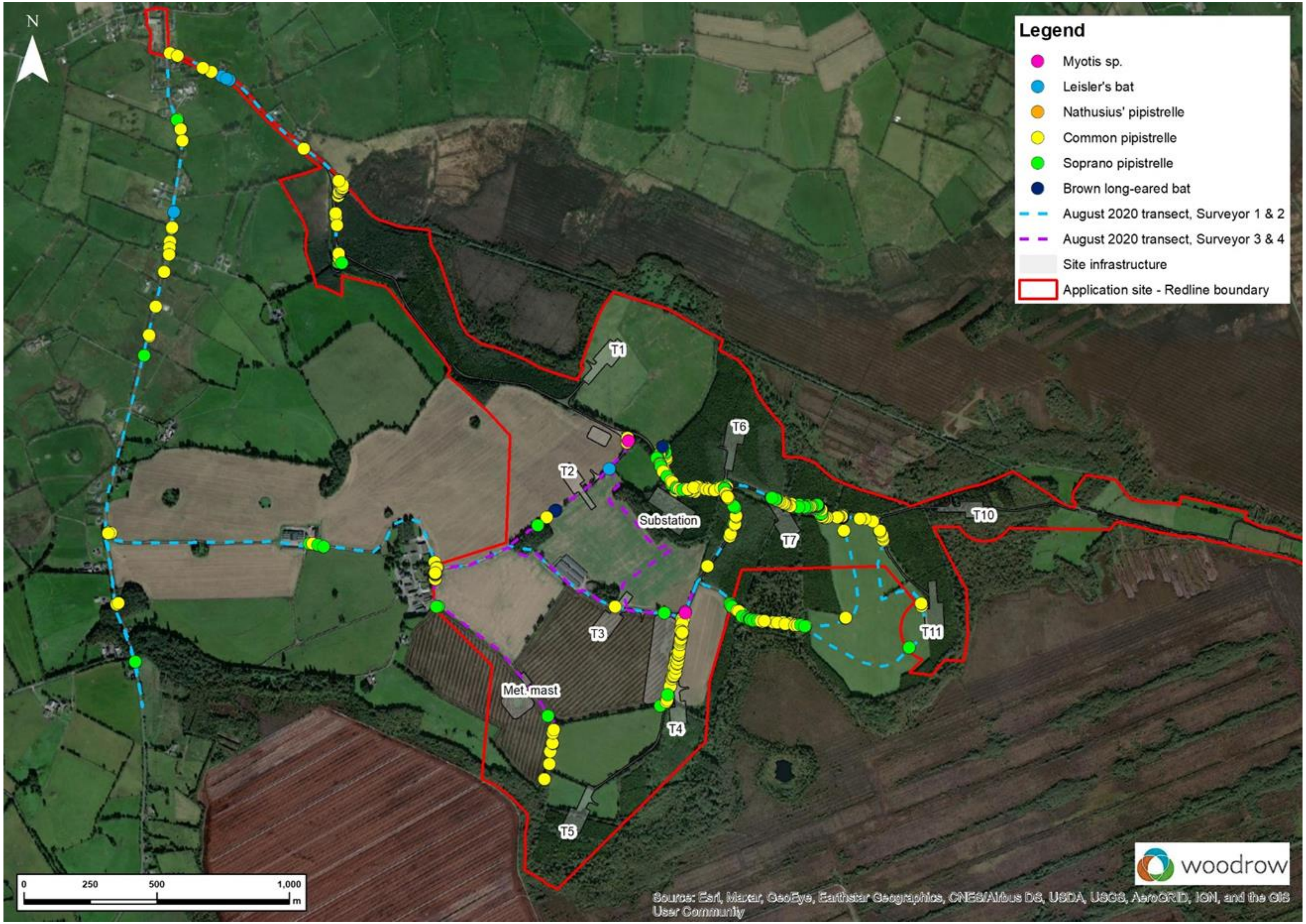


Figure 7 – Coverage and bat registrations for emergence surveys and dusk transect: 05-Aug-2020

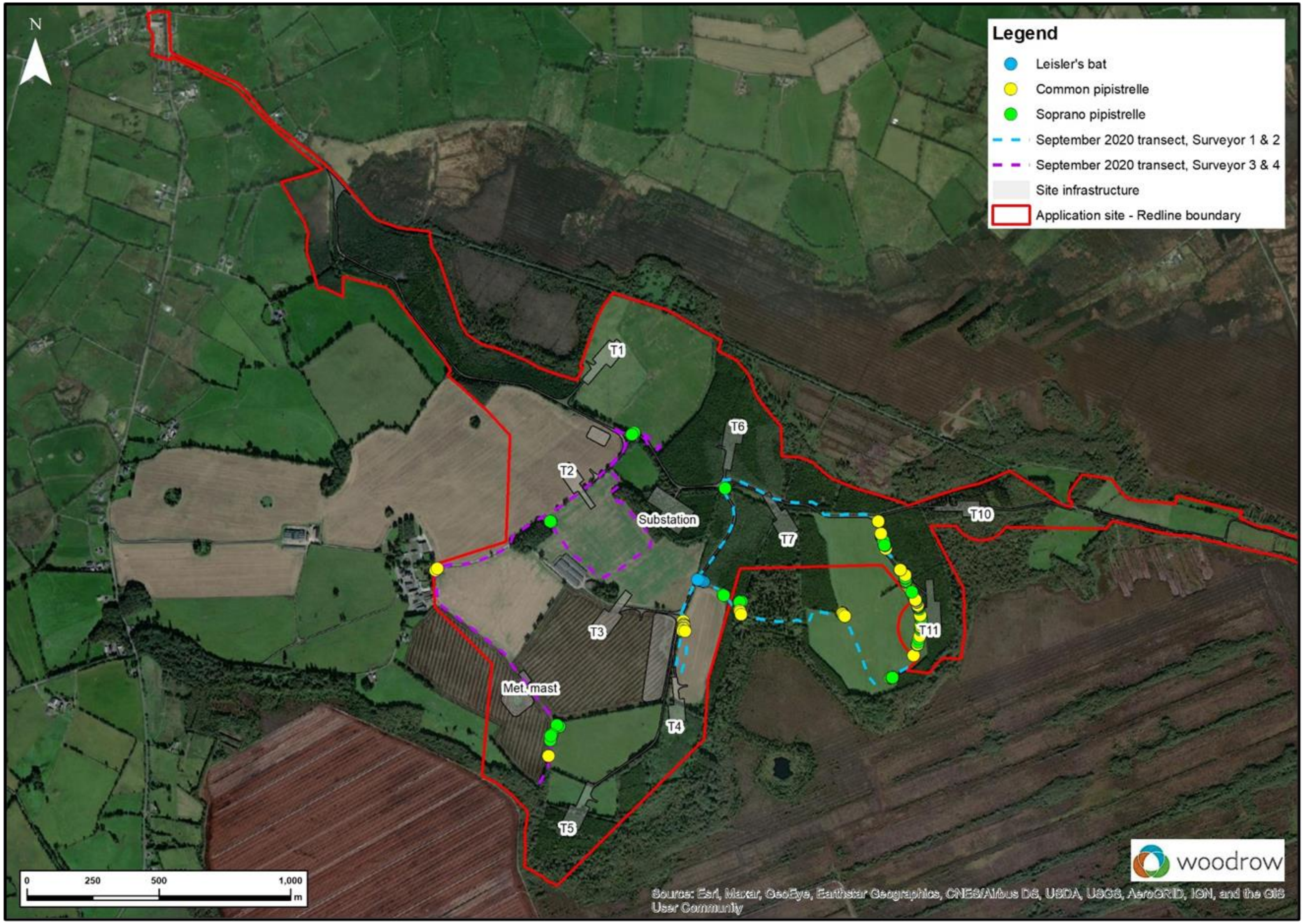


Figure 8 – Coverage and bat registrations for emergence surveys and dusk transect: 02-Sep-2020

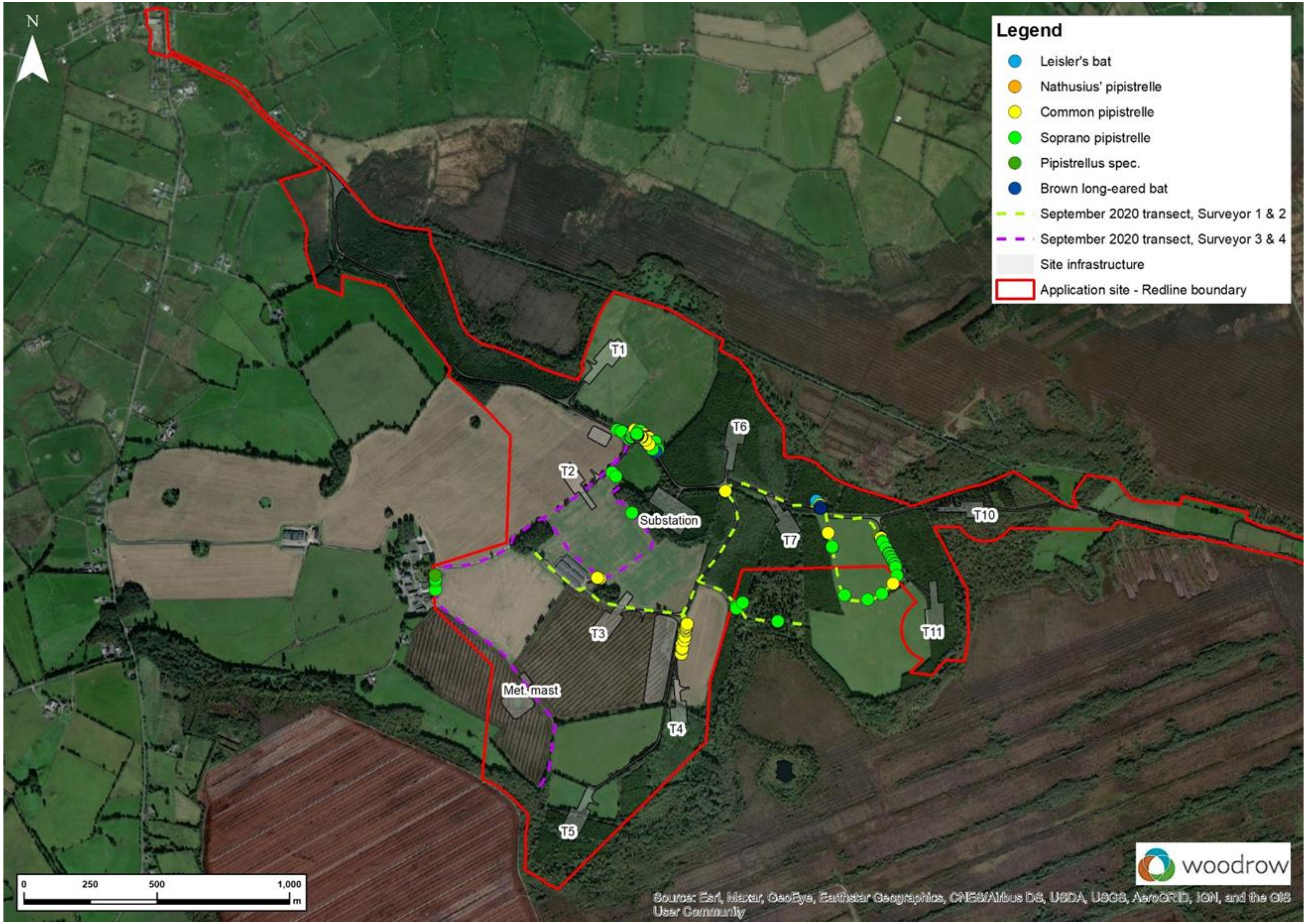


Figure 9a – Coverage and bat registrations for dawn transect and re-entry surveys: 03-Sep-2020

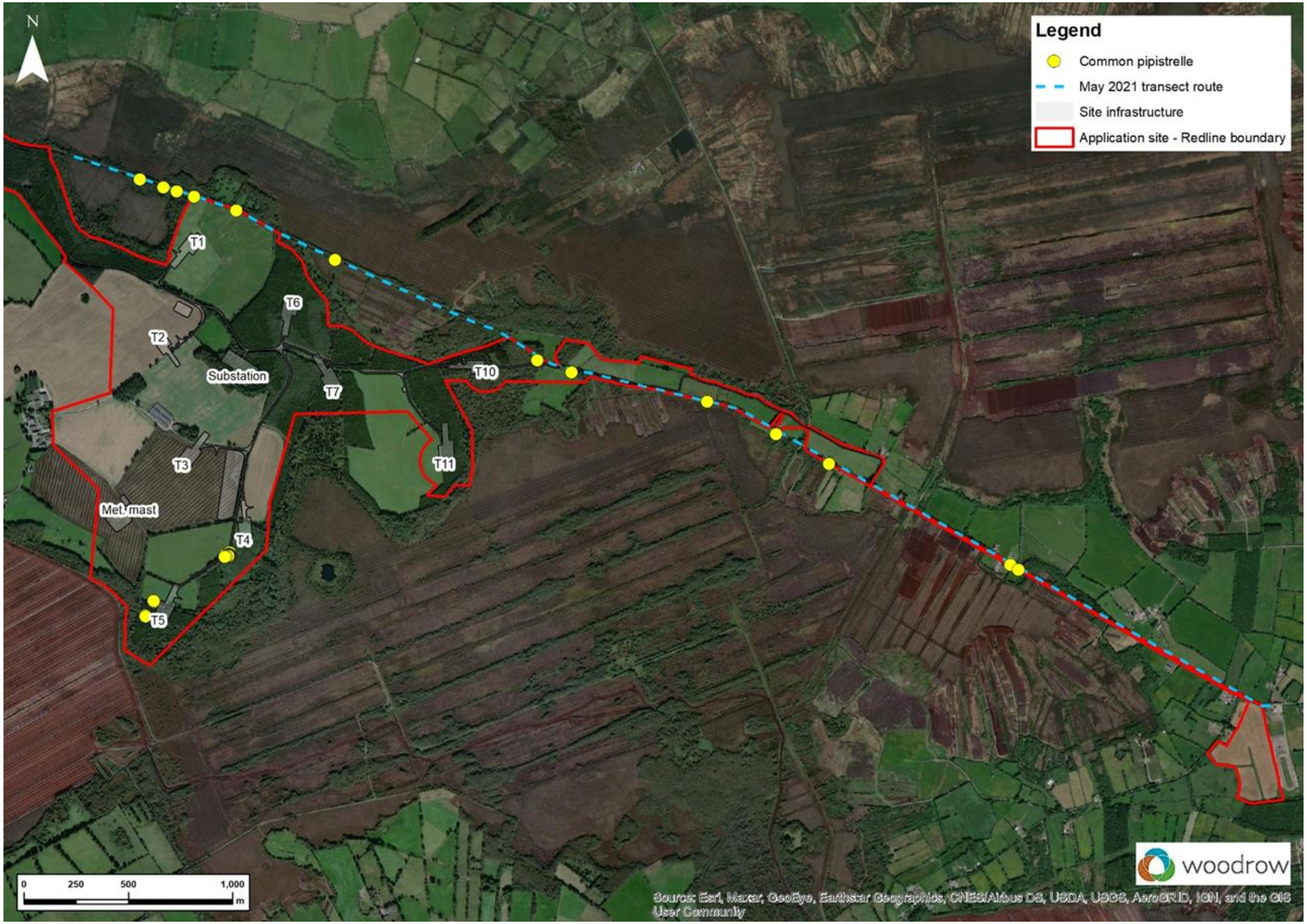


Figure 9b - Coverage and bat registrations for dusk emergence surveys and transect for grid route: 10-May-2021

3.4 Static detector surveys

In compliance with SNH (2019) guidelines, static bat detectors were deployed three times over the 2020 active season at or adjacent to the nine proposed turbine locations and two context locations at Bracklyn Wind Farm – see **Table 2** and **Figure 4**. Weather conditions during the three deployment periods were proven to be compliant with SNH (2019) requirements, that is, 10 nights above thresholds for minimum dusk temperature (8°C) and below thresholds for overnight for rainfall.

Bat activity, based on bat passes per hour was assessed using activity levels as adapted from Kepel *et al*. (2011). **Table 6** shows the levels attributed to 'Low', 'Medium' and 'High' activity. For the purpose of wind farms in Ireland, the activity levels of the Kepel *et al*. (2011) have been adapted to 'High', 'Medium', and 'Low' activity levels in an Irish context. These are illustrated in **Table 7**.

Table 6 – Bat activity levels associated with bat passes per hour (bp/h)
- sourced from A Review of the Impacts of Wind Energy Developments on Biodiversity Kepel *et al*. (2011)

Bat activity	*Nyctalus* species	*Pipistrellus* species	All bat species
Low	2.5	2.5	3.0
Medium	4.3	4.1	6.0
High	8.6	8.0	12.0

Table 7 – Categories for bat activity levels associated with bat passes per hour (bp/h)
Adapted from Kepel *et al*. (2011).

Attributed bat activity level	*Nyctalus* species	*Pipistrelle* species	All bats
Low	0 to 3.5	0 to 3.5	0 to 4.0
Medium	3.6 to 6.5	3.6 to 6.5	4.1 to 10.0
High	> 6.5	>6.5	> 10.0

Further context for activity levels was provided through the analysis of the data with Ecobat. The percentiles generated by Ecobat for specific nights of bat activity allow for the objective classification of bat activity as 'Low', 'Moderate' or 'High'. As Ecobat uses median percentile data it is less influenced by large variance in the data as averages such as bp/h can be. **Table 8** shows the levels of bat activity categories by Ecobat percentile scores, which is suggested by SNH *et al.* (2019) for use in the assessment of risk to local bat population from wind farm developments

Table 8 – Bat activity levels categorised by percentile scores
Source: SNH *et al*. (2019)

Ecobat Percentile	Bat Activity Level
81 - 100	High
61 - 80	Moderate-High
41 - 60	Moderate
21 - 40	Moderate-Low
0 - 20	Low

The following sections detail the results from static monitoring surveys for each of the three seasonal deployments. The bp/h from the static bat detector surveys are tabulated in **Table 12** and show the relative levels of bat activity for each unit across all three deployments.

Figures are provided for each deployment illustrating the location of each static detector with pie charts, which are sized in relation to levels of bat activity recorded (labelled with the total number of bp/h), with the divisions representing the percentage of bp/h recorded for each species present – See **Figure 13**, **Figure 16** and **Figure 19** for spring, summer and autumn deployments respectively.

Likewise, weather data for the three deployment periods has been extracted and is shown graphically in **Figure 14**, **Figure 17** and **Figure 20** for spring, summer and autumn deployments respectively. Weather data in these figures is displayed alongside data from a single unit deployed over the same period to illustrate the relationship between bat activity and weather conditions.

This initial analysis examines the data for the site as a whole examining all values taken across all the detectors over the duration of all three deployments to provide site-wide median activity levels for bats in the Wind Farm Site. The median activity levels on a site-wide basis, as analysed and categorised by Ecobat, showed common pipistrelles to have a 'High' level of activity, soprano pipistrelles have 'Moderate/High' level of activity and Leisler's bats have a 'Moderate' level activity. The remaining species; Nathusius' pipistrelle, brown long-eared bats and *Myotis* species had 'Moderate/Low' levels of activity. These overall activity levels are summarised in **Table 9**.

Table 10 shows that while overall activity levels were 'Moderate/Low' for *Myotis* species and brown long-eared bats, *Myotis* species had 30 nights of 'Moderate/High' to 'High' activity while brown long-eared bats had 5 nights of moderate/high to high activity. **Table 10** also shows that the activity levels for Nathusius' pipistrelles did not at any point exceed moderate/high levels of activity, an activity level which was only measured on two nights for the species. **Table 11** shows which locations and seasons recorded localised and seasonal periods of moderate/high and high activity for species active at these levels.

Table 9 – Summary table showing key metrics for each species recorded.

Species	Median Percentile	95% Confidence Intervals	Max Percentile	Nights Recorded	Median Activity Levels
Myotis species	**39**	47.5 - 69.5	82	215	**Moderate/Low**
Leisler's bat	**52**	56.5 - 76	95	314	**Moderate**
Nathusius' pipistrelle	**23**	21 - 45	77	32	**Moderate/Low**
Common pipistrelle	**83**	87 - 95.5	99	362	**High**
Soprano pipistrelle	**70**	75 - 95.5	100	319	**Moderate/High**
Brown long-eared bat	**23**	29 - 45	85	105	**Moderate/Low**

Table 10 – Number of nights of activity for each species in each activity band
Note: This is relative to the sum of nights recorded across all detectors, n = 471

Species/Species Group	Nights of activity					Total nights recorded
	High	Moderate/ High	Moderate	Low/ Moderate	Low	
Myotis species	3	27	73	72	40	215
Leisler's bat	36	85	99	62	32	314
Nathusius' pipistrelle	0	2	4	11	15	32
Common pipistrelle	196	69	45	21	31	362
Soprano pipistrelle	117	89	55	37	21	319
Brown long-eared bat	2	3	26	39	35	105

Table 11 – Deployment locations and species with High or Moderate-High activity levels

Season	Location	Species	Median Percentile	95% Confidence Intervals	Max. Percentile	Nights recorded	Reference Range[12] (nights)
Spring	D.02	Common pipistrelle	78	59.5 - 84.0	95	13	4,019
	D.04	Leisler's bat	62	58.0 - 67.5	78	17	3,561
		Common pipistrelle	93	83.0 - 94.5	99	18	4,019
		Soprano pipistrelle	71	64.5 - 79.5	91	18	3,565
	D.05	Leisler's bat	70	62.5 - 73.0	86	17	3,561
		Common pipistrelle	88	76.0 - 90.5	96	17	4,019
		Soprano pipistrelle	68	60.0 - 76.0	90	18	3,565
	D.06	Common pipistrelle	92	85.0 - 93.0	94	12	3,830
		Soprano pipistrelle	73	53.5 - 78.5	85	11	3,390
	D.09	Leisler's bat	86	74.0 - 88.5	95	18	3,561
		Common pipistrelle	94	73.0 - 95.0	98	17	4,019
		Soprano pipistrelle	70	53.5 - 76.0	86	17	3,565
	D.10	Leisler's bat	68	53.5 - 73.0	84	15	3,561
		Common pipistrelle	90	58.5 - 91.0	97	17	4,019
	D.11	Common pipistrelle	76	66.0 - 83.5	96	14	4,019
Summer	D.01	Common pipistrelle	65	40.5 - 76.0	87	13	5,592
	D.02	Common pipistrelle	91	56.5 - 95.0	99	12	5,588
		Soprano pipistrelle	88	64.0 - 92.0	99	13	5,292
	D.03	Common pipistrelle	79	42.0 - 82.5	88	11	5,583
	D.04	Common pipistrelle	81	48.5 - 90.0	96	13	5,589
		Soprano pipistrelle	70	43.0 - 80.0	87	9	5,291
		Brown long-eared bat	65	33.0 - 80.0	80	5	1,978
	D.05	Common pipistrelle	63	59.0 - 65.0	65	3	5,588
	D.06	Common pipistrelle	87	71.5 - 96.5	99	14	5,561
		Soprano pipistrelle	86	68.0 - 92.0	97	14	5,265
	D.07	*Myotis* species	61	38.5 - 79.5	81	7	3,367
		Common pipistrelle	95	81.0 - 97.5	98	6	5,581
		Soprano pipistrelle	79	47.0 - 89.5	95	8	5,289
	D.09	Leisler's bat	70	39.5 - 83.0	90	12	4,877
		Soprano pipistrelle	63	16.0 - 70.0	77	9	5,295
	D.10	Common pipistrelle	70	41.5 - 84.5	97	11	5,586
	D.11	Common pipistrelle	78	24.5 - 90.0	91	7	5,572
Autumn	D.02	Common pipistrelle	84	77.5 - 91.5	97	11	4,718
		Soprano pipistrelle	86	75.0 - 89.0	96	12	4,856
	D.03	Common pipistrelle	81	63.5 - 85.0	93	15	4,718
		Soprano pipistrelle	77	59.5 - 81.5	91	15	4,856
	D.04	Leisler's bat	62	50.0 - 68.0	83	15	3,568
		Common pipistrelle	94	79.5 - 96.5	99	15	4,718
		Soprano pipistrelle	93	79.0 - 95.5	100	14	4,856
	D.05	Common pipistrelle	92	70.5 - 97.5	99	11	4,718
		Soprano pipistrelle	94	87.5 - 94.0	97	11	4,856
	D.06	Common pipistrelle	98	95.5 - 98.0	98	5	4,718
		Soprano pipistrelle	99	96.5 - 99.0	99	5	4,856
	D.07	Common pipistrelle	93	86.5 - 96.0	98	11	4,718
		Soprano pipistrelle	98	87.0 - 99.0	100	11	4,856
	D.08	Common pipistrelle	72	52.0 - 83.0	98	14	4,718
		Soprano pipistrelle	62	46.5 - 76.5	97	15	4,856
	D.09	Soprano pipistrelle	64	52.0 - 70.0	75	10	4,856
	D.10	Common pipistrelle	95	89.5 - 97.0	99	11	4,718
		Soprano pipistrelle	92	87.5 - 94.0	97	11	4,856
	D.11	Common pipistrelle	89	70.0 - 91.0	93	10	4,718
		Soprano pipistrelle	76	60.0 - 84.5	91	10	4,856

[12] Reference range refers to the number of nights of similar geographic location, equipment used and time of year to which these data were compared.

Table 12 – Bat activity (bp/h) recorded by static detectors in 2020

Colour coded to reflect levels of bat activity (green – Low, gold – Medium, brown – High)– Under each species the first column shows the total number of bat passes and the second column shows bat passes/hour (bp/h)

Deployment date	Unit ID	Type	Map ID	Turb. No.	Nights	Minutes	Leisler's bat Passes – bp/h		Soprano pipistrelle Passes - bp/h		Common pipistrelle Passes - bp/h		Nathusius' pipistrelle Passes - bp/h		Pipistrelle sp. Passes - bp/h		Myotis species Passes - bp/h		Brown long-eared bat Passes - bp/h		Total Passes - bp/h	
Spring 21-May-2020	001	SM2	D.01	T1	18	Failed	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	019	SM2	D.02	T2	14	7,112	107	0.90	158	1.33	918	7.74	2	0.02	0	0.00	14	0.12	2	0.02	1,201	10.13
	024	SM2	D.03	T3	18	9,058	0	0.00	0	0.00	2	0.01	0	0.00	0	0.00	0	0.00	0	0.00	2	0.01
	032	SM4	D.04	T4	18	9,058	397	2.63	934	6.19	5,680	37.63	83	0.55	0	0.00	159	1.05	18	0.12	7,271	48.16
	029	SM4	D.05	T5	18	9,058	543	3.60	977	6.47	3,599	23.84	13	0.09	0	0.00	306	2.03	70	0.46	5,508	36.49
	022	SM2	D.06	T6	11	5,651	107	1.14	468	4.97	3,638	38.63		0.00	3	0.03	32	0.34	0	0.00	4,248	45.11
	009	SM2	D.07	T7	18	9,058	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
	026	SM4	D.10	T10	18	9,058	479	3.17	176	1.17	3,772	24.99	1	0.01	0	0.00	57	0.38	9	0.06	4,494	29.77
	011	SM2	D.11	T11	15	7,601	290	2.29	220	1.73	1,472	11.62	1	0.01	2	0.02	40	0.32	1	0.01	2,026	15.99
	014	SM2	D.08	Context	16	8,284	57	0.41	14	0.1	137	0.99	0	0.00	1	0.01	0	0.00	0	0.00	209	1.51
	033	SM4	D.09	Context	18	9,058	2,164	14.33	780	5.17	5,873	38.90	25	0.17	0	0.00	38	0.25	6	0.04	8,891	58.90
Summer 23-Jun-2020	025	SM4	D.01	T1	15	7,754	36	0.28	145	1.12	336	2.60	0	0.00	0	0.00	2	0.02	0	0.00	519	4.02
	016	SM2	D.02	T2	14	7,183	161	1.34	2,127	17.77	2,989	24.97	0	0.00	0	0.00	38	0.32	41	0.34	5,356	44.74
	023	SM2	D.03	T3	15	7,754	67	0.52	140	1.08	390	3.02	0	0.00	0	0.00	15	0.12	12	0.09	624	4.83
	286	SM4	D.04	T4	15	7,754	87	0.67	268	2.07	1,303	10.08	0	0.00	0	0.00	48	0.37	62	0.48	1,770	13.70
	031	SM4	D.05	T5	15	7,754	0	0.00	3	0.02	38	0.29	0	0.00	0	0.00	0	0.00	0	0.00	41	0.32
	020	SM2	D.06	T6	14	7,298	38	0.31	1,982	16.30	3,861	31.74	0	0.00	961	7.90	6	0.05	4	0.03	6,852	56.33
	037	SM4	D.07	T7	11	5,520	50	0.54	507	5.51	1,784	19.39	0	0.00	0	0.00	168	1.83	2	0.02	2,511	27.29
	028	SM4	D.10	T10	15	7,754	95	0.74	155	1.20	1,425	11.03	0	0.00		0.00	9	0.07	7	0.05	1,691	13.08
	039	SM4	D.11	T11	15	7,754	1	0.01	23	0.18	344	2.66	0	0.00	0	0.00	0	0.00	0	0.00	368	2.85
	036	SM4	D.08	Context	15	7,754	35	0.27	0	0.00	33	0.26	0	0.00	0	0.00	0	0.00	5	0.04	73	0.56
	027	SM4	D.09	Context	15	7,754	496	3.84	142	1.10	555	4.29	0	0.00		0.00	12	0.09	20	0.15	1,225	9.48
Autumn 25-Aug-2020	038	SM4	D.01	T1	15	10,148	20	0.12	64	0.38	90	0.53	0	0.00	0	0.00	4	0.02	7	0.04	185	1.09
	011	SM2	D.02	T2	11	7,552	96	0.76	819	6.51	1,305	10.37	0	0.00	0	0.00	39	0.31	30	0.24	2,289	18.19
	034	SM4	D.03	T3	15	10,148	142	0.84	407	2.41	555	3.28	0	0.00	0	0.00	32	0.19	17	0.10	1,153	6.82
	051	SM4	D.04	T4	15	10,148	149	0.88	4,626	27.35	4,847	28.66	0	0.00	0	0.00	82	0.48	14	0.08	9,718	57.46
	016	SM2	D.05	T5	11	7,863	24	0.18	1,694	12.93	4,201	32.06	0	0.00	0	0.00	20	0.15	7	0.05	5,946	45.37
	019	SM2	D.06	T6	4	2,745	37	0.81	3,405	74.44	2,209	48.29	0	0.00	0	0.00	7	0.15	0	0.00	5,658	123.69
	010	SM2	D.07	T7	11	7,692	90	0.70	6,436	50.20	2,686	20.95	0	0.00	0	0.00	89	0.69	1	0.01	9,302	72.56
	060	SM4	D.10	T10	11	7,790	80	0.62	1,543	11.88	4,084	31.46	0	0.00	0	0.00	92	0.71	3	0.02	5,802	44.69
	006	SM2	D.11	T11	9	6,798	97	0.86	307	2.71	773	6.82	0	0.00	0	0.00	14	0.12	4	0.04	1,195	10.55
	032	SM4	D.08	Context	15	10,148	265	1.57	673	3.98	784	4.64	1	0.01	0	0.00	27	0.16	12	0.07	1,762	10.42
	007	SM2	D.09	Context	13	9,028	75	0.50	85	0.56	53	0.35	1	0.01	1	0.01	4	0.03	0	0.00	219	1.46

3.4.1 Static monitoring results for spring deployment (21 May – 06 June 2020)

Static bat detectors were deployed for a total of up to 18 nights adjacent to or at the nine proposed turbine locations, with an additional two context locations also covered – see **Figure 4**. Seven out of the eleven static detectors recorded for the full 18 nights, while the other four recorded from 11 to 16 nights. All are considered to be in compliance with SNH guidelines. **Table 12** shows the number of bat passes recorded on each detector over the survey period as well as the bp/h.

Weather data for the spring deployment shows compliance with SNH *et al*. (2019) guidelines of temperatures >8°C at dusk and wind speeds <5 m/s (18 km/h) and little or no rain, for 17 out of the 18 nights deployed (see **Figure 14**). Due to a system failure after set up on the 21-May-2020, weather data was not collected on this date. However, following this, sufficient data was collected for good weather days demonstrating compliance with the guidelines. Wind speeds remained below 5 m/s (18 km/h) during night time hours for the entirety of the deployment period, while evening temperatures were consistently above 8°C at dusk. There was relatively little rain recorded during night-time periods, although some rain was recorded during daylight hours.

Table 12 shows that common pipistrelle bp/h species totals were considered 'High' for seven out of the eleven static locations: D.02; D.04; D.05; D.06; D.10; D.11; and D.09, the context unit located within a bog woodland leading to the lake. The highest level of aggregate bp/h for spring was 58.9 bp/h which was recorded at D.09. The bp/h for Leisler's bats was considered 'High' at D.09, while soprano pipistrelle bp/h was considered 'Medium'. Soprano pipistrelle bp/h was also considered 'Medium' for D.04, D.05, and, D.06.

Figure 13 illustrates the distribution of bat passes recorded at all the deployment location over the spring deployment period. Common pipistrelles and soprano pipistrelles accounted for over 75% of the calls during spring with the exception of D.08 and D.09, the two context detectors. At these detectors, Leisler's bats accounted for approximately 25% of the recorded activity. During the spring deployment, the highest level of total bat activity (58.9 bp/h) was recorded at D.09 while the highest bat activity associated with a turbine location was that of D.04 (48.2 bp/h) which was deployed along a treeline adjacent to T4. **Figure 15** shows the activity patterns of species at D.04 over the course of the deployment. Common and soprano pipistrelles at D.04 were most active at the start of the deployment with activity levels decreasing during the 28-May to the 1-Jun-2020 period then increasing again after this date. This time period coincided with a decrease in minimum nightly temperatures, and also marks when Nathusius' pipistrelles stopped showing activity at this location.

In terms of aggregated bat passes for all species (**Table 12**), total bp/h were considered 'High' for D.04, D.05, D.06, D.10, D.11 and at D.09, the context unit within the bog woodland leading to the lake. D.03 and D.08 had 'Low' levels of aggregate bat passes per hour.

Ecobat analysis for the spring deployment showed that several locations had 'Moderate/High' and 'High' activity levels, as seen in **Table 11**. Common pipistrelles had 'Moderate/High' activity levels at D.02 and D.011 and 'High' activity levels at D.04, D.05, D.06, D.09 and D.10. Soprano pipistrelles had 'Moderate/High' activity levels at D.04, D.05, D.06, and D.09. Leisler's bat had 'Moderate/High' levels of activity at D.04, D.05 and D.10, and 'High' activity levels at D.09.

One of the analysis outputs provided by Ecobat assesses the potential proximity of roosts based on the bat activity recorded relative to sunset. **Figure 10** shows bat activity relative to the time of sunset across the spring deployment with species specific emergence times represented by grey bars, which if significantly covered suggest proximity to a roost (Russ, 2012). **Figure 10** indicates that some common pipistrelles, soprano pipistrelles and Leisler's bats recorded by D.06 may have been dispersing from a roost in the wider area. The Ecobat report suggested the same regarding soprano pipistrelles and D.05. However, considering the wooded (and generally dark) nature of the area, it is also possible that bats were foraging earlier than others in the Ecobat dataset.

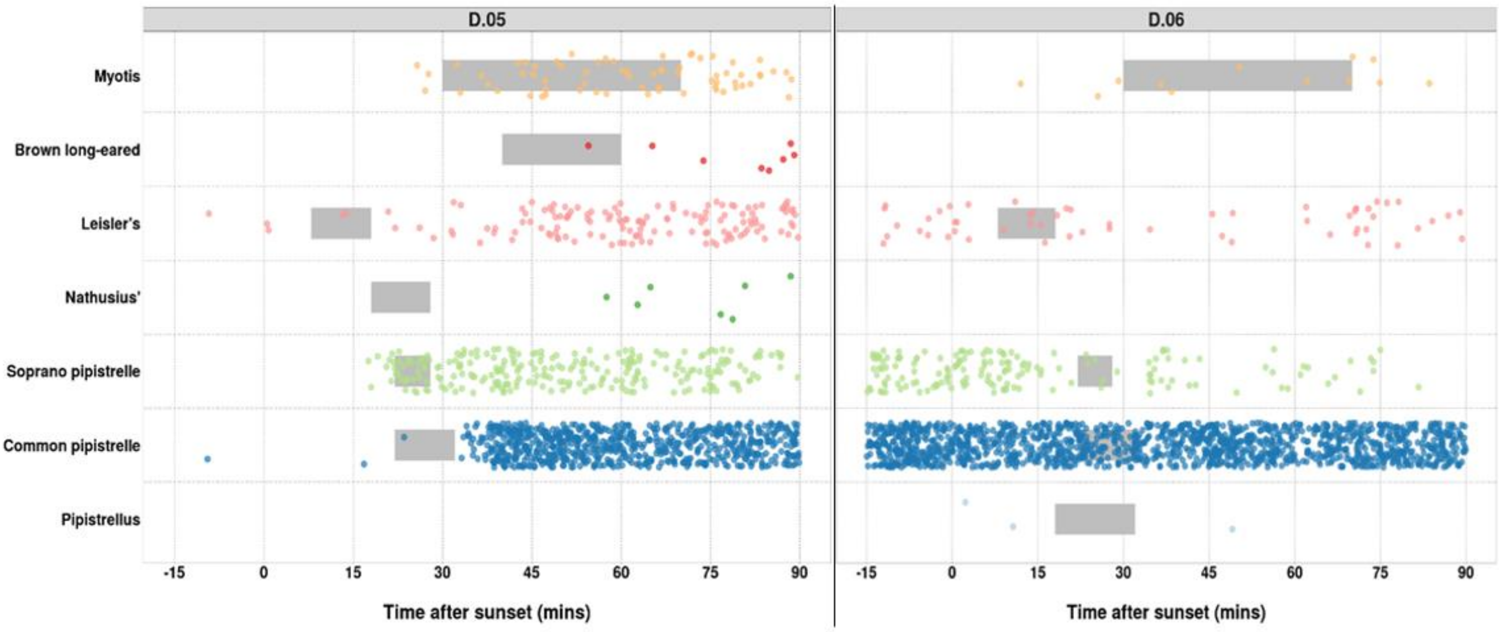


Figure 10 – Indicative proximity of deployment locations to potential roosts in spring 2020

3.4.2 Static monitoring results for summer deployment (23 June – 8 July 2020)

Static bat detectors were deployed for a total of up to 15 nights adjacent to or at the nine proposed turbine locations with an additional two context locations also covered – see **Figure 4**. Though three of the detectors recorded for less than 15 nights, all recorded for more than 10 nights and are thus considered compliant with SNH guidelines. **Table 12** shows the number of bat passes recorded on each detector over the survey period, as well as bat passes per hour (bp/h). **Figure 16** illustrates the distribution of bat passes recorded at all the deployment location over the summer deployment period. **Figure 18** details the high activity levels seen over the summer deployment period at D.06.

Weather data for the summer (July) deployment showed compliance with SNH guidelines of temperatures >8°C at dusk and moderate wind speeds and little or no rain, on most nights. Occasional heavy rainfall of up to 5.2 mm was recorded on three of the deployment nights, 28-Jun-2020, 06 and 07-Jul-2020. Evening temperatures were above 8°C at dusk throughout the deployment period.

As detailed in **Table 12**, similar to the spring deployment, common pipistrelle species totals were considered 'High' for six out of the eleven deployment locations, with the highest levels of activity recorded at D.06 (31.74 bp/h). Bat passes per hour (bp/h) for common pipistrelle species were considered 'Medium' at D.09 (4.29 bp/h) during summer, which was lower than the 'High' spring activity (38.9 bp/h). In further contrast to the spring deployment, common pipistrelle species activity for D.05 was considered 'Low'. Soprano pipistrelle species totals were considered 'Medium' to 'High' at three turbine locations: D.02; D.06; and D.07. Leisler's bat activity was low across all detectors except for D.09 at which a 'Medium' activity level of was recorded (3.84 bp/h). Activity levels were recorded as 'Low' for *Myotis* species and brown long-eared bats with all bp/h values being lower than 1 bp/h with the exception of *Myotis* species activity at D.07 which was still classified as 'Low' (1.83 bp/h). At D.06 there was also 'High' activity of pipistrelle species for which a distinction between soprano and common pipistrelle could not be made, accounting for 961 passes.

In terms of total aggregated bat passes for all species, total bp/h were considered 'High' for five static detectors deployed at D.02, D.04, D.06, D.07 and D.10. Medium levels of bat activity in terms of total aggregated bat passes were recorded at D.01, D.03 and D.09, the context unit located within the bog woodland leading to the lake. Overall, there was a notably lower level of bat activity recorded during the summer deployment in comparison to the spring deployment (165.50 bp/h and 246.07 bp/h, respectively).

Common pipistrelles were the most active species recorded during the summer deployment with common pipistrelle bat species registrations occupying nearly 70% of the total bat registrations (as illustrated in **Figure 16**). The data from the static detector D.06, near the proposed location for T6 is presented above as the location where the highest level of activity was recorded during this deployment period (56.33 bp/h). D.05 recorded a 'Low' level of activity (0.32 bp/h) which is in stark contrast to the 'High' levels recorded in spring and autumn. D.08 and D.11 both recorded 'Low' levels of bat activity, though activity was substantially lower at D.08 than D.11 (0.56 bp/h and 2.85 bp/h, respectively).

Heavy rainfall occurred during two periods during the summer deployment: 27-Jun-2020, and 06 to 07-Jul-2020. Examining D.06 as a sample location for the impact of this weather on bat activity found the; total bat passes were reduced during the 27-Jun-2020. Though rainfall for the majority of 28 and 29-Jun-2020 remained below 1 mm, no *Myotis* species, brown long-eared bats nor Leisler's bats being recorded during this period. Furthermore, very low numbers of common and soprano pipistrelles were recorded during this time period. Reduced numbers of bat passes were also observed during the heavy rain that occurred during the night of the 06-Jul-2020. However, with the exception of D.07 (which was mentioned in the section covering weather related limitations) all detectors recorded an adequate number of nights within compliant weather parameters, having recorded for ≥14 nights to offset the three nights of heavy rainfall.

Ecobat was used to find the areas of 'Moderate/High' and 'High' activity levels for each species (**Table 11**). It was found that common pipistrelle median activity was 'Moderate/High' for D.01, D.03, D.05, D.10, D.11 and 'High' for D.02, D.04, D.06, D.07. Soprano pipistrelle median activity was 'Moderate/High' at D.04, D.07, D.09 and 'High' at D.02, and D.06. 'Moderate/High' median activity levels were measured for Leisler's bats at D.09, brown long-eared bats at D.04 and *Myotis* species. at D.07. Overall summer was the period of the lowest activity in terms of both bat passes per hour and median percentile levels (**Table 12** and **Table 9**)

The potential proximity of roosts based on emergence times of bat species was also analysed with the use of Ecobat. **Figure 11** shows that some common pipistrelles, soprano pipistrelles and Leisler's bats recorded by D.04 and D.06, and Leisler's bats recorded by D.09 may have been dispersing from a roost in the wider area.

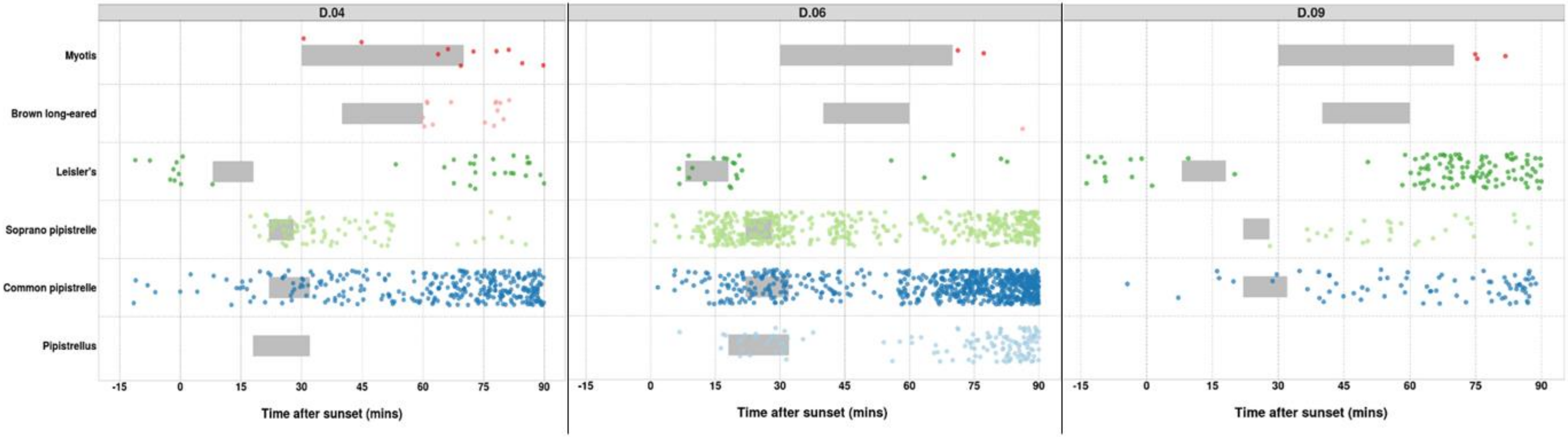


Figure 11 – Indicative proximity of deployment locations to potential roosts in summer 2020

3.4.3 Static monitoring results for autumn deployment (25 August – 9 September 2020)

Static bat detectors were deployed for a total of up to 15 nights adjacent to or at the nine proposed turbine locations including the two context locations – see **Figure 4**. **Table 12** shows the number of bat passes recorded on each detector over the survey period as well as bat passes per hour. Four of the detectors recorded for the duration of the 15 nights while five recorded for between 11 and 13 nights. D11 stopped recording during the 10th night. Only one detector, D.06, was considerably below the compliance time. However, as analysis was conducted using a standardised measurement of bat passes per hour, the results of this detector were still included and analysed. **Figure 19** displays the location of each detector and the total number of bat passes per hour recorded. **Figure 21** details the bat activity levels across the deployment period the static detector deployed along a hedgerow adjacent to T2 (D.02).

Weather data for the September deployment also is compliant with the SNH Guidelines of temperatures >8°C at dusk and moderate wind speeds and little or no rain, on all nights. Wind speeds remained below acceptable levels while evening temperatures were above 8°C at dusk on all evenings. There was relatively little rainfall recorded during night time periods, although some light rain was recorded on seven nights. **Figure 20** displays weather data recorded throughout the deployment period.

As detailed in **Table 12**, common pipistrelle species totals were considered 'High' for eight out of the eleven deployment locations: D.02; D.04; D.05; D.06; D.07; D,08; D.10; and D.11. Common pipistrelle activity was lower at D.02 during the autumn deployment than the summer deployment. In contrast, common pipistrelle registrations were significantly higher at D.05 during the autumn deployment than during the summer deployment. The autumn deployment recorded the highest number of soprano pipistrelle registrations, with six detectors recording 'High' levels of bat activity, with a further two recording 'Medium' levels of activity. All other species totals aside from pipistrelles were considered 'Low' during the autumn deployment. Units at D.01 and D.09 recorded considerably lower bat passes (1.09 bp/h and 1.46 bp/h) compared to all the other deployment locations. 'High' activity was recorded at D.08, which is located in an open field (98 m from the nearest linear feature) and had recorded 'Low' activity over the previous two deployments.

Common and soprano pipistrelles made up the majority of the calls consisting of 50% and 46% of total calls respectively. As was recorded during the summer deployment, D.06 was once again the location where the highest number of bat passes were recorded (123.69 bp/h). D.08 recorded a 'High' level of activity (10.42 bp/h), while D.09 recorded a 'Low' level of activity (1.46 bp/h). These results are quite different from the previous two deployments during which D.09 recorded 'High' and 'Moderate' activity and D.08 only recorded 'Low' activity.

In terms of total aggregated bat passes, all static locations recorded 'High' or 'Medium' levels of activity with the exception of D.01 and D.09. Bat passes at the aforementioned locations observed a gradual decrease from the spring deployment to the autumn. In contrast to the spring and summer deployments, there was a similar level of common and soprano pipistrelle activity (193 bp/h and 187 bp/h respectively). Social calls were also noted frequently during this deployment period. Autumn had the highest total bp/h out of all the seasonal deployments (451 bp/h).

Ecobat was used to find the areas of 'Moderate/High' and 'High' activity levels (**Table 11**) for each species. It found that common pipistrelles had 'High' median activity levels at D.02, D.03, D.04, D.05, D.06, D.07, D.10, D.11 and 'Moderate/High' median activity levels at D.08. Soprano pipistrelles had 'High' median activity levels at D.02, D.04, D.05, D.06, D.07, D.10 and 'Moderate/High' median activity levels at D.03, D.08 and D.09. Leisler's bats had 'Moderate/High' median activity levels at D.04.

Ecobat analysis of species-specific emergence times found that soprano and common pipistrelles recorded by D.05 and D.06 may have been dispersing from roosts in the wider area. The same can be said of brown long-eared in relation to D.05 and soprano pipistrelle in relation to D.07 (**Figure 12**).

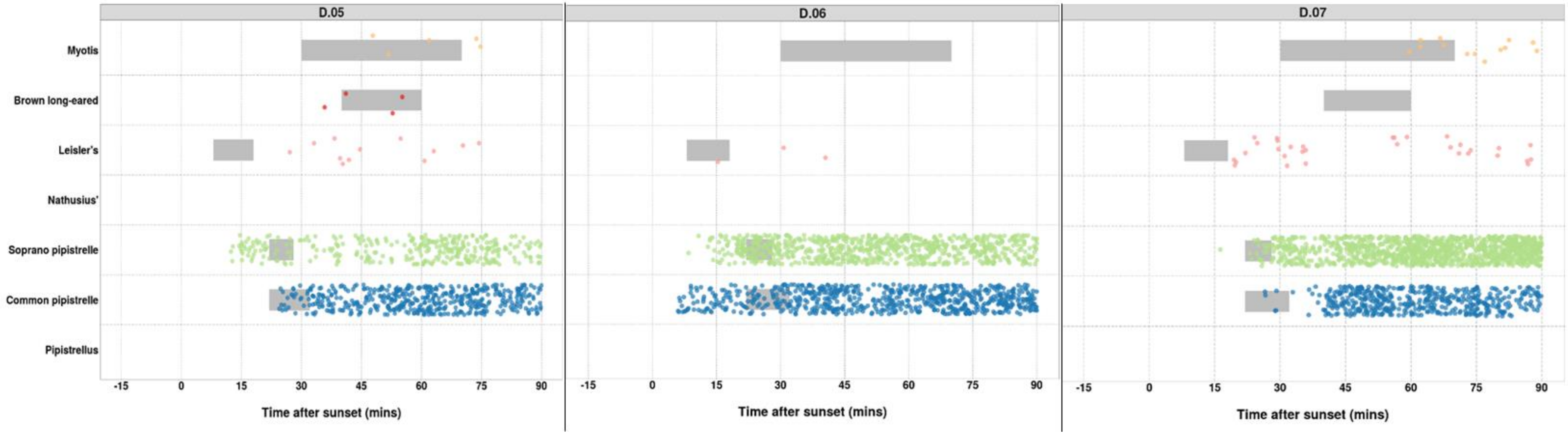


Figure 12 – Indicative proximity of deployment locations to potential roosts in autumn 2020

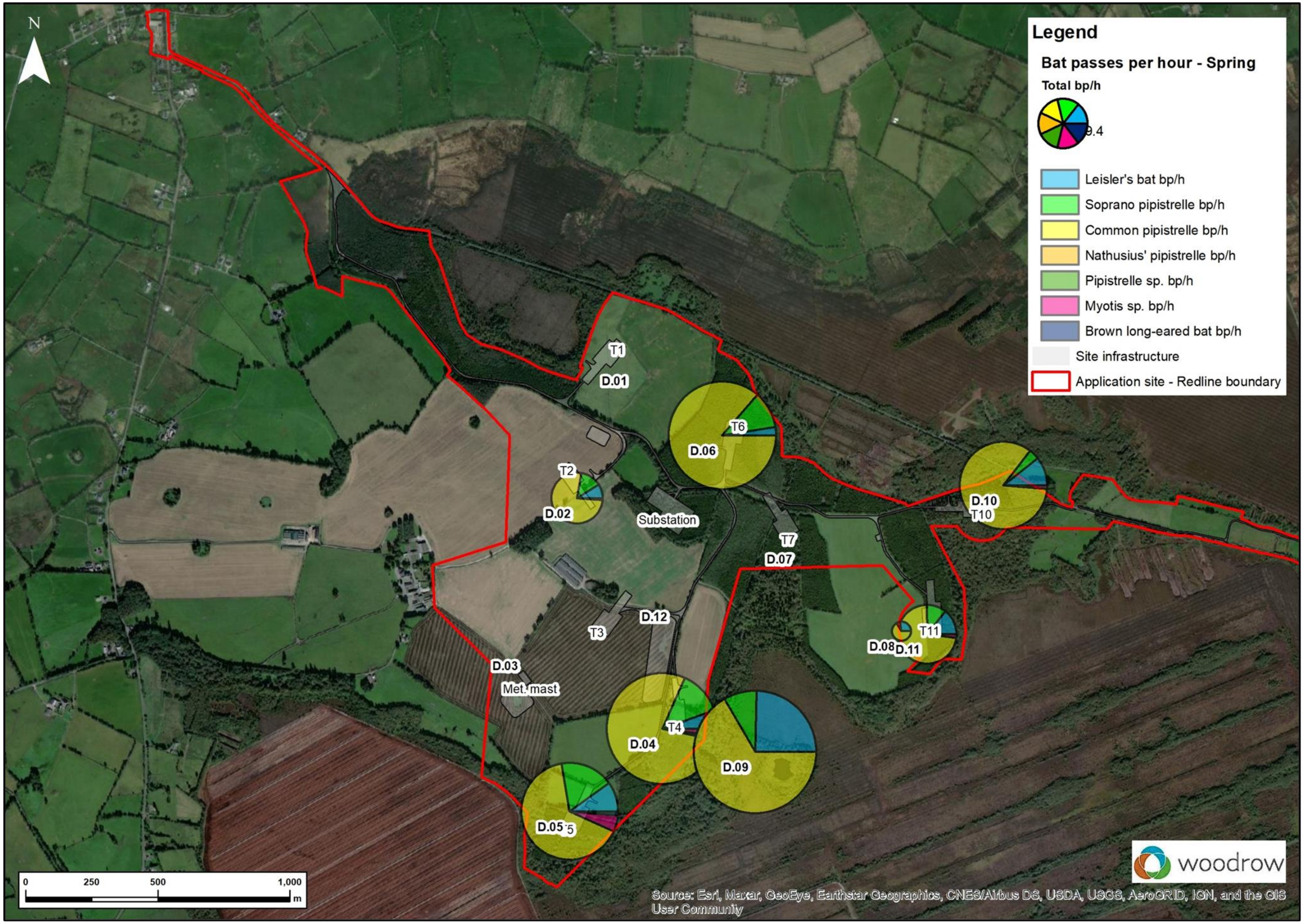


Figure 13 – Total bp/h for each species by static bat detectors for spring 2020

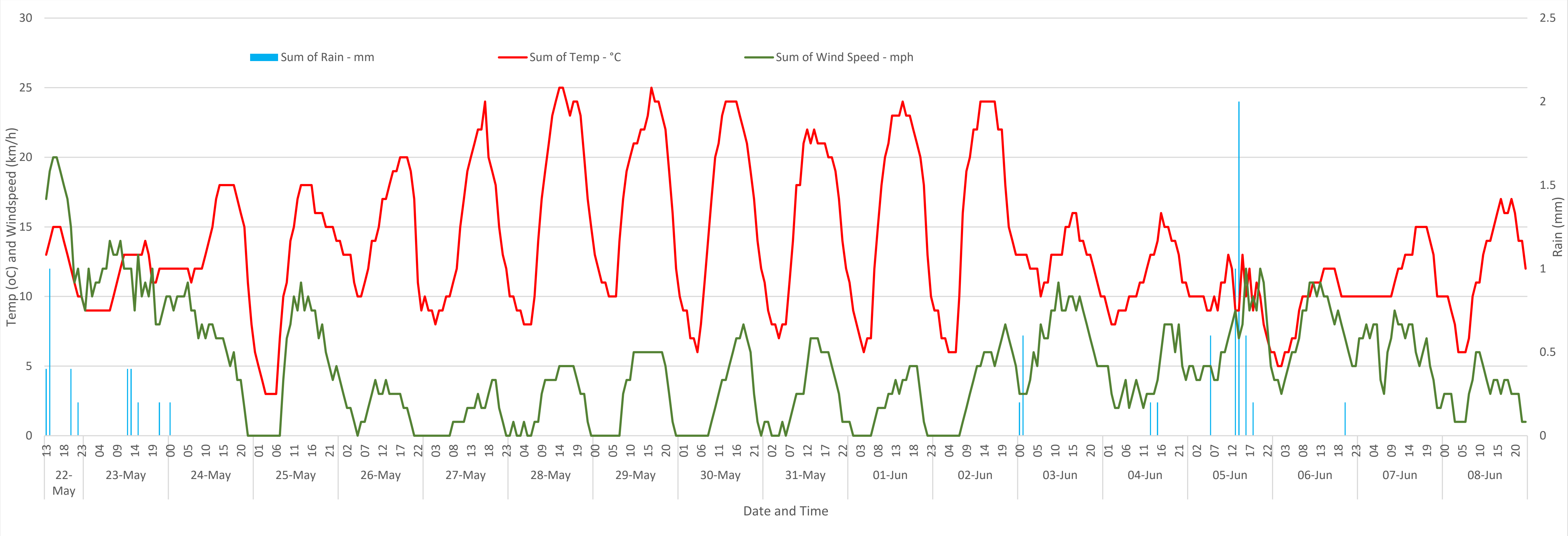


Figure 14 – Spring deployment – Mean hourly temperature, wind speed and rainfall

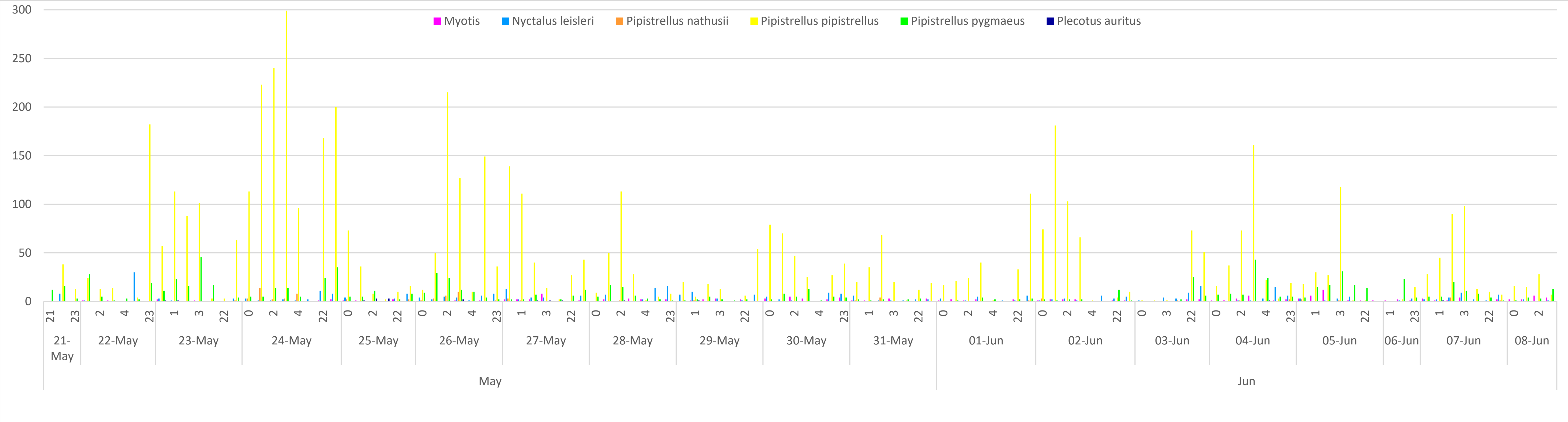


Figure 15 – D.04 - Bat passes over time: 21-May to 08-Jun-2020 (Unit near T4)

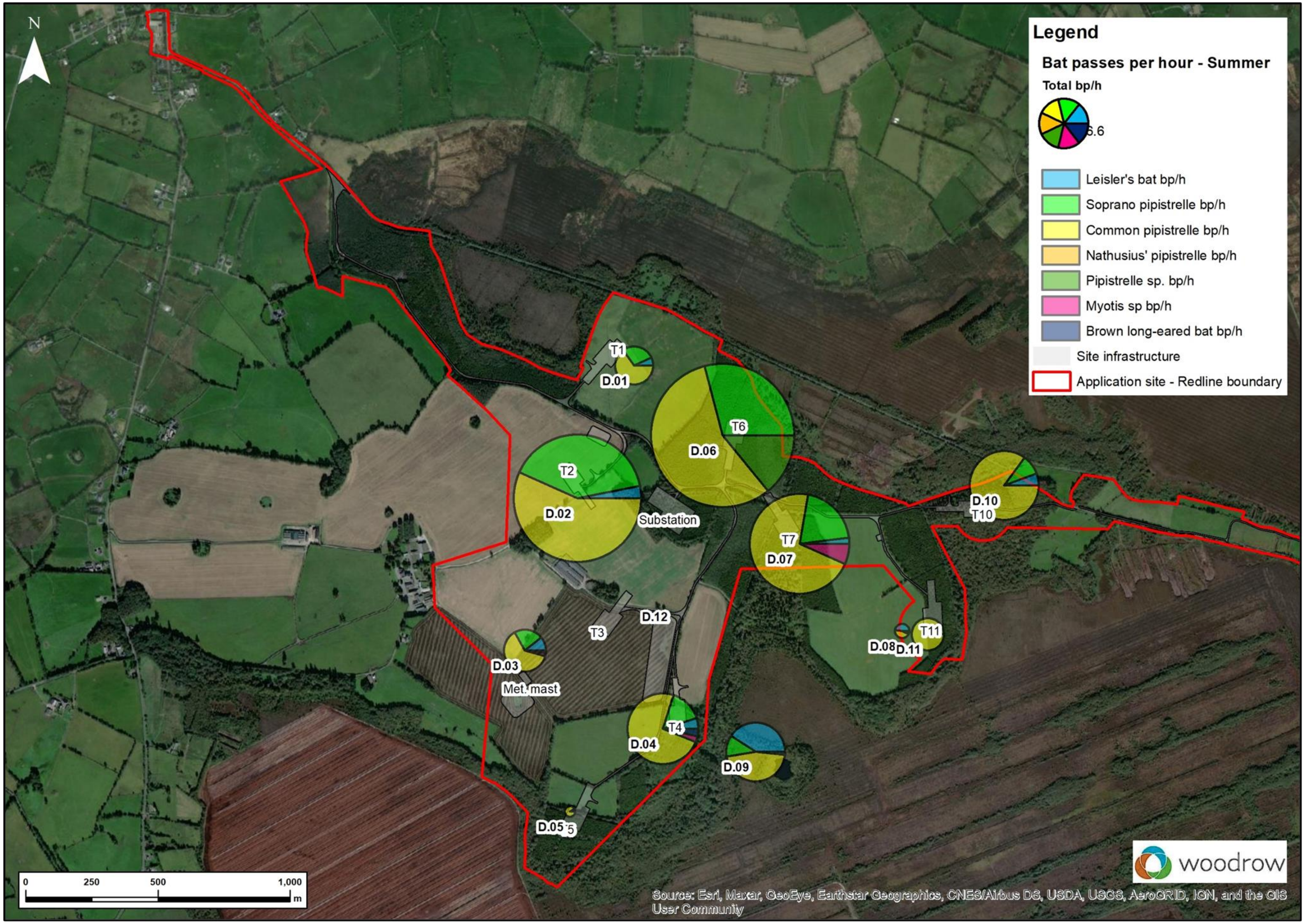


Figure 16 – Total bp/h recorded for each species by static bat detectors for summer 2020

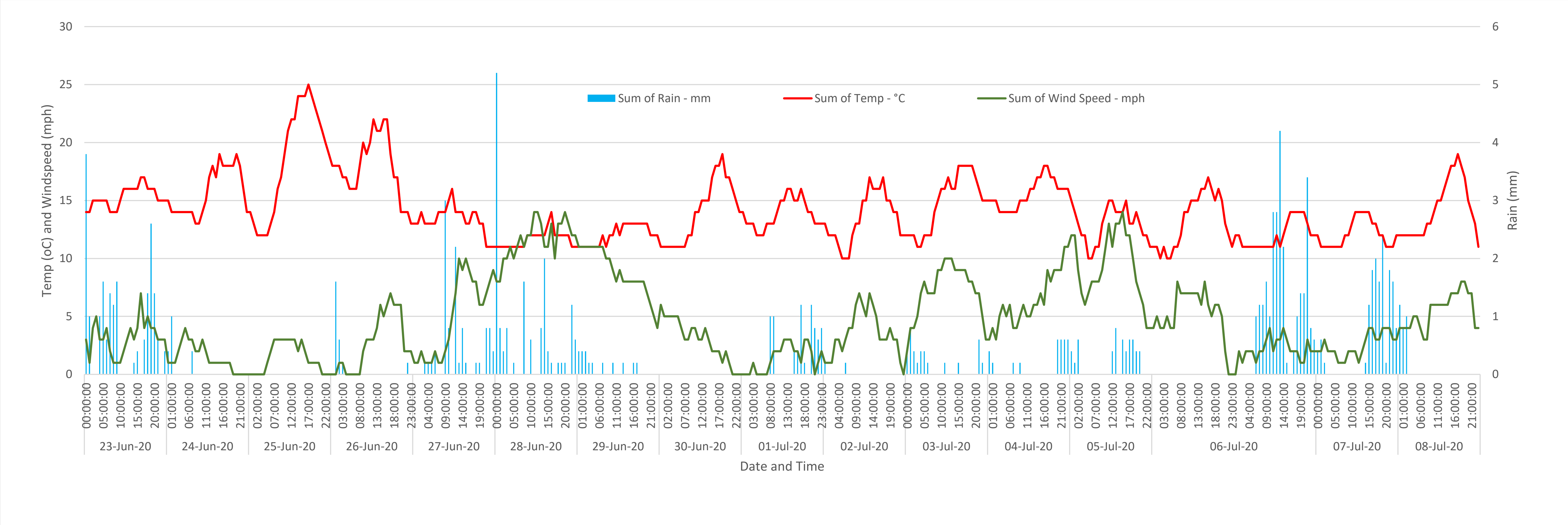


Figure 17 – Summer deployment – Mean hourly temperature, wind speed and rainfall

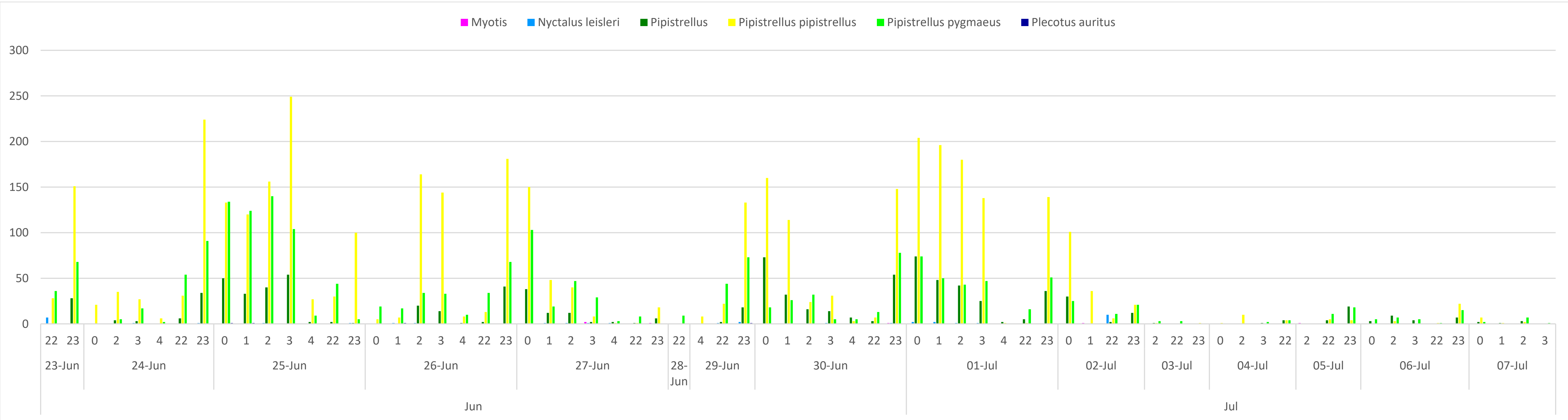


Figure 18 – D.06 - Bat passes over time: 23-Jun to 07-Jul-2020 (Unit near T6)

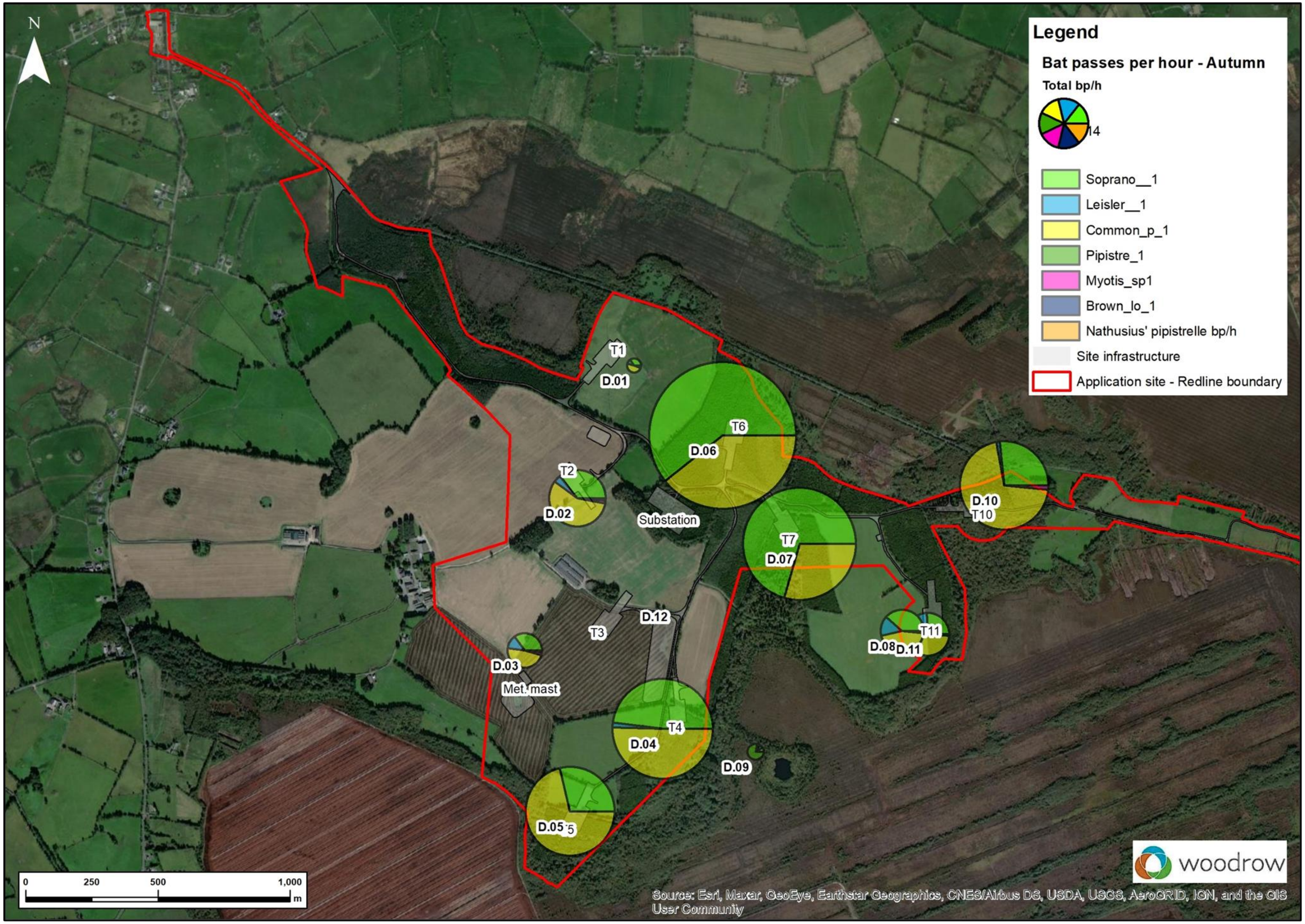


Figure 19 – Total bp/h recorded for each species by static bat detectors for autumn 2020

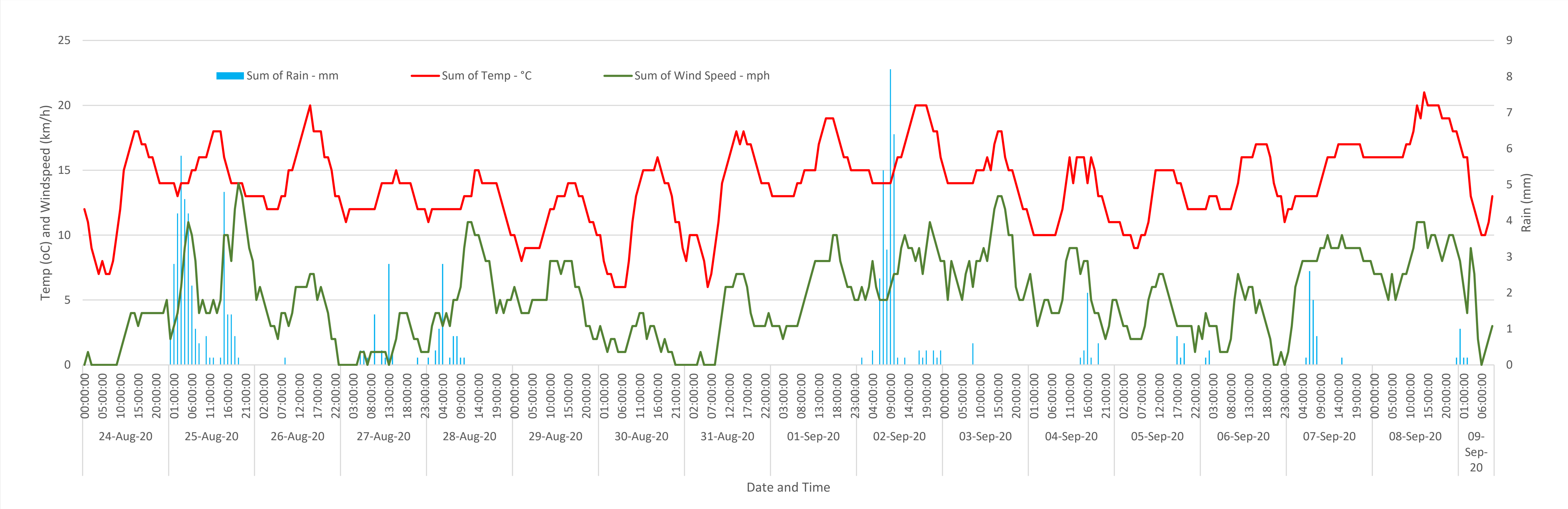


Figure 20 – Autumn deployment – Mean hourly temperature, wind speed and rainfall

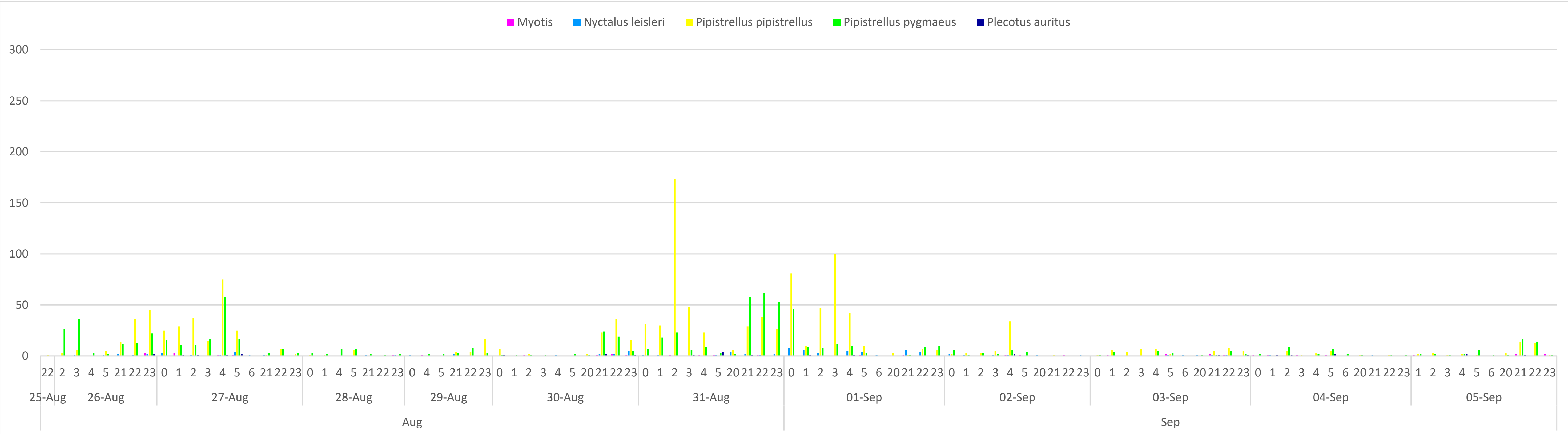


Figure 21 – D.02 - Bat passes over time: 25-Aug to 05 Sep-2020 (Unit near T2)

3.5 Permanent static at height

For the 2020 active bat season, a continuously recording static was erected on a temporary meteorological mast located at 53.569920, -7.076079 on 23-Jun-2020. Data was continuously recorded from microphones located at 2 m and at height, approximately 50 m, throughout the survey season until 05-Oct-2020, with the exception of the nights of the 04 to 08 Sep-2020 due to battery failure. This allowed for comparative analysis between bat activity at various heights within the site. The following section provides details on the data collected from this continuously recording static. **Figure 22** and **Figure 23** shows the level of activity of each bat species recorded throughout the deployment period. The implication of these results on proposed mitigation are discussed further in **Section 6.2.2**.

3.5.1 Overview

Throughout the deployment period, a total of 1,074 Leisler's bat passes were recorded at 50m, while a total of 904 Leisler's bat passes were recorded from the microphone erected at 2 m. A total of 535 common pipistrelle bat passes were recorded at 2 m, significantly more than recorded at 50m where 130 passes were recorded. Similarly, a total of 874 soprano pipistrelle bat passes were recorded from the static throughout the deployment period, with only 34 of these recorded at 50m. Following this trend, a total of 46 brown long-eared bat passes were recorded at 2 m, while only 3 passes were recorded from the microphone erected at 50m. A total of 151 *Myotis* species bat passes were recorded at 2 m, while no *Myotis* species bat passes were recorded from the microphone erected at 50m. Only a single Nathusius' pipistrelle pass was detected and was recorded on 16-Sep-2020 from the mic at 2 m.

The results demonstrate a varied level of bat activity at 2 m compared to at 50m on the Site. A higher level of Leisler's bat activity was recorded at 50m than at 2 m. Leisler's bats are a high-flying species that often forage in open areas above tree level and as such are most at risk of collision causing fatality from wind farm developments. Pipistrelle species are often cited as being at high risk of collision with wind turbines. However, the results demonstrate a higher usage of the Wind Farm Site by these species at ground level than above tree height. Contrary to expectations, 3 brown long-eared bat passes were recorded at height. This is an unexpected finding (and not echoed by results in other locations) as this species tends to forage within closed canopy or close to features, and is known to rarely commute above tree level across open habitat, similar to that of the met mast.

Examining these results, along with the weather conditions with which they occur, provides a clear picture for the prerequisite conditions during which species are likely to be active at 50m. Overall, 3801 bat passes were recorded on the permanent unit, 1295 of which were recorded at 50m. Of these, 1295 passes recorded at 50m, 1243 were recorded at windspeeds below 3 m/s while 1270 were recorded below 3.5 m/s leaving only 25 records of bat passes active at 50m at windspeeds above this level. The three most active species at height were Leisler's bat, common pipistrelle, and soprano pipistrelle are examined in further detail. This latter point is important in ascertaining the potential collision risk resulting from turbines (which cut-in at wind speeds above 3m/s) and potential curtailment or increases in cut-in speed (eg to 3.5m/s) in appropriate conditions (see **Section 6.2.2**).

3.5.2 Leisler's bat

The species most frequently recorded at height were Leisler's bats with a total of 1074 passes being recorded over this survey period. There was an anomalously high peak in Leisler's bat activity on the 31-Aug-2020 at both 2m and 50m detectors (**Figure 24**), which may have resulted from intense feeding by a single bat, or a small number of bats and could have been related to recent cereal harvesting in the area combined with still, mild condtions. For the purposes of examining the relation of this species activity at height to weather, this night was removed for a less distorted view of activity levels and a significant pattern emerged (**Figure 25**).

Leisler's bat activity at 50m is limited by windspeed. Periods of windspeed greater than 6mph (9.65km/h) such as 28-Jun-2020 to 29-Jun-2020 or 01-Sep-2020 to the 11-Sep-2020 had activity lower than 5 passes per night. This is contrasted by increases of activity at height during periods of low wind speeds, particularly from 05-Aug-2020 to 19-Aug-2020 during which wind speed did not exceed 3mph (4.83km/h). During this period activity increased at both 2m and at 50m. However, relative to nights of higher windspeed the increase in activity was proportionally much greater at height than at 2m with nightly passes increasing by between 2 and 5 times the number of passes on nights with windspeeds above 3mph (4.83km/h). This higher level of activity also coincides with the peak temperature of the recording period for this detector (approximately 17°C) though activity at height remained high at lower temperatures provided wind speed remained low (09-Aug-2020 to 11-Aug-2020 in **Figure 25**).

3.5.3 Common pipistrelles

Common pipistrelles were the second most active species at height and their activity relative to height and weather conditions is shown in **Figure 26**. A much lower number of common pipistrelles were recorded at height than Leisler's bat, with only 130 recorded in total. Common pipistrelles were also highly active on the 31-Aug-2020 and once again this is considered to be an outlier in terms of species activity relative to wind and in the case of common pipistrelles in particular the particularly high activity that night was at 2m. Common pipistrelle activity at 50m is exclusively limited to windspeeds equal to or below 3.5 mph (5.63km/h), with the exception of a single pass at height in 5.4mph (8.69km/h). The time at which they were most active at height matched that of Leisler's bats, between 05-Aug-2020 and 19-Aug-2020 when wind speeds remained consistently low. However, even during times of reduced windspeed common pipistrelles were much more active at 2m than at 50m.

3.5.4 Soprano pipistrelle

Soprano pipistrelles were not highly active at height with only a total of 34 passes being recorded across at height during this long-term recording period. Their activity relative to height and weather conditions is shown in **Figure 27**. This species was much more sensitive to increased windspeed and with only one pass recorded above 2.3mph (3.7km/h). Soprano pipistrelles were active during the same time period of low windspeed as the previous two species (09-Aug-2020 to 19-Aug-2020 in **Figure 27**). However, at no point did activity for this species exceed 7 passes at 50m during this time period.

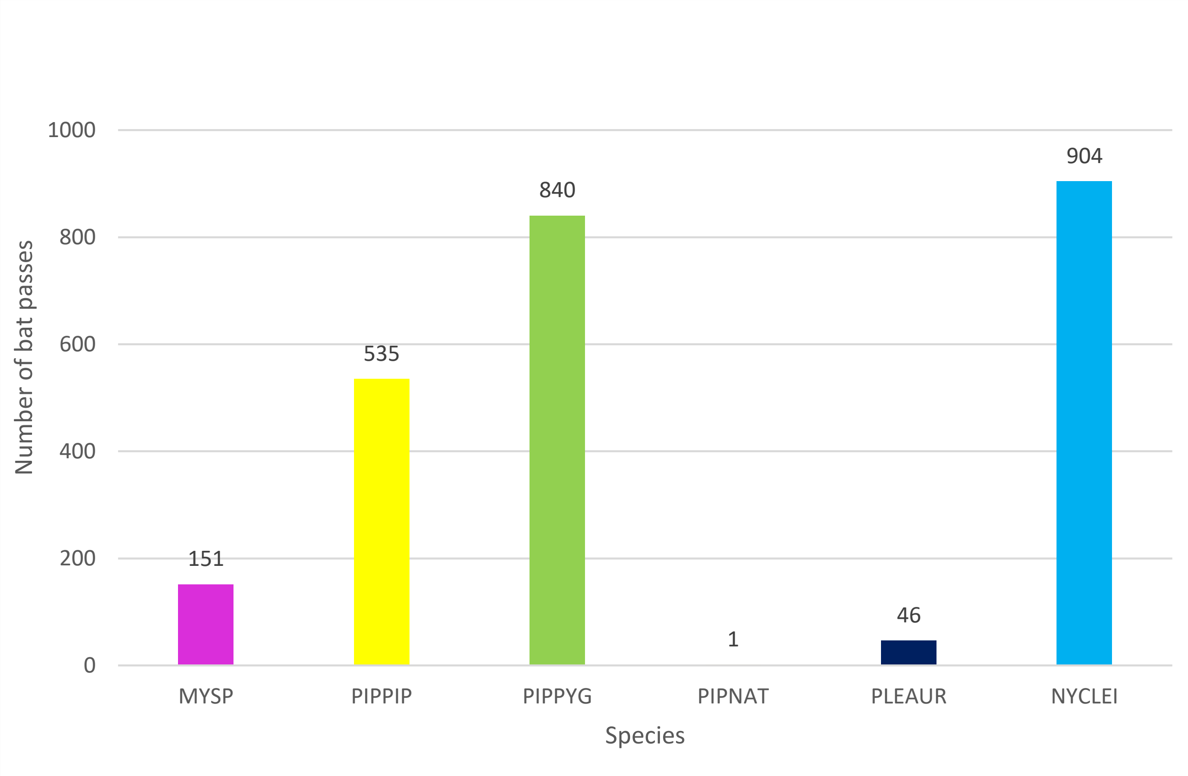


Figure 22 – Total bat passes at continuously recording static - mic height 2 m

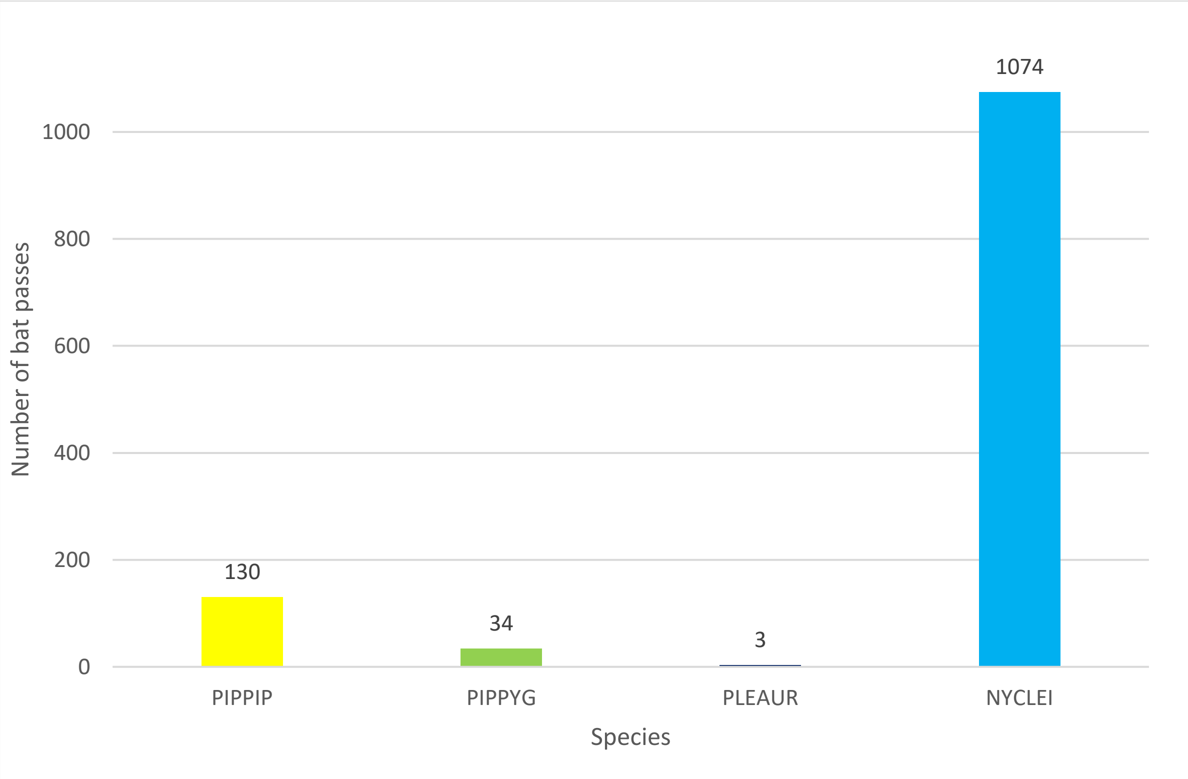


Figure 23 – Total bat passes at continuously recording static - mic height 50 m

SPECIES CODES

MYSP	*Myotis* species	PIPPIP	Common pipistrelle
PIPPYG	Soprano pipistrelle	PIPINAT	Nathusius' pipistrelle
PLEAUR	Brown long-eared bat	NYCLEI	Leisler's bat

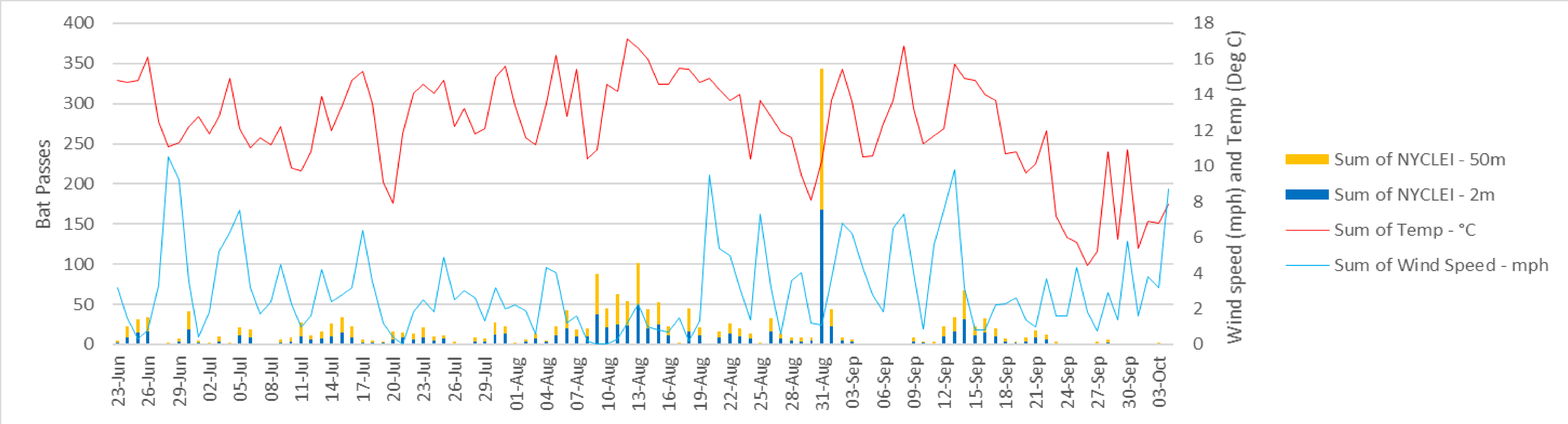


Figure 24 – Leisler's bat activity at 50m and 2m relative to weather conditions

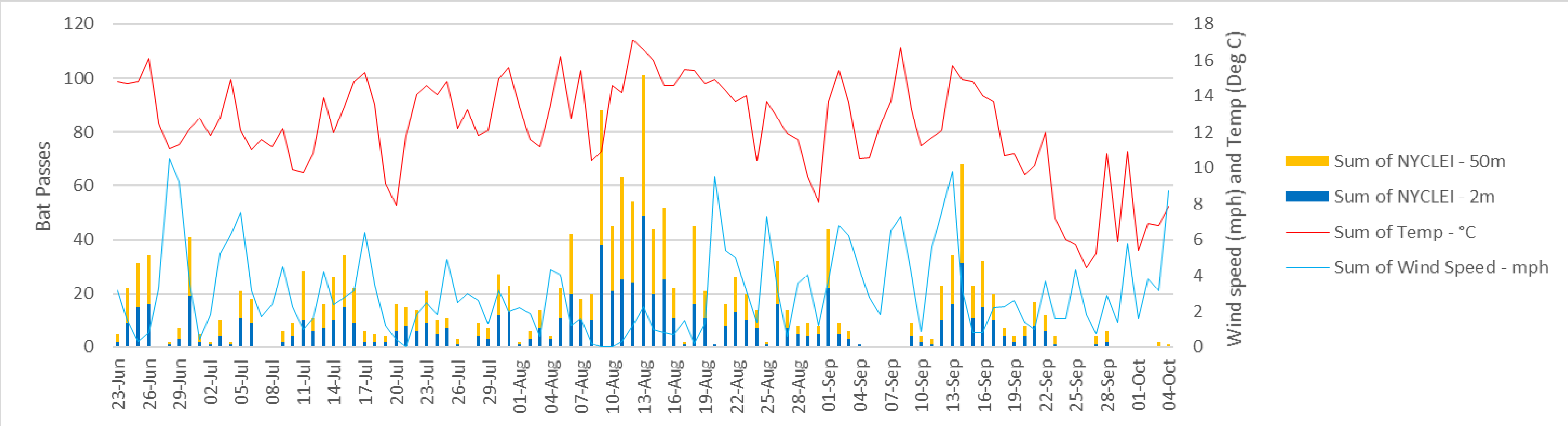


Figure 25 – Leisler's bat activity at 50m and 2m relative to weather conditions
- excluding 31-Aug-2020

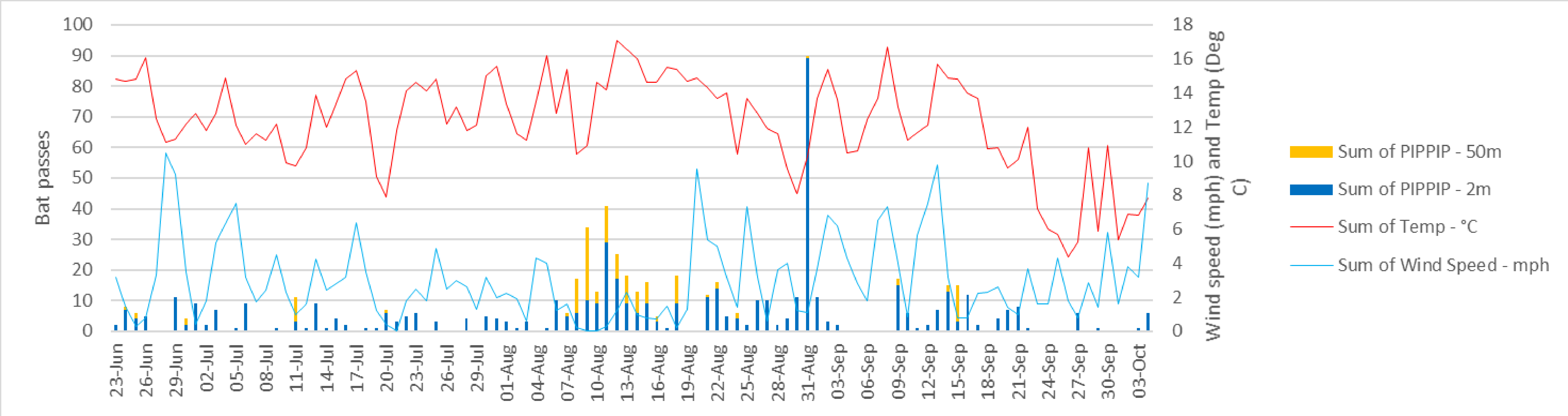


Figure 26 – Common pipistrelle activity at 50m and 2m relative to weather conditions

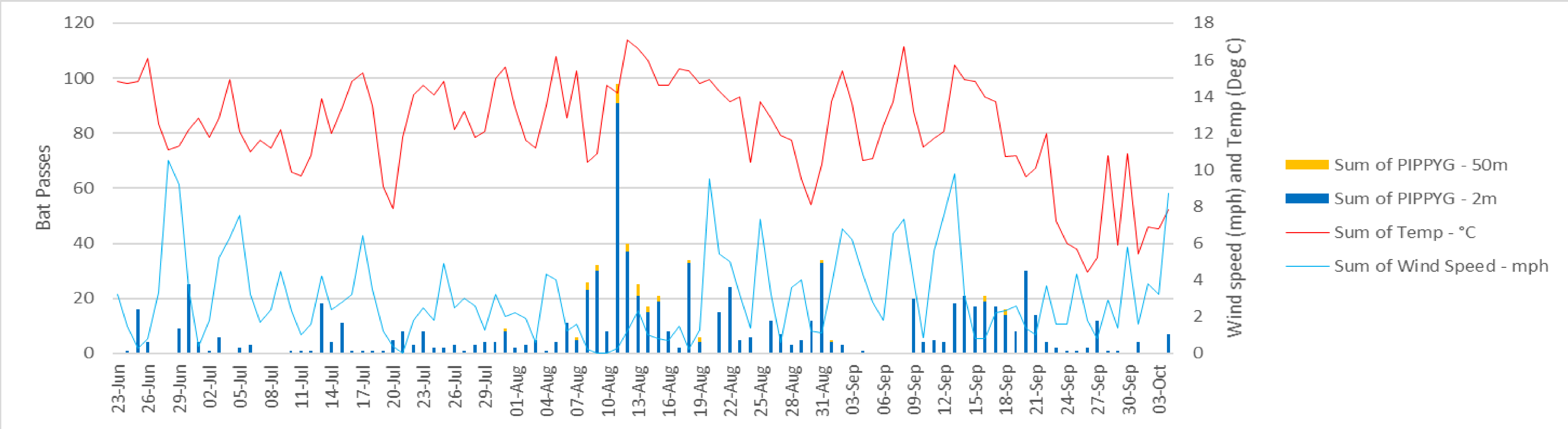


Figure 27 – Soprano pipistrelle activity relative at 50m and 2m relative to weather conditions

4 BASELINE CONDITIONS

The bat surveys at the proposed site for Bracklyn Wind Farm, undertaken as site investigations for potential roost features (PRFs), surveys at potential roosts, walked transects and the use of static bat detectors between May and September, provide robust information to facilitate an understanding of bat how populations utilise the study area. This section summarises the main findings of bat surveys conducted in 2020.

4.1 Habitat availability and roost suitability

The habitat within the Wind Farm Site consists of a mosaic of open fields, conifer plantation, semi-mature to mature broadleaf treelines, and bog woodland. Bat usage of the Wind Farm Site is generally associated with habitat features such as shrub, plantations, old growth woodlands, treelines and hedgerows, which is to be expected given that these are areas where greater foraging opportunities for bats would be predicted.

The proposed locations for T1, T2 and T3 are situated in open fields, whereas, T5, T6, T7, T10, and T11 are situated within conifer plantation while the proposed location for T4 is within young ash plantation. The commercial plantations containing the proposed turbine locations of T4 and T5 are themselves in proximity to broadleaf woodland with broadleaf treelines passing through parts of the commercial broadleaf and conifer plantations respectively. This creates linear features through the conifer plantations along which bats can commute and forage. Linear features such as forestry rides, in which D.06 and D.07 where deployed, provide what is likely to be sheltered areas where bats can glean flying invertebrate prey and capitalise on high insect biomass and levels of activity. The proposed locations for T10 and T11 are in proximity to bog woodland. In the absence of conifer plantation, the interface between open area and this bog woodland would likely be an area of significant bat activity.

There were few potential roost features (PRFs) identified as moderate to high PRF during preliminary habitat suitability assessments and only one with moderate PRF within the potential ZoI of T5 (see **Table 3**). Emergence times recorded during static deployments at D.04, D.05, D.06, D.07 suggest potential for roosts to exist in the wider area.

One of the few roost features classed as moderate was a group of three mature beech c. 150m southwest of the proposed location for T5. In addition, a standing dead scots pine outside the 300m ZoI for T7 was classed as moderate (see **Figure 5**).

Two roosts features were assessed to have high suitability, the crypt and a mature beech tree. However, emergence and re-entry surveys did not suggest the presence of roosts at these locations. The derelict cottage, adjacent to the proposed site entrance to the northwest of the Wind Farm Site, was assessed as being of moderate-high roost potential, though emergence and re-entry surveys only recorded a single soprano pipistrelle flying over the roof of the building.

4.2 Summary of static deployment data

Taking an overview of the static deployment results a number of patterns can be discerned, notably:

- Total bat passes per hour for the majority of static deployments in 2020 were classed as 'High' or 'Medium' using the classification system devised by Kepel *et al.* (2011) – see **Table 12**. Activity levels were classed as 'Low' for units deployed at D.03 and D.08 during the spring deployment, D.05, D.11 and D.08 during the summer deployment and D.01 and D.09 during the autumn deployment. All other static detectors recorded 'High' or 'Medium' levels of total aggregated bat passes as follows:

  Spring deployment

  - D.02, D.04, D.05, D.06, D.10, D.11 and D.09 recorded 'High' activity for total bat passes per hour.

  Summer deployment

  - D.01, D.03 and D.09 recorded 'Medium' activity for total bat passes per hour
  - D.02, D.04, D.06, D.07 and D.10 recorded 'High' activity for total bat passes for all species

  Autumn deployment

  - D.03 recorded 'Medium' activity total bat passes per hour.
  - D.02, D.04, D.05, D.06, D.07, D.08, D.10 and D.11 recorded 'High' activity for total bat passes per hour.

- As summarised in **Table 9** an analysis of median percentile activity levels as classed by SNH *et al.* (2019) on a site wide basis across all three deployments found median activity levels for each species as follows:
  - High for common pipistrelles
  - Moderate/High for soprano pipistrelles
  - Moderate for Leisler's bats
  - Moderate/Low for *Myotis* species, Nathusius' pipistrelle, and brown long-eared bats
  - No species recorded was found to have Low median activity levels
- There was a decrease in recorded activity during the summer deployment for all bat species, with bat passes dropping by 38% from spring to summer and rising by 48% from summer to autumn.
- The highest levels of bat activity were noted at D.06 situated in an open plantation ride during the autumn deployment.
- While overall median activity for the majority of bat species was 'Moderate' or 'Moderate/Low', the maximum percentile values in **Table 10** and **Table 11** show that with the exception of Nathusius' pipistrelles all species exhibited nights of high median activity levels. Nathusius' pipistrelles on their 2 nights of highest activity on this site reached activity level classed as 'Moderate/High'.
- Bat activity was recorded within the survey area for a variety of species with common pipistrelle, soprano pipistrelle, Leisler's bat and to a lesser extent brown long-eared bat, Nathusius' pipistrelle and *Myotis* species being represented in the results.
- The majority of bat activity within the Wind Farm Site was produced by common and soprano pipistrelles and associated with edge of forestry plantations, treelines and shrub.
- D.02, D.03, D.04, D.05, D.06, D.07, D.10 and D.11 are all placed in proximity to linear features such as treelines (**Figure 4**). An important comparison is to be made between D.08 and D.11 which were only approximately 98 metres apart but experienced wide differences in terms of activity levels. The overall low activity at D.08 (98m from feature) and the generally high activity at D.11 (placed at the linear feature) illustrates the potential reduction in bat activity that can be achieved with an adequate turbine buffer and limiting collision risk.
- A summary of monthly activity levels according to Kepel *et al.* (2011) given in **Table 13**.

Table 13 – Summary of bat passes per hour entire survey seasons
(green – Low, gold – Medium, brown – High)

Deployment	Leisler's bat	Soprano pipistrelle	Common pipistrelle	Nathusius' pipistrelle	*Pipistrelle* species	*Myotis* species	Brown long-eared bat	Total
Spring May/Jun 2020 (n = 1534 hrs)	4144 **2.7 bp/h**	3727 **2.73 bp/h**	25091 **16.35 bp/h**	125 **0.08 bp/h**	0 **0.00 bp/h**	646 **0.42 bp/h**	106 **0.07 bp/h**	33850 **22.06 bp/h**
Summer Jun/Jul 2020 (n = 1413 hrs**)**	1066 **0.75 bp/h**	5492 **3.89 bp/h**	13058 **9.24 bp/h**	0 **0.00 bp/h**	961 **0.68 bp/h**	298 **0.21 bp/h**	153 **0.11 bp/h**	21030 **14.88 bp/h**
Autumn Aug/Sep 2020 (n = 1443 hrs)	1075 **0.75 bp/h**	20059 **13.91 bp/h**	21587 **14.96 bp/h**	2 **0.00 bp/h**	1 **0.00 bp/h**	410 **0.28 bp/h**	95 **0.07 bp/h**	43229 **29.97 bp/h**
Total (n = 4390 hrs)	6286 **1.43 bp/h**	29278 **6.67 bp/h**	59736 **13.6 bp/h**	127 **0.03 bp/h**	962 **0.21 bp/h**	1354 **0.31 bp/h**	354 **0.08 bp/h**	98109 **22.34 bp/h**

4.3 Species activity within the Wind Farm Site

During the 2020 season, bat activity was recorded within the survey area for a minimum of six species, including common pipistrelle, soprano pipistrelle, Leisler's bat, *Myotis* species, brown long-eared bat and Nathusius' pipistrelle. The majority of bat activity was attributed to soprano pipistrelle, common pipistrelle and Leisler's bat. Soprano and common pipistrelles were recorded in all months during transect and static surveys and were the most commonly encountered species for static surveys during all of the seasonal deployments.

4.3.1 Pipistrelle species

Common and soprano pipistrelles were recorded throughout the survey area and in all deployments in 2020. For these two dominant pipistrelle species the highest levels of activity were detected at D.04 during the spring deployment, D.06 during the summer deployment and D.07 during the autumn deployment. The results of the static and transect data show that both common and soprano pipistrelles were strongly associated with the edge of forestry plantations, treelines and shrub.

The occurrence of common pipistrelle bats was higher than that of soprano pipistrelles in both the spring and summer deployments. Over the autumn there was greater parity between activity levels for common and soprano pipistrelles. The only detector location to record consistently 'Low' activity levels across all deployments were D.01 and D.03. The 'Low' activity at D.01 was considered a result of the deployments locations in an open field. The 'Low' activity recorded at D.03, located at the end of a linear feature, was likely to be the result of poor connectivity to habitats associated with bats (**Figure 4**). In contrast the treeline on which D.04 was located is a linear feature that exhibits strong connectivity to the surrounding habitats and showed consistent 'High' levels of pipistrelle activity.

On a site wide basis across all the seasonal deployments, common pipistrelle median percentile activity levels were classified as 'High' (83), while soprano pipistrelle median percentile activity levels were classified as 'Moderate/High' (70) (see **Table 9)**. However, examination of specific pipistrelle 'hotspots' within the Wind Farm Site found that many detector locations, including: D.02, D.04, D.06, D.07, D.09 and D.10 experienced activity in the 90 percentile or higher. It is also worth noting that in autumn, the maximum median percentile recorded in relation to a single night of activity recorded for soprano pipistrelles at D.04 and D.07 was 100. Full data is provided in **Table 11**.

According to Lundy *et al.* (2010) Nathusius' pipistrelles are potentially experiencing increased availability of suitable habitats and therefore the species' range throughout Europe may be expanding. The range of Nathusius' pipistrelles is influenced by their positive association to high average minimum temperatures, urbanisation, waterbodies, the absence of peat/heathland and woodland, in this order of importance.

Nathusius' pipistrelle bat activity recorded during static detector surveys was 'Low', with only 125 passes recorded throughout the three seasonal deployments, all of which were recorded during the spring deployment, with the exception of 2 passes recorded in autumn (**Table 9**). There were spikes in activity during the spring deployment with two nights of 'Moderate/High' activity (**Table 10**). The highest levels of activity occurred at D.04, D.05 and D.09. These detectors were all aligned along a strongly connected habitat features containing natural woodland and a bog lake (**Figure 4**). The absence of this species over the summer deployment and near absence in the autumn deployments is likely to be the result of the migratory pattern exhibited by Nathusius' pipistrelles, which involves migration to Western Europe in autumn and winter and migration to Eastern Europe in late spring (Russ 2001[13]).

The continuously recording static detector, with a microphone deployed at height on the temporary met mast, recorded 1,376 pipistrelle passes at 2m) compared to 164 at 50m. A higher number of common pipistrelles than soprano pipistrelles were recorded at 2m and at 50m height (common pipistrelle passes at 50m comprised 19.5% of the recorded passes at that location for the species, while soprano pipistrelle passes at 50m comprised 3.9% of the recorded passes at that location for the species. This implies that common pipistrelles are more likely to fly at rotor height. The relationship of the activity at 50m to weather conditions, turbine rotor operation, and potential collision, has been explored in **Section 3.5.3** and **Section 3.5.4**.

4.3.2 Leisler's bat

The third most commonly recorded species, after common and soprano pipistrelles, during all seasonal deployments was Leisler's bat. Registrations of Leisler's bats were higher during the spring deployment (28.48bp/h across all detectors). Unlike pipistrelles, Leisler's bat activity was not influenced as heavily by the presence of linear features, being recorded at 'Low', but consistent rates across all detectors with the exceptions of 'Medium' and 'High' activity at D.05 and D.09 in spring and 'Medium' activity at D.09 during summer. Units deployed at D.09 located within the bog woodland leading to the lake recorded the highest levels of Leisler's activity during the spring and summer deployments, but was surpassed by D.08 during the autumn deployment. The 'High' activity at D.09 during the spring and summer relative to autumn is likely to be a result of increased insect activity at the bog lake habitat making it an attractive foraging habitat.

'High' median activity levels were documented once for Leisler's bats, at D.09 during the spring. 'Moderate/High' levels of Leisler's bat activity were recorded at D.04, D.05, and D.10 during the spring, at D.09 during summer and at D.04 during autumn. Levels of Leisler's bat activity during transects was relatively low.

The continuously recording static detector with a microphone deployed at height recorded similar levels of Leisler's flying at height (50m) and at 2m (1,074 and 904 passes respectively). This highlights the higher level of potential collision risk for this species. The relationship of the activity at 50m to weather conditions, turbine rotor operation, and potential collision, has been explored in **Section 3.5.2**.

4.3.3 Myotis species

Bat passes per hour (bp/h) recorded for *Myotis* species during static detector surveys was classified as 'Low' at all deployment locations and across all deployment seasons. Summer and autumn *Myotis* species activity levels were a similar (< 2.5 bp/h for all statics). *Myotis* species activity across all detectors was at its highest level during the spring deployment (4.48 bp/h). There was a total of 739 bat passes recorded during all static detector surveys and no passes recorded during transect surveys. Although the bp/h activity levels were classed as low throughout the survey period for

13 Russ, J.M., Hutson, A.M., Montgomery, W.I., Racey, P.A. and Speakman, J.R., (2001.) The status of Nathusius' pipistrelle (Pipistrellus nathusii Keyserling & Blasius, 1839) in the British Isles. Journal of Zoology, 254(1), pp.91-100.

Myotis species activity levels were slightly higher at D.04 and D.05 during the spring; and at D.07 during the summer; and at D.04, D.07 and D.10 during the autumn.

In terms of median activity levels, D.07 recorded a median activity level of 'Moderate/High' for *Myotis* species during the summer. This slightly higher activity level documented on more than one occasion is likely to be due to the proximity to a drainage ditch to the north which would provide good foraging habitat for *Myotis* species

During the 2020 bat survey season, *Myotis* species were recorded throughout the Wind Farm Site in small numbers at all the turbine locations.

4.3.4 Brown long-eared bat

It is acknowledged that accurately monitoring brown long-eared activity can prove quite difficult as this species is known to make low amplitude calls and frequently forage using their eyes or ears rather than echolocation (Collins 2016[14]; Russ 2012). As a result, brown long-eared bats are frequently underrepresented in surveys which rely on the use of bat detectors.

Activity levels recorded for brown long-eared bat were the second lowest for all the bat species occurring within the Wind Farm Site (after Nathusius' pipistrelle), with no bat passes recorded during transect surveys and only a total of 184 bat passes recorded over the three 2020 seasonal deployments.

However, it is important to note these findings suggest that they can occasionally be active at a height of 50m as detected by the static unit deploying a microphone at height (**Figure 23**). Though brown long-eared bat activity was detected at height, it was at very low levels with only three calls being recorded, two of these calls occurred within a one-minute window and are therefore likely to have originated from the same individual bat. The third call occurred at a separate time and date. While the recording of three call registrations constitutes a very low level of activity, it is important to highlight this behaviour, as it demonstrates brown long-eared bats behaving contrary to the species' documented foraging and commuting patterns. It is unlikely that this level of activity within the collision risk zone would heighten the level of collision risk for this species.

Levels of brown long-eared bat activity remained 'Low', but consistent across all detectors on all seasonal deployments, with a slight decrease in activity during the autumn deployment. D.05 detected the highest levels of activity in spring (0.46 bp/h). D.04, which was deployed in similar surroundings and in relatively close proximity to D.05, recorded the highest levels of activity in summer (0.48 bp/h). In autumn the highest level of brown long-eared bat activity was recorded at D.02 (0.24 bp/h).

On a site-wide basis, brown long-eared bat median activity was assessed to be 'Moderate/Low'. However, the slightly higher level of activity at D.04 was classified as 'Moderate/High' upon analysis of the median activity percentiles. D.04 is positioned on a treeline with high connectivity to broadleaf woodland to the south and southwest; and is likely to provide high commuting and foraging value to brown long-eared bats.

14 Collins, J. (ed.) (2016) Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn). The Bat Conservation Trust, London. ISBN-13 978-1-872745-96-1

4.4 Bat activity associated with proposed turbine locations

Table 12 shows the static detector results for all units deployed over the in 2020 active bat season, including by species and aggregated totals. In compliance with the SNH *et al*. (2019) guidelines, static detectors were deployed at or adjacent to all turbine locations on three occasion during the active bat season. These results are summarised in **Table 14** below.

The results show that the majority of static deployments recording 'High' or 'Medium' (as per Kepel *et al.*, 2011) are shown in **Table 14**, with levels of for total aggregated bp/h activity classed as 'Low' only being detected at D.08 during the spring deployment, D.01, D.05, D.11 and D.08 for the summer deployment and D.01, and D.09 for the autumn deployment.

Table 14 – Summary of bat activity recorded by static detectors in 2020
Colour coded to reflect activity levels (blue – technical issue, green – Low, gold – Medium, brown – High), as per Kepel *et al.* (2011)
*NOTE: For D.06 in autumn data shown was collected over 5 nights

Survey season	Detector	Total Bat Passes	Passes- bp/h
Spring	D.01	0	0.00
	D.02	1,201	10.13
	D.03	2	0.01
	D.04	7,271	48.16
	D.05	5,508	36.49
	D.06	4,248	45.11
	D.07	0	0.00
	D.10	4,494	29.77
	D.11	2,026	15.99
	D.08	209	1.51
	D.09	8,891	58.90
Summer	D.01	519	4.02
	D.02	5,356	44.74
	D.03	624	4.83
	D.04	1,770	13.70
	D.05	41	0.32
	D.06	6,852	56.33
	D.07	2,511	27.29
	D.10	1,691	13.08
	D.11	368	2.85
	D.08	73	0.56
	D.09	1,225	9.48
Autumn	D.01	185	1.09
	D.02	2,289	18.19
	D.03	1,153	6.82
	D.04	9,718	57.46
	D.05	5,946	45.37
	D.06	5,658	123.69
	D.07	9,302	72.56
	D.10	5,802	44.69
	D.11	1,195	10.55
	D.08	1,762	10.42
	D.09	219	1.46

4.4.1 Bat activity at T1

The main factor determining bat activity recorded within the Wind Farm Site is considered to be strongly correlated with proximity of deployment locations to habitat features. The unit deployed to cover T1 was placed in an open arable crop field at the map ID D.01, approximately 190 m from the nearest habitat feature. This detector provides a good frame of reference for the levels of activity to be expected in the absence of features and plantation woodland. The detector at D.01 recorded 'Medium' aggregated bat activity in summer and 'Low' activity in autumn (**Table 12**). Although the spring deployment covering T1 failed, the context detector D.08 was in a very similar habitat setting, being located in an open field of improved grassland *c*. 98 m from the nearest habitat feature. D.08 recorded 'Low' activity levels for spring and summer; but recorded much higher activity levels in autumn. Based on similar open habitat characteristics, it is considered that spring bat activity at T1 would be line with the low levels of activity recorded at D.08.

It has been documented that soprano pipistrelles, Leisler's bat and Nathusius' pipistrelle are not as active around linear features from July to October as they are from April to June, which is likely to be as a result of migration and changing seasonal food sources (Kelm *et al.* 2014[15]). However, Kelm *et al.* (2014) did not document this behaviour in common pipistrelles. An autumn increase in activity was not detected at D.01 (as was seen at D.08 and D.12 at ground level) and is considered to be linked to the more open landscape surrounding D.01 and therefore likely to offer poorer foraging opportunities for bats.

D.01 recorded a bat activity classed as 'Medium' (Kepel *et al*., 2011) during the summer. This trend was driven by common pipistrelle activity with their median activity percentile being the most active species at this location, classed as 'High/Moderate' for the summer period. However, relative to the other proposed turbine locations, this deployment location generated the third lowest total bp/h activity for the summer deployment.

4.4.2 Bat activity at T2 and T3

Both detectors D.02 and D.03 were placed 120 m and 288 m respectively from proposed turbine locations T2 and T3. They were both placed along linear features which were separating arable crop fields, while the proposed detector locations were within the adjacent open fields. Though these detectors were placed in similar habitats D.02 recorded 'High' levels of activity for all three deployments, while D.03 recorded 'Medium' levels of activity for the two deployments on which it was active, summer and autumn.

The difference in bat activity measured between these two detectors is likely a result of the different levels of connectivity to other treelines and woodlands. The hedgerow on which D.03 was positioned is quite isolated from any other habitat features (**Figure 4**). In contrast the bank/hedgerow/open treeline on which D.02 was located was strongly connected to nearby woodlands; and in particular to two treelines assessed to be of moderate/low roost potential, both of which were within 300m ZoI from T2 (**Figure 1** and **Figure 5**). The emergence and re-entry survey conducted along these treelines in Aug-2002, recorded high levels of activity (**Figure 7**), and it is considered that bats potentially commuting from roosts along the hedgerow/treeline on which D.02 was deployed may contribute to activity at this location.

Given that the proposed turbine location for T2 and T3 are some distance away from the habitat features on which D.02 and D.03 were positioned; 'Medium' and 'High' activity levels are considered unlikely to be representative of the levels of bat activity that the more open location of the proposed turbine would generate. The lower activity recorded by D.01 and D.08 are likely to provide a more accurate representation of bat activity at T2 and T3, as they are in fields and are also an approximate

15 Kelm, D.H., Lenski, J., Kelm, V., Toelch, U. and Dziock, F., 2014. Seasonal bat activity in relation to distance to hedgerows in an agricultural landscape in central Europe and implications for wind energy development. *Acta Chiropterologica*, *16*(1), pp.65-73

distance of 100-200m from the nearest habitat feature. Both of these detectors recorded much lower activity. However, unlike D.01, D.08 experienced a surge in activity in autumn (classified as 'High') which could be a result of being slightly closer to a linear feature than D.01.

4.4.3 Bat activity at T4

D.04 was positioned within 53m of the proposed location of T4. D.04 recorded 'High' activity levels for all three deployments (**Table 11**, **Table 12**). Though the proposed turbine location is in an area of young ash plantation, which was considered to offer limited foraging opportunities for bats, the surrounding treelines are potentially of high value to commuting bats. This is supported by the neighbouring static location (D.09) also recording 'High' levels of bp/h activity in spring and 'Medium' levels of bp/h activity in summer.

The habitat features of treelines and a bog pool which are in close proximity of D.09 provide good foraging conditions for bats and this is reflected in the measured activity levels. The treelines surrounding the proposed location of T4 provide connectivity of broadleaf woodland to the south and west of its location, and to the bog pool and its surrounding woodland to its east. Though the mature beech tree to the west of D.04's location was assessed to have high roost potential, an emergence and re-entry survey found it not to comprise a roost. However, an analysis of species-specific emergence times does suggest that there may be potential common pipistrelle, soprano pipistrelle and Leisler's bat roosts in the wider area (see **Figure 11**).

4.4.4 Bat activity at T5

D.05 was located on a treeline separating a conifer plantation from a field of improved grassland. The proposed location of T5 is 58m to the south of D.05 in the middle of the conifer plantation. The reason D.05 recorded some of the highest levels of activity in spring and autumn is a result of this conifer plantation being surrounded to the west, south and east by broadleaf woodland and also has two broadleaf, scrubby treelines running through the area (refer to **Table 3**). Emergence times suggest the proximity of a soprano roost in spring (see **Figure 10**) and a soprano and common pipistrelle roost in autumn (see **Figure 12**).

Given that the conifer plantation, with the two broadleaf treelines within it, is a proposed area for felling, the bat activity is not representative of the situation that will exist when the proposed turbines are constructed. The best representative for bat activity in this area (post-felling) is likely to be D.08, which experienced very 'Low' levels of bat activity in spring and summer, though this detector did record a surge in 'High' activity for autumn (**Table 12**). However, D.08 is not a perfect analogue as the proposed felling area of conifer plantation, in some cases, does not create a uniform buffer from the turbine in all directions as large as 98m (D.08's distance from a linear feature). Using D.08 as an analogue also informs that activity levels will likely remain high in autumn regardless of the open area created through felling.

4.4.5 Bat activity at T6 and T7

D.06 was the location which recorded the highest levels of bat activity for summer and autumn (even though it only recorded for half the duration of the autumn deployment). It was the location of the third highest bat activity during spring. A possible reason this location showed such high levels of activity is that the linear gap in conifer plantation created by the forestry ride. The evidence from this survey suggests this habitat provided a highly valuable foraging area for bats, particularly common and soprano pipistrelles. Though outside 300m ZoI the treeline to the southwest of the proposed turbine location for T6 could have been a potential driver in the high activity levels recorded by D.06. Though roost surveys found that there were potential roosts within 300m of the proposed location of T6, the species-specific emergence times recorded by D.06 suggest that there may be potential Leisler's bat roost(s) in the wider area (see **Figure 10** and **Figure 11**). The call emergence times of common and soprano pipistrelles also suggest a potential roost in the wider area (see **Figure 10**, **Figure 11**, **Figure 12**). Evidence from the transect surveys suggest a there is a likely active roost within the 'T' shaped treeline some 290m to the southwest of D.06 (and 355m southwest of the proposed T6 location), in particular during the autumn transect survey (see **Figure 7** and **Figure 9**). It is likely that emergence from a roost in this area to forage in the forestry ride near D.06 is producing the trend of early emergence times and activity at D.06.

D.07 was located in a very similar location to D.06 and also recorded very high levels of activity. However, the emergence times recorded for D.07 do not suggest many species roosting nearby, with the exception of a potential soprano pipistrelle roost being nearby during the autumn deployment (see **Figure 12**)

It is worth noting that the Ecobat median activity percentiles for common pipistrelle and soprano pipistrelle in autumn at D.06 were 98 and 99 respectively (**Table 11**). This places the activity levels seen at this location in the top 2% and top 1% activity levels for each of these species documented within 200km of their respective locations and during similar times of the year on Ecobats database. For D.07 in autumn the median activity percentiles recorded for common and soprano pipistrelles were 93 and 98 respectively. However, as mentioned in **Section 1.5.4** these figures represent potentially inflated numbers as a result of thorough species identification in noise files and external influences of the Ecobat analysis software.

Both of these static detectors are located in forestry rides within conifer plantations, which are areas of proposed felling and as such does not represent the habitat that will be in place once the turbine at T6 has been erected, due to the need for key-holing. It is likely that the closest analogue to D.06 and D.07 in terms of distance to a linear feature will be D.08, which recorded very ‘Low’ bat activity during spring and summer and ‘High’ activity in autumn. However, D.08 is not a perfect analogue as the proposed felling area of conifer plantation in some cases does not create a uniform buffer from the turbine in all directions as large as 98m (D.08’s distance from a linear feature). Using D.08 as an analogue also informs that activity levels will likely remain high in autumn regardless of the open area created through felling.

4.4.6 Bat activity at T10

The detector location for D.10 was 127m to the northeast from the proposed location for T10. It was also placed in an area of conifer plantation which was in the process of being felled over the duration of this survey period. Though all deployments recorded ‘High’ bp/h levels there is an increase from spring to summer and a further increase from summer to autumn. The woodland adjacent to this clearing was classed as a bog woodland. The broadleaf treeline created through the felling of this conifer plantation provided a linear feature of high potential for foraging bats. This was reflected in the ‘High’ activity levels seen for total bat species bp/h (**Table 12**). The presence of a nearby stream to the north of D.10 also contributed to the ‘High’ activity levels acting as a strong commuting and foraging feature.

During spring activity for Leisler’s bat in this location was classed to be in a ‘Moderate/High’ percentile standing out from the site-wide evaluation that Leisler’s bat activity was classed as ‘Moderate’. Common pipistrelle and soprano pipistrelle activity were classed as high in autumn with their activity being in the 95 and 92 percentiles respectively (**Table 11**). The ongoing felling was a likely driver in the increased activity levels seen in autumn, as the removal of conifer woodland created strong linear features for foraging bats along the periphery of the surrounding bog woodland.

4.4.7 Bat activity at T11

Bat activity in terms of bp/h was classed as ‘High’ in spring and autumn and ‘Low’ in summer for D.11 (**Table 12**). Common pipistrelles were recorded to have activity in a ‘Moderate/High’ percentile level for spring and summer and a ‘High’ percentile level in autumn. This trend is not unique to this location and marks an overall seasonal trend in bat activity. Though only 98m to the west of D.11, D.08 recorded much lower activity than D.11 in spring and summer and almost the same levels of activity in autumn. The ‘High’ activity in autumn at D.08 is potentially driven by the documented lower reliance of some bat species on linear features in the July – October period (Kelm *et al.* 2014).

Given that the conifer plantation along which D.11 was placed is an area of proposed felling the recorded activity does not represent the situation that will exist post-felling. Activity levels recorded at D.08 provide some context for what to expect in this situation. However, as was the case with T6 and T7, D.08 is not a perfect analogue for bat activity levels post-felling, as current proposed felling plans are not forming a uniform buffer of similar distance to that of D.08 to a linear feature. Using D.08 as an analogue for post felling conditions also highlights that activity levels will likely remain high in autumn regardless of the open area created through felling.

4.5 Association of bat activity with features

The results of both transect and static surveys conducted in 2020 and 2021 clearly show the strong association between bat passes and habitat features (**Figure 13**; **Figure 16**; **Figure 19**). For the 2020 static surveys, single units were deployed to monitor bat activity at turbine locations. Units deployed along forestry edges (such as D.04), which were strong habitat features within the site, recorded significantly higher levels of bat activity whereas the other units were deployed to cover turbines in relatively open habitats, (such as D.01) recorded significantly lower levels of bat activity. For the most part, the majority of statice locations which saw consistent ‘Moderate/High’ and ‘High’ activity levels were those mentioned in **Section 1.5.1** as being either along linear features such as treelines or along edge features such as the interface of conifer to native woodland and conifer plantation to open field (**Table 11**).

The emergence and transect surveys conducted on 10-May-2021, while not recording the presence of any roosts recorded the use of broadleaf treelines for commuting bats, as detailed in **Section 3.2.1**.

Possibly the best example of the preferences shown by bats for habitat features versus open habitat; as paired units, D.08 and D.11 were deployed at T11, with one covering a feature and the other covering the adjacent open area. D.08 was 98m from the feature while D.11 was placed on the feature. With the exception of autumn there is a clear difference in activity levels between these two detectors (**Table 12**). The context detector D.09 also clarifies the relationship between linear features, seasonality and bat activity. D.09 saw the highest level of common pipistrelle activity and the highest overall activity in spring (**Table 12**) likely as a result of its position along a commuting path to the high-quality foraging area of the bog pool. It also saw a sharp decrease in activity from spring to summer to autumn.

Given the contrasting patterns seen at D.08 and D.09, bats, particularly pipistrelles, become less reliant on linear features and will forage in the open. However, the increase in pipistrelle activity in open habitats in autumn is not uniform across the site. While activity at D.08 increased it decreased at D.01 and the D.12 ground level detector (**Figure 28**). The difference in activity levels based on proximity to linear features is of particular importance given that the majority of detectors on this site were placed along features.

While the data presented shows high levels of activity, it is important to note that the baseline data for bat activity on the site is heavily influenced by linear features at which activity was recorded. The baselines at the three detectors which were not placed along linear features provide an insight into the activity levels which are likely to be emulated following felling around the turbines, and potential removal of linear features and replacement of them outside the turbine risk zone.

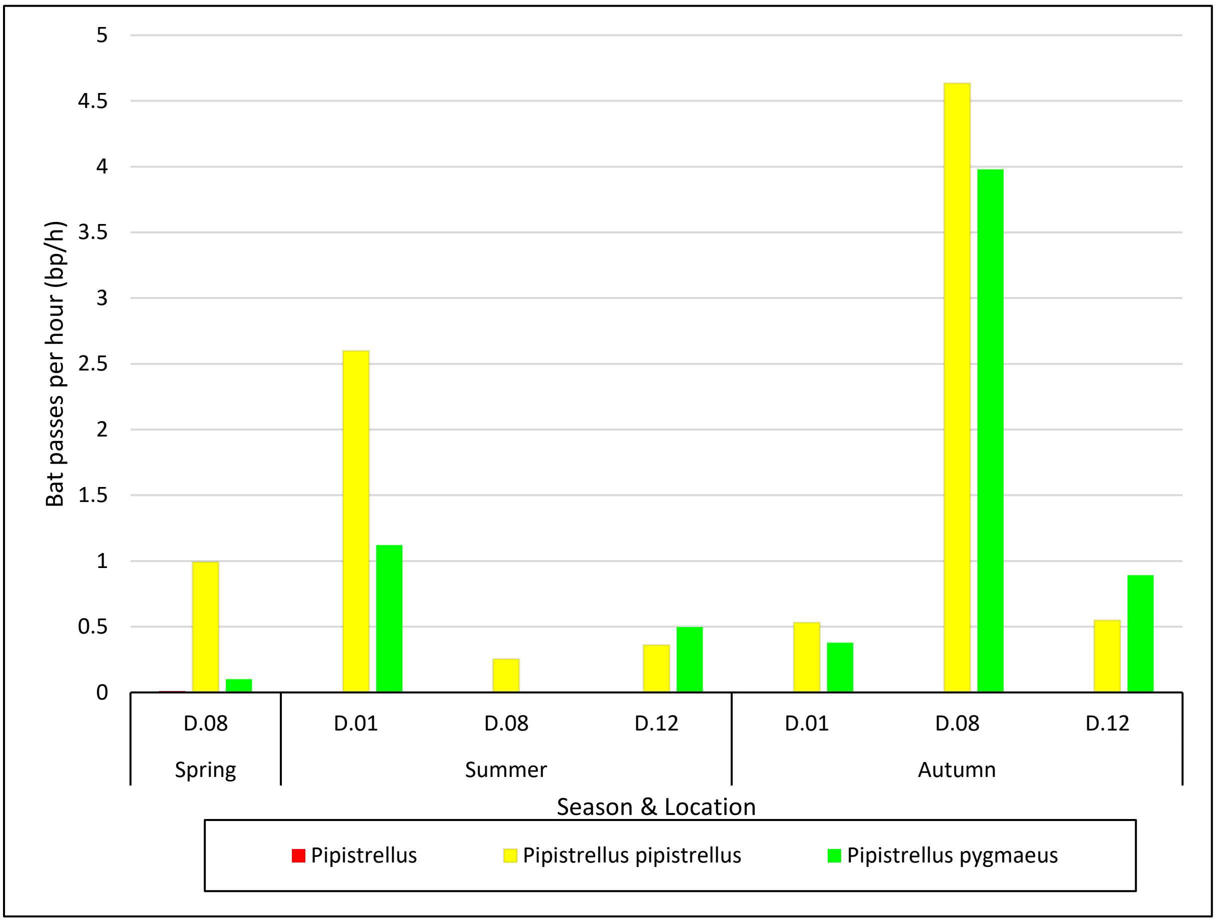


Figure 28 - Pipistrelle spp. activity levels at the three detectors not positioned on linear features

5 ASSESSMENT OF POTENTIAL IMPACTS

5.1 Ecological evaluation of bat species

Bats are protected by law in the Republic of Ireland under the Wildlife Act 1976 and subsequent amendments (2000 and 2010). Under the Wildlife Act, it is an offence to intentionally disturb, injure or kill a bat or disturb its resting place. Under this legislation it is unlawful to destroy, alter or disturb known bat roosts without an appropriate derogation licence, as issued by the National Parks and Wildlife Service (NPWS).

All bat species fall under Annex IV of the EU Habitats Directive (1992), whereby member states have a burden of responsibility to protect bats and their resting places wherever they occur. The EU Habitats Directive has been transposed into Irish law with the European Communities (Birds and Natural Habitats) Regulations 2011. In order to comply with the requirements of these regulations wind farm applications in Ireland need to be assessed as to their potential impact on bat populations.

In order to undertake an assessment of the potential impact of the proposal on bats, it is important to take into account not only what bat species and numbers are present on the site, but also how susceptible those species are to impacts from wind turbines and how susceptible populations of the species occurring are to the impacts in an Irish context.

SNH *et al*. (2019) provides guidelines for conducting risk assessment for bat species occurring on wind farms; however, it is not fully clear how the assessment methodology relates to Irish bat populations. Therefore, the assessment of the Bracklyn Wind Farm Site draws on several sources to emulate the SNH guidance, including Marnell *et al.* (2009)[16] and Wray *et al*. (2010)[17] for the bat population assessments in Ireland (see **Table 15**). For collision risk of bat species to wind turbines, (see **Table 16**) SNH *et al*. (2019) is used, which updates previous species risk assessment published in Natural England (NE, 2014)[18].

As listed in **Table 15**, on an all-Ireland basis, Leisler's bats are considered to be *Near Threatened*, while all other species are categorised as *Least Concern* (Marnell *et al.*, 2009).

As shown in **Table 16**, Leisler's bats and Nathusius' pipistrelles are considered as *high risk* of direct impacts from with wind turbines, as they regularly fly in the open and at heights, which may put them at risk of collision or barotrauma from turbines. The SNH *et al*. (2019) guidelines consider both common and soprano pipistrelles to be at *high risk* of direct impacts from wind turbines; based on a study investigating bat collisions at Wind Farm Sites across the UK (Mathews *et al*, 2016), which found both these species to be amongst the most commonly recorded casualties during searches of turbines. The SNH *et al*. (2019) guidelines update Natural England guidance, which had classified common and soprano pipistrelle as *medium risk* species (NE, 2014), based on flight behaviours of common and soprano pipistrelles that habitually fly low and close to landscape features, such as hedgerows. *Myotis* species and brown long-eared bats are considered as *low risk* based on behaviour and foraging techniques of these species.

Based on population status in Ireland and risk level in relation to adverse interactions with turbines, it is important to ascertain, which bat populations may be threatened due to impacts from wind turbines, and this assessment is shown in **Table 17**. On the basis of this information, it is clear that particular attention should be paid to Leisler's bats and Nathusius' pipistrelles, which are believed to be

16 Marnell, F., Kingston, N. & Looney, D. (2009). *Ireland Red List No. 3: Terrestrial Mammals*, National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.

17 Wray, S., Wells, D., Long, E. & Mitchell-Jones, T. (2010) *Framework for valuing bats in Ecological Impact Assessment*, CIEEM journal. Edition 70. Pg. 23 – 25. December 2010.

18 Natural England (2014). *Bats and onshore wind turbines*: *Interim Guidance* 3rd Ed. Natural England Technical Information Note TIN051, Natural England, Peterborough.

susceptible to impacts from wind turbines and have populations of *high population vulnerability*, in the context of wind turbine developments in Ireland. Leisler's bats are generally considered to forage habitually at height in more open landscapes and are less associated with habitat features than other bat species. Nathusius' pipistrelles are known to be migratory and may fly at height during migration. For this assessment we adhere to SNH *et al*. (2019) guidance, under which common and soprano pipistrelles are considered to have *medium population vulnerability* to wind farm developments in Ireland due to behaviour in relation to turbines. Whiskered bats are also classed as *moderately vulnerable*, due scarcity in Ireland. Brown long-eared bats and the two other Irish *Myotis* species (Daubenton's bat and Natterer's bat) are considered to have *low vulnerability* to wind farm developments in Ireland.

Table 15 – Conservation status of bat species in Ireland (Marnell *et al*. 2009)

Species	Rarity in Ireland Wray *et al*. (2010)	Irish status (Marnell *et al*., 2009)
Daubenton's bat *Myotis daubentonii*	Rarer (Frequent/widespread)	Least concern
Whiskered bat *Myotis mystacinus*	Rarest (Scarce/widespread)	Least concern
Natterer's bat *Myotis nattereri*	Rarer (Scarce/widespread)	Least concern
Leisler's bat *Nyctalus leisleri*	Rarer (Frequent/widespread)	Near threatened
Common pipistrelle *Pipistrellus pipistrellus*	Common (Widespread)	Least concern
Soprano pipistrelle *Pipistrellus pygmaeus*	Common (Widespread)	Least concern
Nathusius'pipistrelle *Pipistrellus nathusii*	Rarer (Rare/restricted)	Least concern
Brown long-eared bat *Plecotus auritus*	Rarer (Frequent/widespread)	Least concern

Table 16 – Level of collision risk to individual bats from wind turbines
Sources: Adapted from Natural England (2014) & SNH *et al*. (2019)

Collision risk		
Low risk	**Medium risk**	**High risk**
Myotis species Brown long-eared bat	Common pipistrelle (NE, 2014) Soprano pipistrelle (NE, 2014)	Leisler's bat Nathusius' pipistrelle Common pipistrelle (SNH, 2019) Soprano pipistrelle (SNH, 2019)

Table 17 – Level of potential vulnerability of bat populations in Ireland
Sources: Adapted from Wray *et al*. (2010), Natural England (2014) & SNH *et al*. (2019)
Population vulnerability: Yellow = ***low*** Beige = ***medium*** Red = ***high***

Ireland		Collision risk		
		Low risk	Medium risk	High risk
Relative abundance	**Common species**		Common pipistrelle Soprano pipistrelle (**NE, 2014**)	Common pipistrelle Soprano pipistrelle (**SNH *et al*., 2019**)
	Rarer species	Daubenton's bat Natterer's bat Brown long-eared bat		Leisler's bat Nathusius' pipistrelle
	Rarest species	Whiskered bat		

5.2 Valuing bat populations

The nature conservation value of a receptor is based upon a geographic hierarchy of importance. The following categories are used to inform the assessment of impacts:

International: sites, habitats and species populations of international or European importance;

National: sites, habitats & species populations of national importance;

Regional: sites, habitats & species populations of importance in a regional (NW) context;

County: sites, habitats & species populations of importance in a county context;

Local: sites, habitats & species populations of importance in a parish or district context;

Low: sites, habitats & species populations of less than local importance, still of some value.

Approaches to attributing nature conservation value to species have been developed for bats (see Wray *et al*. 2010). The approach to scoring foraging habitat and commuting features is summarised in **Table 18**.

Using the criteria set out in **Table 18** and based on the baseline data collected during surveys, it is considered that the study area scored:

- 4 for roosts/ potential roosts nearby
- 5 for foraging habitat characteristics
- The following for number of bats
  - 20 for number of bats for common pipistrelle and soprano pipistrelle
  - 10 to 20 for number of bats for Leisler's bat
  - 10 for number of bats for *Myotis* species, Nathusius' pipistrelle and brown long-eared bat

This equates to species specific scores of:

- 31 for common pipistrelles and soprano pipistrelles. This ranks the Wind Farm Site as holding foraging populations of these species that are of ***Regional Importance***.
- 24 to 34 for Leisler's bat. This ranks the Wind Farm Site as holding foraging populations of this species of ***County to Regional Importance***
- 24 for *Myotis* species (Daubenton's bat and Natterer's bat), Nathusius' pipistrelle and brown long-eared bats. This ranks the Wind Farm Site as being of ***County Importance***
- 39 for *Myotis* species (Whiskered bat if occurring*). This ranks the Wind Farm Site as being of ***Regional Importance***

  ***Note**: Whiskered bats are considered to occur locally in small numbers across Ireland and it is acknowledged that it is a species that can go undetected during surveys (McAney, 2006)[19]. There were no records received from BCI within 10-km of the site and there are no records for Co. Westmeath/Co. Meath published on NBDC Biodiversity Maps. The closest locations of Whiskered bat occurrence are over 20 km from the proposed development. The species could potentially occur on a site like Bracklyn Wind Farm; however, expected occurrence would be considered unlikely, and as the risk of collision for *Myotis* species is considered low further consideration is only given to this species within its Genus (i.e. as *Myotis* species).

  With the exception of Nathusius' pipistrelle (and whiskered bat if it occurred), the bat species recorded utilising the Wind Farm Site are generally considered common and widespread in an

19 McAney, K. (2006) A conservation plan for Irish vesper bats. Irish Wildlife Manuals, No. 20. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.

Irish context (Marnell *et al*., 2009 & Roche *et al*., 2014[20]). Taking into account the EU Annex IV protected status of bats, the bat assemblage is considered to represent a feature of ***Regional Importance***.

Table 18 – Scoring system for valuing sites and foraging areas/ commuting routes for bats

Score	Species	Score	Number of bats	Score	Roosts/ potential roosts nearby	Score	Foraging habitat characteristics / Type and complexity of linear features
2	Common	5	Individual bats	1	None	1	Site without established vegetation e.g. urban
						1	Absence of (other) linear features
				3	Small number	2	Suburban areas or intensive agriculture
						2	Unvegetated fences and large field sizes
5	Rarer	10	Small number	4	Moderate number or not known	3	Isolated woodland, less intensive agriculture etc
						3	Walls, with many gaps or flailed hedgerows, isolated well grown hedgerows, and moderate field sizes
				5	Large number or close to protected areas for bats	4	Large connected woodland blocks, mixed agriculture etc
						4	Well-grown and well-connected hedgerows, small field sizes)
20	Rarest	20	Large number	20	Close to or within SAC for bats	5	Mosaic of pasture, woodlands and wetlands
						5	Complex network of mature well-established hedgerows, small fields and rivers/streams

Importance	Score
International	> 50
National	41-50
Regional	31-40
County	21-30
Local	11-20
Not important	1-10

20 Roche, N., Aughney, T., Marnell, F. & Lundy, M. (2014). Irish Bats in the 21st Century. Bat Conservation Ireland. Cavan, Ireland

5.3 Risk Assessment

The following sections provide a preliminary assessment of the potential impacts on bats during two phases of the project, including construction phase impacts and operational phase impacts. The results of the definitive impact assessment will be provided within Chapter 5 (Biodiversity) of the Environmental Impact Assessment Report (EIAR) for the proposed development, which will also assess the potential impacts during a decommissioning phase.

The results from bat survey conducted over the active season of 2020 show a level of activity that would be expected at a site with connecting patches of scrub, small plantations, bog woodland, defunct hedgerows, broadleaf woodlands and treelines. An initial (Stage 1) potential risk assessment for the Bracklyn Wind Farm Site was carried out using the risk assessment matrix provided in SNH *et al*. (2019) – Table 3a. For habitat risk, *Moderate* was entered into the matrix as the Wind Farm Site was assessed to have:

- *Buildings trees or other structures with moderate-high potential as roost sites on or near the site.*
- *Habitat could be used extensively by foraging bats.*
- *Site is connected to the wider landscape by linear features such as scrub, tree lines and streams.*

For project size, the *Medium* category was selected as this is the best fits the proposed Bracklyn Wind Farm. These two parameters returned a site risk score of **3**, which is considered a ***medium site risk***.

The next of step of the risk assessment (Stage 2) uses a second matrix (Table 3b in SNH *et al*., 2019) to derive an overall risk assessment based on the activity level of high collision risk species, which in this instance are Leisler's bat, common pipistrelle, soprano pipistrelle, and Nathusius' pipistrelle. The Stage 2 **-** risk assessment matrix is reproduced in **Table 19** and for each of the four high collision risk species the activity score is multiplied by the site risk score, which as stated above was determined to be 3 – medium risk site. Active levels are derived from Ecobat; however, consideration is also given to activity levels derived from Kepel *et al*. (2011) and both are summarised in the following bullet points:

- Based on Kepel *et al*. (2011), activity recorded by the majority of static deployments was high on a site wide basis for common pipistrelle and soprano pipistrelle activity. Activity for Leisler's bat was low with occasional high activity at specific deployment locations during specific deployments. Activity for *Myotis* species, brown long-eared bats and Nathusius' bats was considered low throughout the survey.

- Based on the SNH *et al*. (2019) activity categories used to describe the percentile outputs generated by Ecobat, the overall levels of bat activity for the turbine location surveyed and across all three seasonal deployments in 2020 found ***high*** levels of activity for common pipistrelles, ***moderate/high*** levels of activity for soprano pipistrelles, ***moderate*** levels of activity for Leisler's bats and ***moderate/low*** levels for *Myotis species*, brown long-eared bats and Nathusius' pipistrelles. As detailed in **Table 10** and **Table 11** specific deployment locations in specific seasons and specific nights were flagged as generating high or moderate/ high levels of bat activity.

Table 19 – Stage 2: Overall risk assessment matrix
Source: SNH *et al*. (2019)

Potential site risk level	**Ecobat activity category** (or equivalent justified categorisation)					
	0 Nil	**1 Low**	**2 Low-moderate**	**3 Moderate**	**4 Moderate-high**	**5 High**
1 Lowest	0	1	2	3	4	5
2 Low	0	2	4	6	8	10
3 Medium	0	3	6	9	12	15
4 High	0	4	8	12	15	18
5 Highest	0	5	10	15	20	25

For **common pipistrelles**, categorised by Ecobat as having high activity levels, the Stage 2 risk assessment matrix returns a score of ***15 – high risk*****.**

For **soprano pipistrelles**, categorised by Ecobat as having moderate/high activity levels, the Stage 2 risk assessment matrix returns a score of ***12 – medium risk***.

For **Leisler's bat**, categorised by Ecobat as having moderate activity levels, the Stage 2 risk assessment returns a score of ***9 – medium risk***.

For **Nathusius' pipistrelles**, categorised by Ecobat as having moderate/low activity levels, the Stage 2 risk assessment returns a score of ***6 – medium risk***.

To account for seasonal or localised peaks in activity SNH *et al*. (2019) note the importance of also assessing the highest levels of activity recorded for each of the high collision risk species within the Wind Farm Site.

Common pipistrelles, **soprano pipistrelles** and **Leisler's bat** were all scored as having local and seasonal high activity levels, which returns a Stage 2 risk assessment matrix maximum score of 15 – high risk.

The outputs of the overall risk assessment are then considered in the context of any potential impacts at the population level for species assessed having high population vulnerability (see **Table 17**), which in Irish context are Leisler's bat and Nathusius' pipistrelle.

Table 20 provides a summary of bat population vulnerability to wind farm impacts (see **Table 17**), species activity recorded at the Bracklyn Wind Farm Site (low, medium, high based on Kepel *et al*., 2011 and high, moderate-high based on SNH *et al*., 2019) and the regional importance attached to bat populations found to occur at the Bracklyn Wind Farm Site (locally to internationally important based on Wray *et al*, 2010 – see **Table 18**).

Table 20 – Summary of impact assessment

Including bat population vulnerability to wind farm impacts, species activity recorded and the regional importance attached to bat populations found to occur at the Bracklyn Wind Farm Site

Species	Population vulnerability wind farms impacts	Activity levels at Bracklyn WF Based on Kepel *et al*. (2011) Range in bp/h is shown for all the static bat detectors deployed	Activity levels at Bracklyn WF Ecobat	Population Importance at Bracklyn WF (Scoring based on Wray *et al*., 2010)
Leisler's bat	**High**	**Low** at most turbine locations, except: High: D.09 in spr. Medium: T5 in spr. Medium: D.09 in sum. <u>Range of bat passes/ hour</u> 2020: 0.007 to 14.33 Abundance: Possibly occurring sporadically in moderate number	**Moderate** - Median Activity Levels **High** 36 of 215 nights **Moderate-high** 85 of 215 nights T4, T5, (spr)	County to Regional (24 to 34) **<u>Risk Assessment</u>** 9 to 15 Medium to High
Nathusius' pipistrelle	**High**	**Low** Notes: Sporadic - activity <u>Range of bat passes/ hour</u> 2020: 0.007 to 0.25 bp/h Abundance: Small numbers	**Moderate-low -** Median Activity Levels **Moderate/High** 2 of 32 nights **Moderate** 10/80 nights	County (24) **<u>Risk Assessment</u>** 6 Medium
Soprano pipistrelle	**Medium**	**High** at most turbine locations in aut **Medium** at most turbine locations in spr **Low** at most turbine locations in summer <u>Range of bat passes/ hour</u> 2020: 0.010 to 50.20 bp/h Abundance: Large number of bats with highly seasonal activity	**Moderate/High** - Median Activity Levels **High** 117 of 319 nights T2, T6 (sum) T2, T4, T5, T6, T7, T10 (aut) **Moderate-high** 89 of 319 nights T4, T5, T6, T9 (spr) T1, T4, T7 (sum) T2, T3, T4, T11 (aut)	Regional (31) **<u>Risk Assessment</u>** 12 to 15 High
Common pipistrelle	**Medium**	**High** at most turbine locations across all seasons: <u>Range of bat passes/ hour</u> 2020: 0.008 to 33.30 bp/h Abundance: Large number of bats	**High** - Median Activity Levels **High** 196 of 362 T5, T6, T10 (spr) T2, T4, T6, T7 (sum) T2, T3, T4, T5, T6, T7, T10 (aut) **Moderate-high** 69 of 362 nights T2, T11 (spr) T1, T3, T5, T10 (sum) T8 (aut)	Regional (31) **<u>Risk Assessment</u>** 15 Medium to High
***Myotis* species**	**Low**	**Low** <u>Range of bat passes/ hour</u> 2020: 0.015 to 2.03 bp/h Abundance: Small numbers (1 to 5 bats)	**Moderate-low -** Median Activity Levels **Moderate-high** 27 of 215 nights T7 (sum)	County to Regional (24 to 39) **<u>Risk Assessment</u>** N/A
Brown long-eared bat	**Low**	**Low** <u>Range of bat passes/ hour</u> 2020: 0.006 to 0.40 bp/h Abundance: Small numbers	**Moderate-low -** Median Activity Levels **High** 2 of 105 **Moderate-high** 3 of 105 nights T4 (sum)	County (24) **<u>Risk Assessment</u>** N/A

5.4 Impact on bats

Wind turbines and associated infrastructure present a number of potential impacts to bats, namely:

1. Damage of or disturbance to roost sites during construction
2. Loss or fragmentation of habitat
3. Collision with rotor blades and barotrauma
4. Displacement or disturbance of commuting or migration routes

The first two of these are most relevant to the construction phase of the project, while the latter two relate to potential impacts in the operational phase. The following sections provide an assessment of the potential impacts on bats during the two phases of the project, including construction phase impacts and operational phase impacts.

Overall, for the turbine location surveyed and across all three seasonal deployments the results from bat surveys conducted over the 2020 active season found that *Myotis* spp., brown long-eared bats and Nathusius' pipistrelles were active at low to moderate levels, Leisler's bats were active at moderate levels, soprano pipistrelles were active at moderate to high levels and common pipistrelles were active at high levels.

No hibernation or maternity roosts were identified within the turbine envelope; however, given the levels of activity and emergence time data within the survey area and the wooded nature of the area, roosts are considered likely to occur in the wider area. The activity data also suggests that there are high quality foraging areas along linear features such as the stream on site, tracks within the conifer plantations and along their interface with mature native woodland and clearings.

5.5 Construction phase: potential direct impacts on bats

In terms of the zone of influence for construction works, potential for direct effects to occur were assessed within 20m of the proposed site infrastructure, including temporary features (site compound, deposition areas) and for the grid connection route this was reduced to a 5m corridor along the route. This assessment area is referred to as the works/construction corridor within this report.

Loss of a roost site resulting from demolition or disturbance during construction would be considered as a significant negative impact of a proposed development. Potential direct impacts on bats resulting from wind farm construction include vegetation removal, resulting in a loss of potential roost sites in mature trees or the removal/modification to existing buildings on the Wind Farm Site. The potential for any vegetation/building removal or modification to impact on roost site along the grid connection route and at the substation also needs to be considered. The areas which have already been scheduled to be felled for these purposes are shown in **Appendix 2** and **Appendix 3**.

The assessment of low to negligible potential for roost sites within conifer plantation affected by vegetation clearance with the exception of T5, which was assessed to have two treelines of low to moderate roost potential within an area of proposed felling (**Figure 5**). Proposed felling is to consist of the following:

- The removal or surgery of broadleaf treelines for the construction of the access track
- The removal of conifer plantation to the southwest of T1 to create an entrance track
- The removal of the bank/hedgerow/ open treeline near T2
- The removal of semi-mature broadleaf treeline and conifer plantation at T5
- The removal of semi-mature broadleaf treeline and young ash plantation at T4
- The removal of conifer and mixed broadleaf plantation surrounding T6, T7, T10, and T11

Though roost surveys classed these conifer plantations as having low to negligible roost potential, Ecobat emergence time analysis suggests that there are potential roosts in the wider area surrounding D.04, D.05, D.06, D.07. Of these potential roosts, those in the wider area surrounding D.04 and D.06 could be maternity roosts if present. Given that the results of the roost surveys conducted concluded that roosting is limited to semi-mature to mature broadleaf, the felling conducted on conifer plantation and mixed broadleaf plantation is considered to have a negligible impact on bat roosts. The felling areas around T4 and T5 do contain broadleaf treelines. The broadleaf treeline within the felling area of T4 was classed as having low roost potential. The broadleaf treeline within the felling area for T5 contains two trees of moderate roost potential. While these trees do contain some suitable roost features, given our understanding of species composition within the site, and particularly those areas, in the event those treelines are in use, they are in use by the two most common species, common and soprano pipistrelles. Using Wray *et* al. 2010 to assess the value of roost types, the presence of any potential roosts within the felling areas are of ***Local*** importance. Therefore, the removal of these treelines in the absence of mitigation are considered to be ***Significant*** at the ***Local*** level.

5.6 Construction phase: potential secondary impacts on bats

Potential secondary impacts on bats resulting from construction works are limited to the loss of foraging and commuting habitats/features utilised by bats. Disturbance of roosting and foraging bats through lighting impacts was considered; however, it is understood that there will be no night-time working at the site and as such no additional lighting will be required during the construction phase of the works. In addition, the species utilising this site most – Leisler's bat, soprano pipistrelle and common pipistrelle – are less sensitive to light pollution than the less commonly recorded species – brown long-eared bats and *Myotis* species.

The proposed development site holds a number of defunct hedgerows, treelines, shelter belts and small patches of woodland that are known to be used by foraging and commuting bats. This survey shows that the linear features within conifer plantations are highly active foraging grounds for bats. Vegetation removal as a result of the proposed felling detailed in the previous section will also impact on bat foraging patterns within the site, particularly given the high levels of activity seen in these conifer plantations. However, currently felling plans within the site in many cases do not disrupt the continuation of linear features for commuting. The only location in which is the removal of treeline considered to disrupt connectivity within the site is the removal of broadleaf treeline at T4.

In the absence of mitigation, vegetation removal has the potential secondary impacts of the proposal upon bats are considered, without mitigation, to be ***Significant*** at the ***County*** scale.

5.7 Operational phase: Potential direct impacts on bats

Both direct collision with rotor blades and barotrauma (injuries to internal air cavities and blood vessels caused by sudden change in air pressure behind a moving blade), have been found to directly impacts bats (e.g. Cryan & Barclay, 2009,[21] Rydell *et al*., 2010,[22], Cryan *et al*. 2014,[23] & Mathews *et al*., 2016[24]). The evaluation of Irish bat species likely to be at risk from collision and barotrauma is detailed in **Table 17**; and is in part related to the likelihood of different species flying at rotor blade height in an open landscape. The SNH *et al*. (2019) guidance incorporates the 50 m set-

21 Cryan, P. & Barclay, R (2009). Causes of Bat Fatalities at Wind Turbines: Hypotheses and Predictions. *Journal of Mammalogy* 90, 1330-1340

22 Rydell, J., L. Bach, M. J. Dubourg-Savage, M. Green, L. Rodrigues & A. Hedenström. (2010). Bat mortality at wind turbines in northwestern Europe. *Acta Chiropterologica* 12:261-274.

23 Cryan, P. M., P. M. Gorresen, C. D. Hein, M. R. Schirmacher, R. H. Diehl, M. M. Huso, D. T. Hayman, P. D. Fricker, F. J. Bonaccorso & Johnson D. H. (2014). Behavior of bats at wind turbines. *Proceedings of the National Academy of Sciences* 111:15126-15131.

24 Mathews, F. Richardson, S. Lintott, P. & Hosken, P. (2016). *Understanding the Risk to European Protected Species (bats) at Onshore Wind Turbine Sites to inform Risk Management*. Final Report from University of Exeter University for RenewableUK and the UK Department of Energy & Climate Change (DECC)

back distance between the rotor swept area and habitat features (such as forestry edge and treelines/ hedgerows), which was originally published in the Natural England guidance. However, this guidance mainly applies to certain species, such as common and soprano pipistrelles, which are known to follow linear habitat features when foraging or commuting. It is not relevant to areas where linear features are absent or sites where Leisler's bat activity is high, since this species is just as likely to fly over open terrain as along habitat features.

Different bat species have different foraging behaviours and ecological requirements, infrastructure such as wind turbines may affect different species in different ways. Each bat species recorded at the Wind Farm Site is considered in the following sections. It is important to note that the probability of impact is lower for those turbines located away from habitat features. In open habitat, the probability of such an impact is considered less likely. However, where turbines are located within close proximity to features such as hedgerows and treelines (notably T4, T5, T6, T7, T10 and T11), there is potential for a greater occurrence of bats within the rotor-swept area, resulting in increased potential for impact. The current proposed areas of felling (**Appendix 2**

Maps showing bat feature could also create linear feature in close proximity to the turbine blades creating a risk of higher activity than previously recorded. There was a difference in documented activity at D.10 as across deployments as felling had already begun in the surrounding conifer plantation. In the area which had been felled the detector, placed along the newly created linear feature, recorded higher levels of activity post-felling.

5.7.1 Operational phase: Potential direct impacts on common and soprano pipistrelles

As listed in **Table 17**, both common pipistrelle and soprano pipistrelle are considered to be of high risk of injury or mortality from turbines, resulting from either barotrauma (injuries to internal air cavities and blood vessels caused by sudden change in air pressure behind a moving blade) or collision, based on the behaviour and foraging techniques of this species. Both species typically show an affinity to habitat features such as woodland/plantation edge, scrub, treelines and hedgerows; however, pipistrelles are also known to forage more regularly in open habitat. Some of the proposed infrastructure at the site is close to features that are used by these species for foraging/ commuting. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found that these two species of pipistrelle were amongst the casualties most commonly recorded during turbine searches.

As summarised in **Table 20**, common and soprano pipistrelles are widespread and common throughout Ireland; however due to flight behaviour, population vulnerability to wind farm developments for both species is classed as *Medium* (**Table 17**). Overall common pipistrelle activity was classed as high and soprano pipistrelle activity was classed as 'Moderate/High' with 'High' seasonal activity, which gives a risk assessment of high.

Some of the proposed infrastructure at the site is close to features that are used by these species for foraging, notably turbines in the eastern part of the site, that are proposed adjacent to treelines. Recorded levels of these species occurring at turbine locations were considered to be high at T2. T4, T5, T6, T7, T10 and T11, with high levels of common pipistrelle activity being recorded in either spring, summer or autumn deployments at these locations.

Without mitigation, potential impacts of the operational phase upon common pipistrelle and soprano pipistrelle are considered to be ***Significant*** at the ***Regional*** level.

5.7.2 Operational phase: Potential impacts on Nathusius' pipistrelle

As listed in **Table 17**, Nathusius' pipistrelles are considered as *high risk* of injury or mortality from wind turbines resulting from either barotrauma or collision; as this species regularly flies in the open and at heights. Nathusius' pipistrelles are strong flyers and known to be migratory in parts of their

European range and may fly at height during migration. A review of turbine related bat fatalities in Europe (Rydell *et al*., 2010) found that 13% of the casualties were Nathusius' pipistrelles.

As summarised in **Table 20**, Nathusius' pipistrelles are classed as having high population vulnerability to wind farm developments due the assumed vulnerability of the population and flight behaviour. It is acknowledged that there is limited population assessment data available for this species in Ireland; however, indications are that the range and frequency with which this species are recorded is increasing. In an Irish context, the apparent range expansion could be an apparition caused by increased survey effort and improved survey techniques. Nathusius' pipistrelles activity was classed as 'Low' according to Kepel *et al.* (2011) (**Table 12**) or 'Moderate/ Low' according to SNH *et al.* (2019) (**Table 9**) with an increased level of activity in spring (**Table 10**; **Table 12**), which gives an overall risk assessment of *medium* for this species in the context of the Wind Farm Site. Even when considering seasonal or localised risk the assessment remains medium.

Without mitigation, potential impacts of the operational phase on Nathusius' pipistrelles are considered to be ***Significant*** at the ***County*** level.

5.7.3 Operational phase: Potential direct impacts on Leisler's bat

As listed in **Table 17**, Leisler's bats are considered as being at high risk of impact from wind turbines, based on species behaviour and foraging techniques, in terms of both the likelihood of barotrauma or collision. Leisler's bats are strong and fast in flight, regularly foraging over, or taking direct flights across, open habitats at heights within the collision risk zone for wind turbines. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found that common noctule bats (*Nyctalus noctula*), were amongst the casualties most commonly recorded during turbine searches (along with common and soprano pipistrelles). Common noctule bats are not known to occur in Ireland; however, it is a similar species to Leisler's bats (lesser noctule bats) in terms flight behaviour, and therefore similar levels of collision-risk would be predicated. Leisler's bats are very sparsely distributed in England and Wales, and only occasionally recorded in Scotland; and this explains why it was not encountered during turbine searches based in the UK. Leisler's bat is listed as Near Threatened on the Irish Red List of Terrestrial Mammals (Marnell *et al*. 2009).

Levels of Leisler's bat activity were notably higher in Spring. According to median activity levels D.05, D.09, and D.10 recorded moderate/high Leisler's activity in spring. Using bp/h and Kepel *et al.* (2011) for analysis only context detector D.09 recorded 'High' levels during the spring deployment and 'Medium;' levels during the summer deployment. It is likely that these patterns are consistent with a spring flux in activity with bats that then move to a different area.

Without mitigation, potential impacts of the operational phase upon Leisler's bat are considered to be ***Significant*** at the ***County to Regional*** level.

5.7.4 Operational phase: Potential direct impacts on *Myotis* species

As listed in **Table 17**, bats of the genus *Myotis* are considered as being at low risk of impact from wind turbines based on species behaviour and foraging techniques. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found a single carcass of a *Myotis* bat during the searches (a Natterer's bat - *Myotis nattereri*). *Myotis* species in the UK are rarely recorded fly at heights above the canopy (20 to 30 m) and tend to prefer a more cluttered habitat due to their short range, high frequency echolocation characteristics. Furthermore, their relatively slow flight speed allows them to manoeuvre well and therefore have the agility to avoid collision events (Mathews *et al*., 2016 & Rydell *et al*., 2010). Because of the behaviour exhibited by these species, the probability of direct operational impact is *Unlikely*

As summarised in **Table 20**, overall *Myotis* bat activity was classed as 'Low' (Kepel *et al*., 2011) or 'Moderate/ Low' (SNH *et al*., 2019) and population vulnerability to windfarm developments for all three *Myotis* species regularly occurring in Ireland is classed as *Low*. Therefore, no overall collision risk assessment is required for this Genus.

Even without further mitigation, potential impacts of the operational phase upon *Myotis* species are considered to be ***Not Significant.***

5.7.5 Operational phase: Potential direct impacts on brown long-eared bat

As summarised in **Table 17**, brown long-eared bats are considered as being at low risk of impact from wind turbines. A study (Mathews *et al*., 2016) monitoring bat fatalities at wind farms around the UK found a single brown long-eared bat carcass during the searches. The static detector recording at height (50m) recorded two brown long-eared bat at this height, which is unusual for this species. Typically, this species flies at low height and close to vegetation. However, this behaviour is highly anomalous for this species and the presence of 1 or 2 individuals does not reflect the risk posed to the species population as a whole. The standard mode of flight behaviour exhibited by this species results in the probability of an impact from wind turbines to be *Unlikely*.

As summarised in **Table 20**, overall brown long-eared bat activity was classed as 'Low' (Kepel *et al*., 2011) or 'Moderate/ Low' (SNH *et al*., 2019) and population vulnerability to windfarm developments for this species is classed as *Low*. Therefore, no overall collision risk assessment is required for this species.

Even without further mitigation, potential impacts of the operational phase upon brown long-eared bat are considered to be ***Not Significant.***

5.8 Operational phase: Potential secondary impacts on bats

Disturbance of roosting bats and disturbance of foraging bats though lighting impacts during the operational was considered to be *Unlikely*, as the installation of additional lighting proposed will be minimal. However, there will be additional security lighting on the substation and the site generally supports relatively high levels of bat activity. The species utilising this area most – Leisler's bat, soprano pipistrelle and common pipistrelle – are less sensitive to light pollution than the less commonly recorded species – brown long-eared bats and *Myotis* species.

6 RECOMMENDATIONS AND MITIGATION

The likely significant effects of the proposed development on bats have been assessed and in the absence of mitigation the following significant effects were identified:

- During the construction phase the likely direct impacts on bats roosting near turbine locations are areas of proposed felling was considered *Significant* at the *Local* scale.
- During the construction phase the likely secondary impacts on foraging/commuting bats due to the removal of vegetation was considered *Significant* at the *Regional* scale.
- During the operational phase the likely direct impacts on foraging/ commuting bats from collision or barotrauma due to the location of wind turbines was considered to be:
  - *Significant* at the *Regional* level for common and soprano pipistrelles.
  - *Significant* at the *County to Regional* level for Leisler's bat.
  - *Significant* at the *County* level for Nathusius' pipistrelle.
  - *Not significant* for other less-susceptible species recorded, i.e. *Myotis* species and brown long-eared bats

Mitigation measures have been identified and discussed for the following potential effects:

1. Avoidance of potential direct impacts to tree roosting bats
2. Avoidance of potential secondary impacts on bat foraging/ commuting habitat
3. Avoidance of wind turbine collision or barotrauma events for bats

This section also discusses the options for the provision of compensatory/replacement habitat and any requirements for post-construction monitoring.

6.1 Mitigation to avoid potential direct impacts on tree roosting bats

Throughout the proposed development site, vegetation removal will be required to facilitate construction of wind farm infrastructure, mainly for access tracks and the provision of turbine foundations and areas of hardstanding. Several treelines have been identified as supporting potential roost features (PRFs) classed as low to moderate, with the occasional high PRF. While no roosts were identified during the 2020 active season, roost surveys were not exhaustive and there is a risk the any trees identified as supporting PRF, which are earmarked for removal during construction, could become occupied prior to works commencing. Given the types of features identified within the proposed works corridor, mainly ivy clad trees with the occasional potentially suitable holes/cracks, it is anticipated that occupancy of any PFR will be limited to transitional roosts, e.g. autumn mating roosts. It is also considered that the surrounding area holds a number of structures offering higher suitability for the formation of significant maternity and hibernation roosts, e.g. Bracklyn House.

Noting that areas within the site, including within potential felling areas, hold PRFs that could potentially support bats in the future, pre-construction roost surveys will be an important component of the species protection plan. For any trees found to be occupied by roosting bats prior to construction, an exclusion zone will be implemented to prevent disturbance during times of occupancy. **Table 21** provides restrictive periods for different types of roosts, and therefore by extension restrictive periods for construction works, during which the exclusion zone for construction work would be applicable. The extent of the exclusion zone can be up to 30 m for any notably disruptive works such as pile-driving; however, the mitigation measure should be proportional to the disturbance levels emanating from the construction activity.

Under the Wildlife Act, it is an offence to intentionally disturb, injure or kill a bat or disturb its resting place. Under this legislation it is unlawful to destroy, alter or disturb known bat roosts without an appropriate derogation licence, as issued by the National Parks and Wildlife Service (NPWS). Pre-construction surveys will inform the application of a derogation license from NPWS to undertake appropriate mitigation actions as required to ensure the conservation of bats, if found to be utilising roosts within the construction corridor. Reporting of pre-construction bat surveys will be required to demonstrate due diligence regarding avoidance of disturbance to potential bat roosts.

Given the types of features identified within the works corridor, mainly ivy clad trees with the occasional potentially suitable holes/cracks, it is anticipated that occupancy of any PRF, if any, will be limited to transitional roosts, e.g. autumn mating roosts.

While acknowledging the limited likelihood of the treelines where vegetation removal/cutting is proposed to facilitate wind farm infrastructure; the mature trees identified as supporting PRFs will require further pre-construction roost surveys and assessment in acknowledgement that they have the potential to be utilised by bats in the future. The following locations have been highlighted as requiring this:

- ‘T’ shaped treeline
- Beech Treeline to the southwest of T4
- Treelines on either side of T5
- Treeline to the southeast of T11
- Treeline to the northwest of T7

Pre-construction/ pre-vegetation removal bat roost surveys will include the following elements:

1. Areas listed above which are earmarked for vegetation removal will be thoroughly re-assessed for PRFs. Surveys will be conducted by an appropriately experienced ecologist.
2. Any trees supporting PRFs will be targeted with further surveys, including emergence/re-entry surveys and/or roost inspections (using endoscopes and thermal imaging cameras) to determine occupancy of any moderate to high PRFs identified.
3. If any bat roosts are identified, further assessment will be required to determine the type of roost (e.g. maternity, hibernation, mating, transitional), species using the roost and the level of occupancy.
4. For any roost sites occupied these surveys will inform the application of a derogation license from NPWS to undertake appropriate mitigation actions as required to ensure the conservation of bats. These could include measures to exclude bats from potential roost holes prior to vegetation removal and provision of alternative roost sites.
5. Reporting of pre-construction bat surveys will be required to demonstrate due diligence regarding avoidance of disturbance to potential bat roosts.

Table 21 – Optimal season for works at different roost types
Source: Kelleher & Marnell (2006)[25]

Bat usage of site	**Optimum period for carrying out works** (some variation between species)
Maternity	01-Oct to 01-May
Summer (not a proven maternity site)	01-Sep to 01-May
Hibernation	01-May to 01-Oct
Mating/swarming	01-Nov to 01-Aug

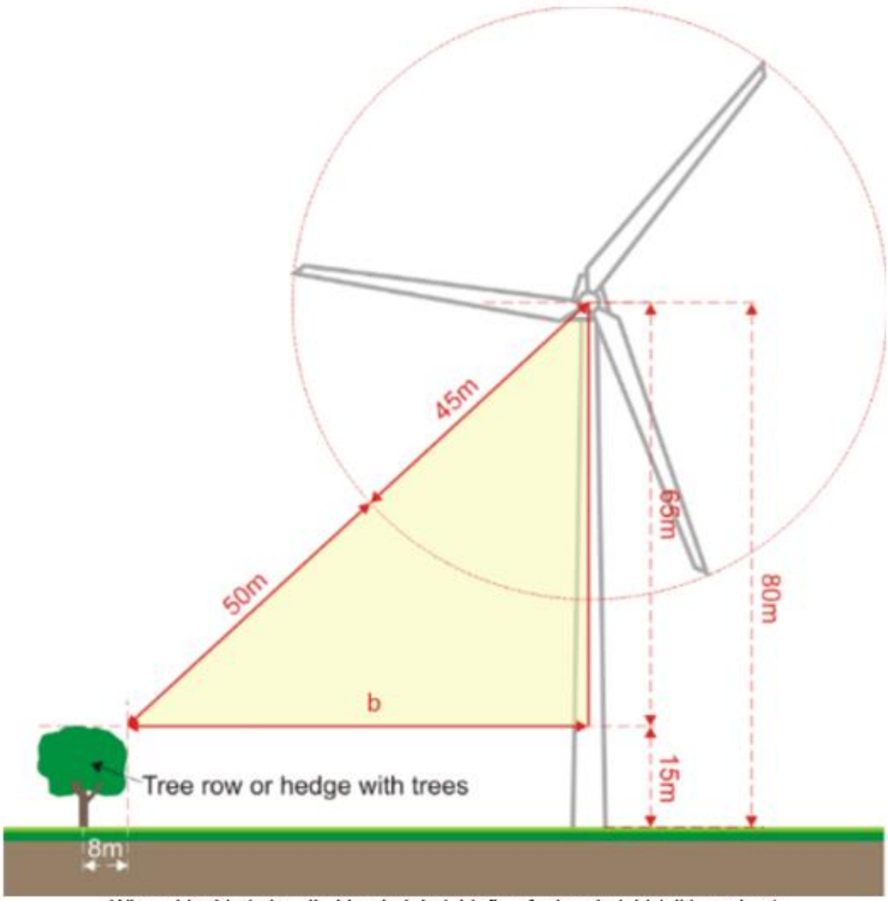
25 Kelleher, C. & Marnell, F. (2006) Bat Mitigation Guidelines for Ireland. *Irish Wildlife Manuals*, No. 25. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland

6.2 Mitigation to avoid collision or barotrauma

6.2.1 Mitigation by avoidance

The main mitigation measure here is avoidance. This relates to the design of the wind farm infrastructure to implement a minimum of 50 m separation distance from habitat features used by bats and the tips of turbine blades; as recommended by the Natural England (2014) [26] guidelines, which have been adopted by SNH *et al*. (2019) [27]. The equation used to calculate stand-offs is reproduced in **Figure 29**. The specification for the proposed turbines (Vestas V162) provides for a tip height of 185m comprising a blade length of 81m (rotor diameter of 162m) and a hub height of 104m. The SNH turbine buffer equation can be calculated for a range of feature heights using these dimensions, see **Table 22**.

Based on the turbine dimensions specified, bat features buffers for low (3m) and high (30m) feature heights will range from between 83m and 108m, respectively.



Where bl = blade length, hh = hub height, fh = feature height (all in metres)

$$b = \sqrt{(50 + bl)2 - (hh - fh)2}$$

Figure 29 – Equation to calculate turbine tower buffers
- required to maintain 50 m standoffs - blade tip to habitat feature

26 Natural England (2014). *Bats and onshore wind turbines: Interim Guidance* 3rd Ed. Natural England Technical Information Note TIN051, Natural England, Peterborough

27 Scottish Natural Heritage, Natural England, Natural Resources Wales, Renewable UK, Scottish Power Renewables, Ecotricity Ltd, University of Exeter & Bat Conservation Trust (2019). *Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation*.

Table 22 – Turbine tower buffering distances for a range of feature heights

Feature height (fh)	**Turbine-feature buffer** bl = 81 m hh = 104 m Lowest rotor swept = 23 m
3 m	83 m
5 m	86 m
10 m	91 m
15 m	96 m
20 m	101 m
25 m	**104 m**
30 m	108 m
40 m	114 m

It is considered unlikely that the any trees will reach heights of over 25 m over the 30-year lifespan of the proposed development and **Figure 30** shows the proposed turbine locations with 83 m and 104 m buffers as minimum and maximum turbine buffers based on the calculations shown in **Table 22**. This illustrates locations where vegetation removal will be required relative to potential feature heights surrounding the proposed turbines and also clearly demonstrates that the Application Site (redline boundary) adequately accommodates felling requirements.

As the majority of habitat is plantation, which will not exceed a 25 m feature height before felling, the maximum extent to which felling for turbine buffers is proposed has been pre-determined and bat feature buffer 104 m is considered adequate to accommodate all scenarios for this site.

Maps showing the default 104 m buffer for each turbine individually along with current proposed felling zones and potent roost features (PRFS) are provided in **Appendix 2 -** the maximum (104 m) and minimum (83 m) range is also displayed for context. Significant vegetation removal is required at T4, T5, T6, T7, T10, and T11 to avoid potential bat foraging within the vicinity of the turbines. Separate to bat feature buffers, felling is also required for the substation and small sections at the entrance track to T1 and at the site entrance.

Appendix 3 provides a series of maps showing the proposed felling zones in relation to the habitat types that will be affected by the felling operations, based on a 25 m feature height (i.e. a turbine tower to feature standoff of 104 m), as well as the felling area for the substation.

One location where the pre-determined buffer distance will not be met in full is at T10, due to the presence of Annex I bog woodland habitat. This habitat is located to south of T10 and will not be felled (**Figure 36** in **Appendix 3**). Areas of non-Annex I bog woodland, cherry laurel and remaining plantation will be removed. The other area where the buffer will not be met in full is the area of oak-birch-holly woodland to the east of T11, which will be retained to avoid impacting on a habitat of Local (higher value) importance. A small section of the proposed felling area for T5 will not be felled to avoid impacting on Bracklin Wood. Further mitigation, in relation to monitoring retained woodland habitat within the bat feature buffers for T5, T10 and T11 is outlined in **Section 6.4**.

The area where trees/scrub is cleared to create the turbine buffers for foraging/commuting bats must be rendered as unsuitable as possible, and maintained as such over the lifetime of the wind farm. Felled timber and branches must be removed, with stumps brashed to ground level. Some excess spoil from excavation works during construction will be broadcast to cover over any ground stumps to create a more homogeneous surface around these felled areas. To prevent the area scrubbing up, a mowing or grazing regime will be implemented and monitored as part of the Habitat Management Plan (see **Annex 5.6**).

6.2.2 Mitigation by curtailment

It is anticipated that implementing bat feature buffers (as detailed in **Section 6.2.1**) will limit bat activity in the vicinity of turbines and will be effective in reducing the potential for collision risk. However, SNH *et al*. (2019) acknowledge that it is difficult to predict how bat behaviour will change post-construction and this supported by Richardson *et al*. (2021) studying turbine mediated bat fatalities at 23 wind farm sites across the UK. Therefore, further mitigation informed by post-construction monitoring may be required.

One such option is smart curtailment, whereby turbines identified in high-risk locations by post-construction monitoring are feathered to run at < 2rpm, while optimal flight conditions for bats occurs. Smart curtailment has the potential to limit collision risk for Leisler's bat, in particular, as this species' feeding behaviour is often associated with open areas and therefore may be less responsive to mitigation involving vegetation removal around turbines (although, as detailed in **Section 3.5**, recorded Leisler's bat activity on the site was generally low, with more activity recorded during spring, at the proposed locations of T4 and T5).

Any requirement for smart curtailment, and the parameters that would influence it, must be guided by a coherent and comprehensive post-construction monitoring methodology, which will clarify the bat usage of the site at turbine locations post-construction, the likely relationship with temporal and weather parameters, and will identify any potential collisions (noting the difficulties highlighted above in predicting how bat usage of the site may change post-construction). However, the pre-construction surveys, including surveys at height and the measurement of weather parameters, do allow for the identification of relationships between bat usage and weather parameters, that will demonstrate how an effective smart curtailment approach, specific to individual turbines, can be implemented. These include:

- 96.7% of recorded Leisler's bat passes at 50m were at wind speeds of under 7m/s (at 50m)
- 97.9% of recorded Leisler's bat passes at 50m were temperatures of over 8°C (at 50m)
- 96.0% of recorded Leisler's bat passes occurred at times of zero precipitation
- Recorded Leisler's bat activity on the site was generally low, with more activity recorded during spring, at the proposed locations of T4 and T5 (which may be related to Leisler's bats feeding over forestry prior to setting up maternity roosts for example)

Information such as that detailed above, together with information on temporal usage of the site at specific turbine locations post-construction (including usage over the season and over night-time periods within specific seasons), can be utilised to provide a highly effective mitigation approach by smart curtailment by implementing curtailment during the periods and environmental parameters that are known to be preferred by at risk-species.

6.3 Mitigation to avoid potential secondary impacts on bat foraging / commuting habitat

Several locations have been identified where, vegetation removal has the potential to impact on foraging and commuting bats, with the following areas highlighted as locations where the impact will be negative, including:

- The loss of conifer plantation at T5, T6, T7, T10 and T11
- The loss of ash plantation at T4 and T6.
- The removal of broadleaf treelines at T4, T5 and T11

Project design has attempted to avoid the removal of treelines, hedgerows and woodland habitats utilised by bats. To compensate for any unavoidable loss of bat commuting/foraging habitat there will be an equivalent area identified as compensatory habitat.

Compensation should aim to maximise future woodland, hedgerow and treeline ecological function by specifying an appropriate species mix and replacement locations to maximise connectivity. In the latter case, full consideration must be taken of bat usage of the site. It is proposed that compensatory planting of hedgerow/treeline habitat is undertaken in order to maintain connectivity between the woodland surrounding T4 and T5 (particularly the beech woodland to the southwest of T4) to the woodland and bog pool in the east of the site, which D.09 showed was of high foraging value. Connectivity between the mature beech treeline to the southwest of T4 and the treeline of semi mature beech tracking north from T4 should also be maintained. Maintaining this connectivity would involve the planting of hedgerow/treeline habitat in the field to the east of T4/north of T5.

This replanting, given adequate buffer distance from the turbine, would complement the mitigation for collision and barotrauma by acting as linear features along which bats commute, reducing their likelihood of commuting through the buffer zone. The removal of vegetation to implement turbine buffers is not anticipated to significantly reduce the edge effects that create habitat features utilised by bats and may actually increase this, in combination with compensatory planting leading to an enhancement of the foraging features within the Application Site.

One area in which the current felling plan is likely to impact habitat connectivity within the site is at T4. Compliance to SNH buffer guidelines will require the removal of semi-mature broadleaf treelines which provide commuting pathways connecting the south west and east of the site. A proposed re-planting plan for this location is outlined in **Figure 32** of **Appendix 3**. This proposed re-planting of broadleaf treeline seeks to maintain the connectivity provided by treelines around T4 between the south and eastern parts of the site. The proposed replanting would also require the retention of a linear feature to the south of the turbine in the form of young ash plantation edge or re-planted broadleaf. Given the distance from the turbine, trees to the south of the turbine location must be managed and kept below 20m in height while the trees to the west and northwest of the turbine location must be managed and kept below 30m in height.

6.4 Post-construction monitoring

Based on the levels of pre-construction bat activity and the proposed extent of felling, post-construction monitoring at selected turbines will be required. Although the extent to which bats are affected by collisions with turbines is not fully understood, measures, including vegetation removal will reduce the potential for bat collisions or barotrauma occurring once the proposed wind farm is operational. A post-construction monitoring plan for bats should be adopted, with consideration given to turbines where the recommended 50m separation buffer from blade tip to habitat features falls close to the turbines, notably relevant to T4, T5, T6, T7, T10 and T11, where high levels of pipistrelle bat activity were recorded.

Post-construction monitoring should include monitoring using static bat detectors, as well as a bat fatality search methodology. This will provide further information on the bat usage of the site at turbine locations post-construction and will also provide information on collisions. This information will indicate whether mitigation measures are effective. Any need for remedial measures will then be assessed, successful remedial measures have included increasing of cut-in speeds during specific weather conditions (low wind speeds and high night time temperatures) during the spring and autumn months (‘smart curtailment’, as outline in **Section 6.2.2**).

As outlined in **Section 6.2.1** the minimum separation distance for bat feature buffer, as required by SNH guidelines, will not be met at T5, T10 and T11, due to the presence of important habitat, that will be retained within the buffers. Enhanced post-construction monitoring is to be conducted along the broadleaf woodland habitat edge in order to investigate bat use of the feature and inform any need for further felling to reduce feature height (without impacting integrity of the habitat). Alternatively, or in combination with extending felling areas, development of a curtailment plan may be required if there are seasonal/weather driven peaks in bat activity along the habitat edges retained within the bat feature buffers.

6.4.1 Monitoring intervals

Bats and Onshore Wind Turbines: Survey, Assessment and Mitigation (SNH 2019) state "*In order to evaluate the success of the curtailment regime, a minimum of 3 years of monitoring should take place during which time casualty searches and acoustic monitoring should take place concurrently*".

A 3-year monitoring programme is recommended for bats, with monitoring in years 1, 2, and 3, post-construction.

Note: Start dates for monitoring years should be in line with either the start of the breeding season or non-breeding season; and it is acceptable for the post-construction – monitoring year 1 to commence prior to the final close-out of construction, as long as the turbine is erected and turning, i.e. posing a collision risk.

6.4.2 Survey area for bat monitoring

The bat survey area for post-construction phase monitoring is defined as the turbine locations identified as holding a risk to bats. On the basis of existing information, this is considered to be T4, T5, T6, T7, T10 and T11, with a particular emphasis on T10 and the interface of buffer zone to bog woodland habitat.

6.4.3 Activity surveys

SNH (2019) recommends that post-construction methodologies for activity surveys should mirror those required for the pre-construction period. Activity surveys will include deployment of static detectors at a minimum of 3 deployments per active season, for a minimum of 10 nights per deployment. This will include one deployment between early May and mid-June, 1 deployment between mid-June and the end of August, and 1 deployment between early September and the end of October.

6.4.4 Collision monitoring

Turbine searches are implemented to detect any fatalities (and possibly injured animals) due to collisions with turbines. Currently, there are no standardised methodologies for monitoring of wind farm collisions in Ireland and there will need to be a monitoring plan agreed with the planning authority. A post-construction bat monitoring plan must include detailed methodology for conducting turbine searches with consideration given to the following:

- *Frequency and seasonality turbine searches* - monitoring should be undertaken at times identified as presenting the greatest risk of collision, which in this case, is spring to autumn (the active bat season).
- *Timing of searches* - searches commencing at dawn may limit scavenging of any causalities from the preceding night/ day; and while nocturnal scavengers like foxes will be active during the night, it is important to sample this period effectively.
- *Type of search team employed* - Trained wildlife detection dogs have been shown to be significantly more effective than humans in detecting fatalities from collision, especially in detection of smaller carcasses and where long/ dense vegetation limits visibility of the ground (Mathews *et al*. 2013).
- *Size of search areas around turbines* - A search area of r = 65 m is often selected, as studies monitoring collision have found that the core radius around turbines, where the majority of collision casualties fall, is within 50 m of turbines (Arnett 2006) and this is also an appropriately sized search area that can be effectively searched by an appropriately trained sniffer dog in a single time period.
- *Weather conditions* - Climatic conditions, such as humidity are known to affect detectability of scent particles by sniffer dogs and conditions prior to the search day will determine the likelihood of

collisions occurring and it is important to try and sample periods when collisions are more likely and avoid those when collision risk is lower. Whenever possible, searches should not be undertaken on days following prolonged calm periods and when this is unavoidable, e.g. due to scheduling issues a note will accompany the search data.

- *H&S considerations* - searches will only be conducted within the weather parameters dictating access into the site and to the turbines – specifically excluding periods of high wind speeds, when a lighting-strike risk alert has been issued, during periods of dense snow cover and when turbines are iced.
- *Survey routes* - Including transect intervals and how the route covered will be recorded (GPS, the ViewRanger app or similar)
- *Duration of searches* – Typically, for a search area of r = 65 m human search effort should last for a minimum of 1 hour per turbine (lone-surveyor) or a minimum of 40 minutes per turbine for a single dog team. A single dog is unlikely to be able to search more than 4 turbines per day, as senses become over stimulated and dogs lose interest especially when no carcases are located and become fatigued.
- *Information recorded* – The following information should be recorded:
  - Search method (dog/human), turbine identification number, time of dawn/sunrise, start time and search duration for each turbine, route taken using a GPS, ViewRanger App. or equivalent.
  - For any remains (including feather spots) a grid reference will be taken and the distance to the closest turbine recorded. The remains will be photographed in situ and described. Once photographed, all the remains will be bagged for identification and if collision is suspected as the cause of death, the carcass will be sent for autopsy.
  - Any signs or observations scavenging species in the environs
  - A list of other species encountered
  - Weather conditions during the search
  - An assessment of flight conditions preceding the search day will be made.
  - At regular intervals over the survey year, the search area around each turbine will be described in terms of vegetation cover and easy of searching.
- *Determination of scavenging rates* – Baited trip cams can be deployed over a given survey year to determine what scavengers are active on the site and how quickly carcasses are removed.
- *Determination of surveyor detection rates* – All survey teams will have detection rates tested and scored using a standardised methodology.

Figure 30 – Range for turbine-feature buffers, as calculated in Table 22

7 CONCLUSIONS

A survey of, and impact assessment for, the bat population on the Wind Farm Site was conducted and found, in the absence of mitigation there is potential for significant effects on the following features that are considered to be of *County* to *Regional* importance, including:

- During the construction phase the potential for direct impacts on bats roosting in trees located along the assess track and in areas near proposed turbine locations to be *Significant* at a *Local* scale.
- During the construction phase the potential for secondary impacts on foraging and commuting bats due to the removal of vegetation was considered *Significant* at a *County* scale.
- During the operational phase the potential direct impacts on foraging/commuting bats – collision or barotrauma to common and soprano pipistrelles considered *Significant* at a *Regional* scale, to Leisler's bat considered *Significant* at a *County to Regional* scale, and to Nathusius' pipistrelles *Significant* at a *County* scale.

Mitigation measures have been proposed including:

- The development of a species protection plan to identify any active tree roosts within the works corridor, including grid connection route prior the commencement of construction works; and will include the application for a derogation licence for NPWS, to conduct any species protection works, operations, or procedures as required.
- Implementing bat feature buffers, which involving removal of vegetation around turbines to maintain a minimum separation distance of 50m between blade tip and feature. The likely effectiveness of this can be seen when comparing relative activity levels at D.08 and D.11.
- Compensatory habitat for foraging/commuting bats to replace "like-for-like" within the proposed development site and maintain overall connectivity. This will be detailed in the Habitat Management Plan for the proposed development.
- A full suite of post-construction bat surveys, as detailed in SNH *et al.* (2019) designed to monitor the efficacy of bat feature buffers and inform requirements for further remedial measures, such as increasing of cut-in speeds at specific turbine locations experiencing elevated periods of bat activity at height due specific weather conditions.

It is considered that the proposed measures, if implemented as recommended and in full, will mitigate entirely for any potential impacts on foraging, commuting, or roosting bats at the proposed Bracklyn Wind Farm and will result in an overall residual impact on bats the utilising the Wind Farm Site of ***Low Significance***. The EIAR – Biodiversity Chapter provides the definitive impact assessment and specific details on the application of appropriate mitigation measures.

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APPENDIX 1

- STATIC DETECTOR LOCATIONS

Plate 1 – D.01

Plate 2 – D.02

Plate 3 – D.03

Plate 4 – D.04

Plate 5 – D.05

Plate 6 – D.06

Plate 7 – D.07

Plate 8 – D.08

Plate 9 – D.09

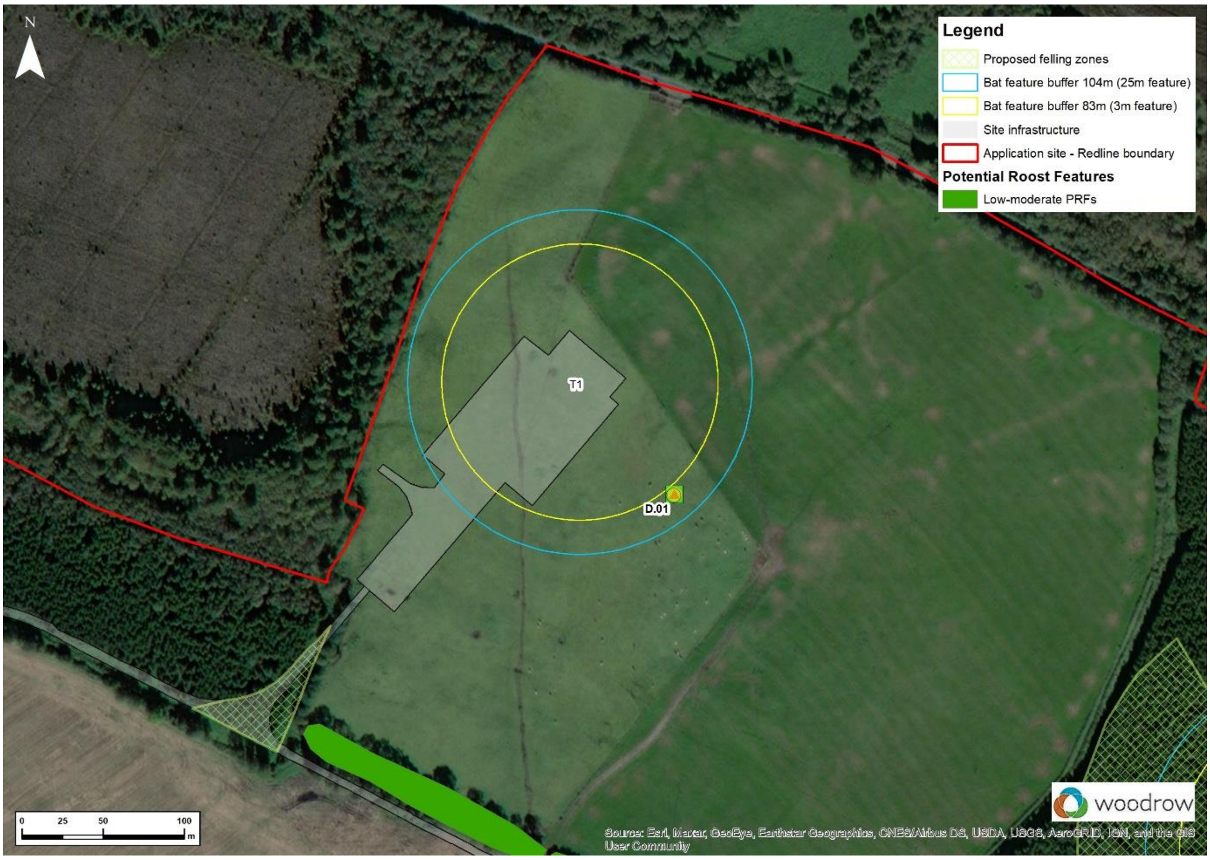
Plate 10 – D.10

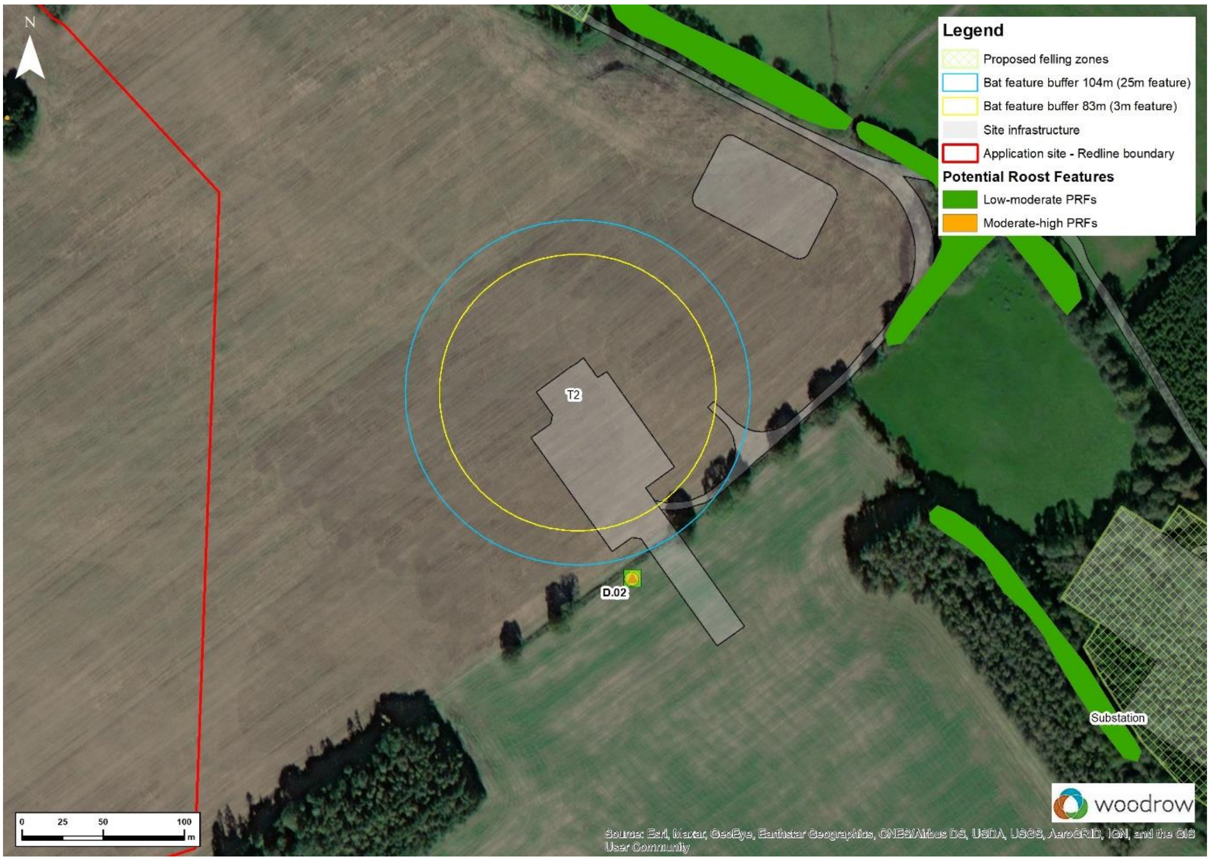
Plate 11 – D.11

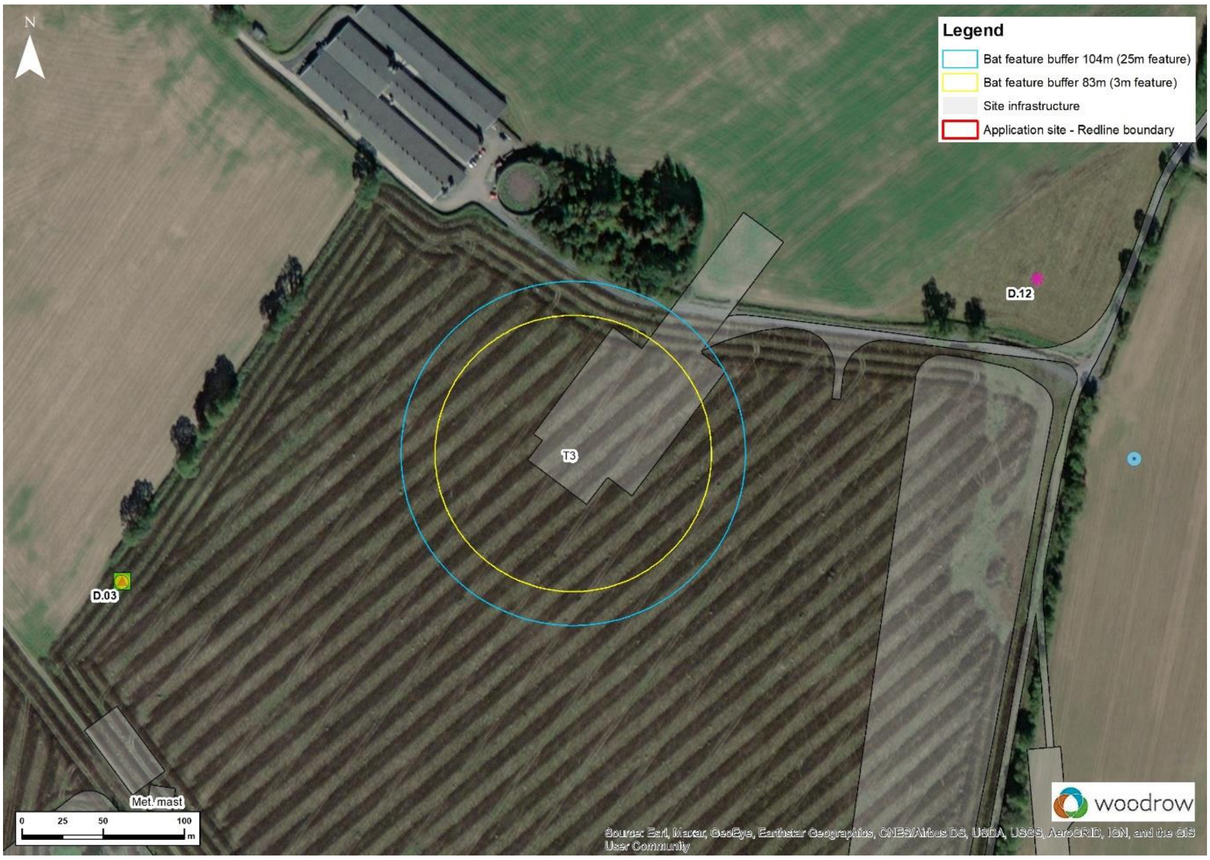
Plate 12 – Continuous recording at height

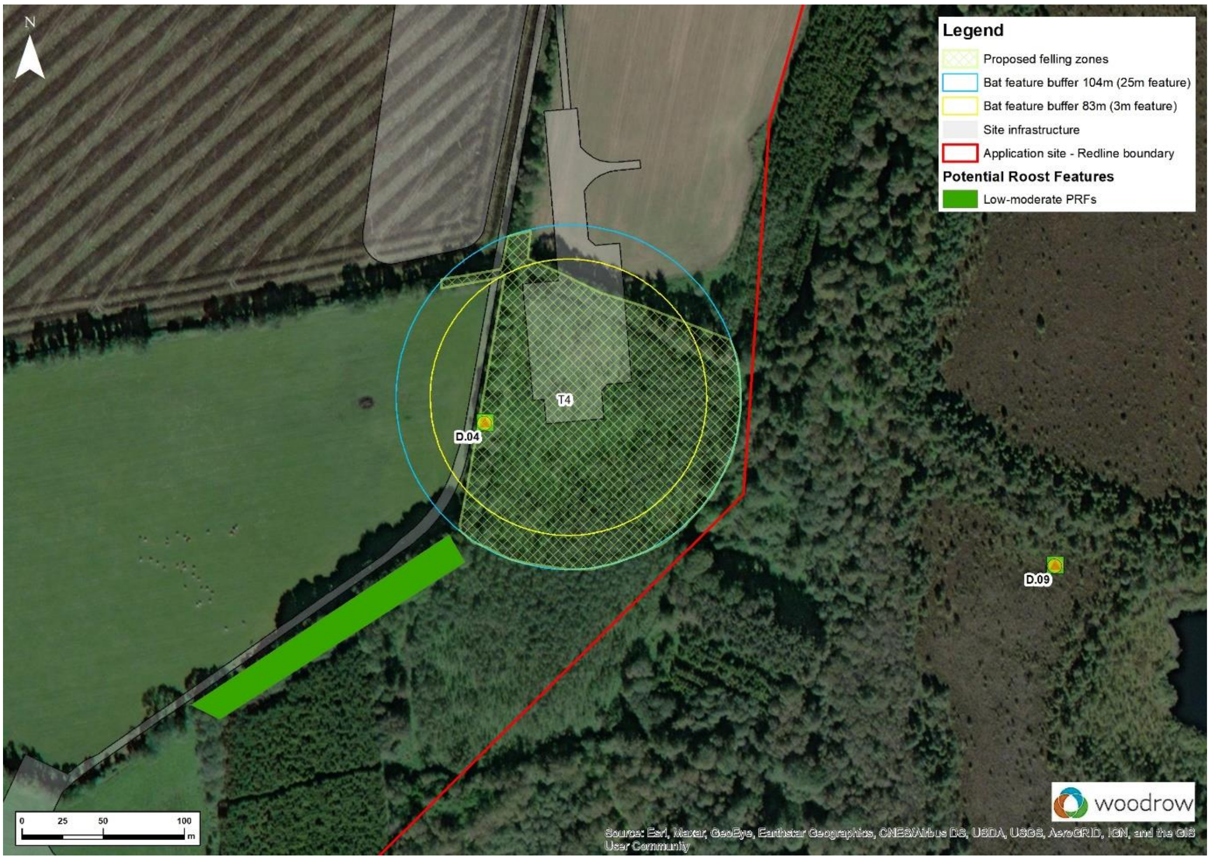
APPENDIX 2

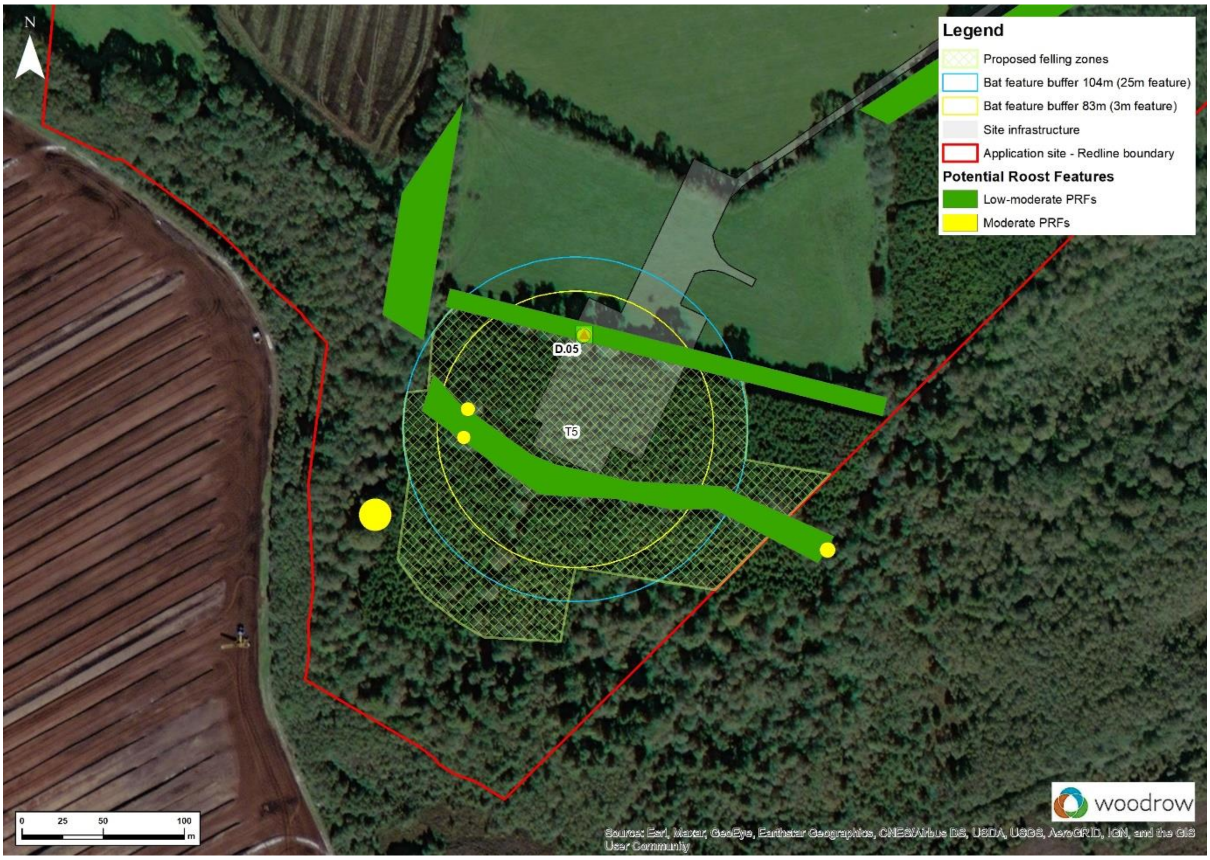
- **MAPS SHOWING BAT FEATURE BUFFERS & PROPOSED FELLING AREAS**

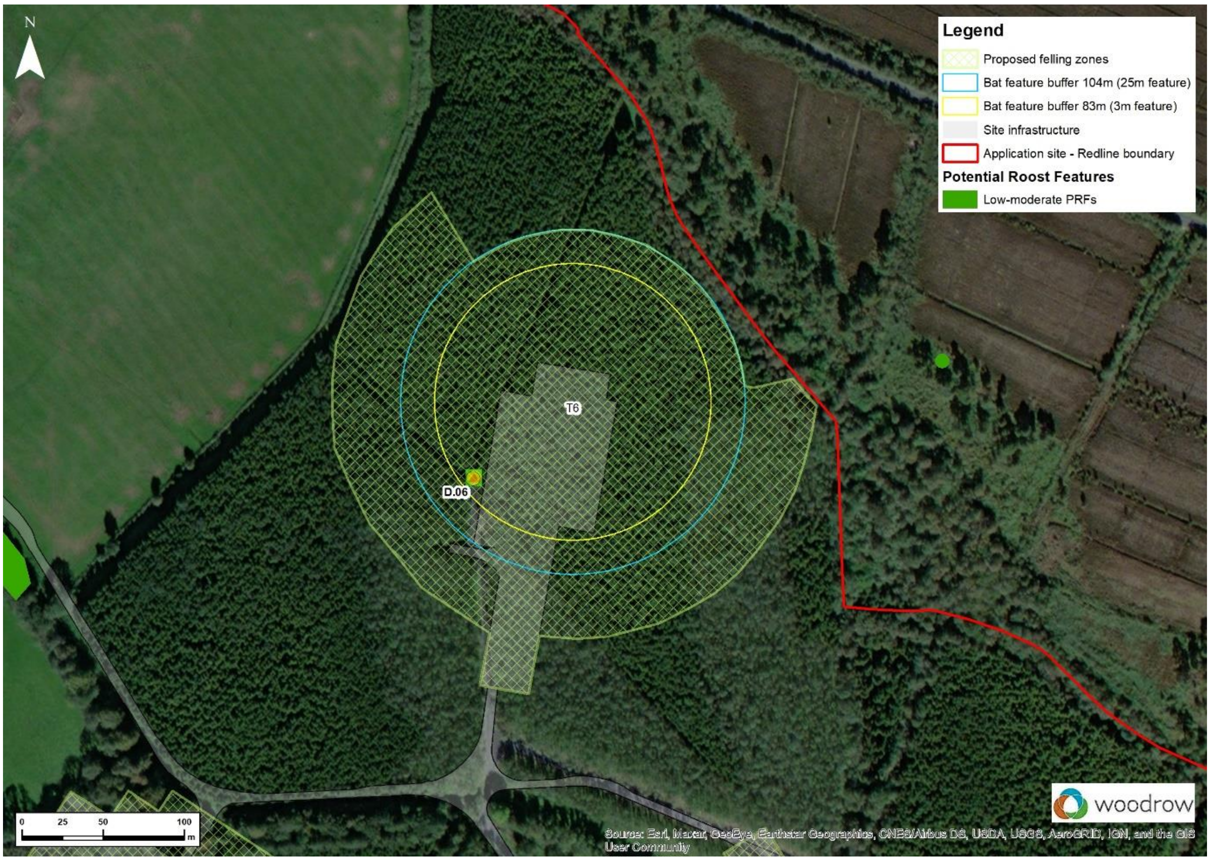

N
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
T1
D.01
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
Moderate-high PRFs
T2
D.02
Substation
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Legend
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
D.12
T3
D.03
Met. mast
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
T4
D.04
D.09
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
Moderate PRFs
D.05
T5
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community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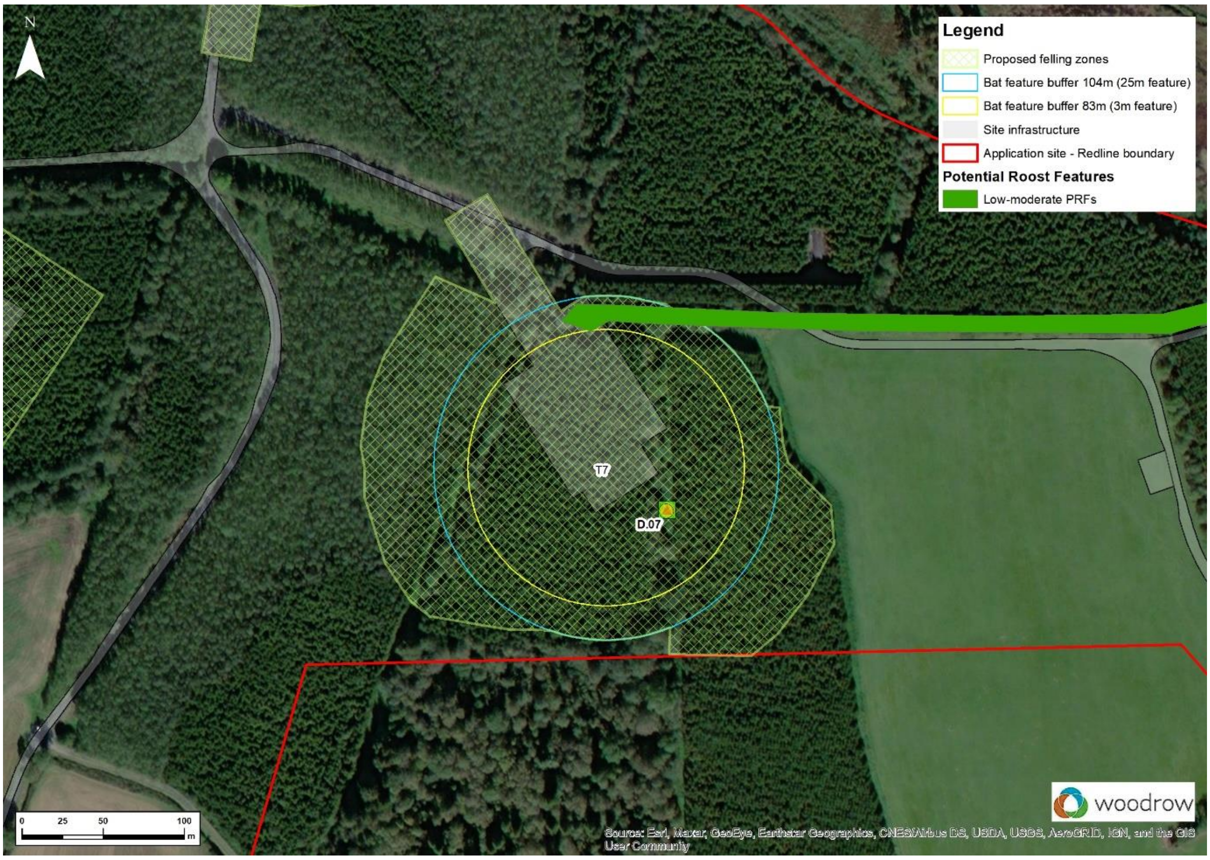
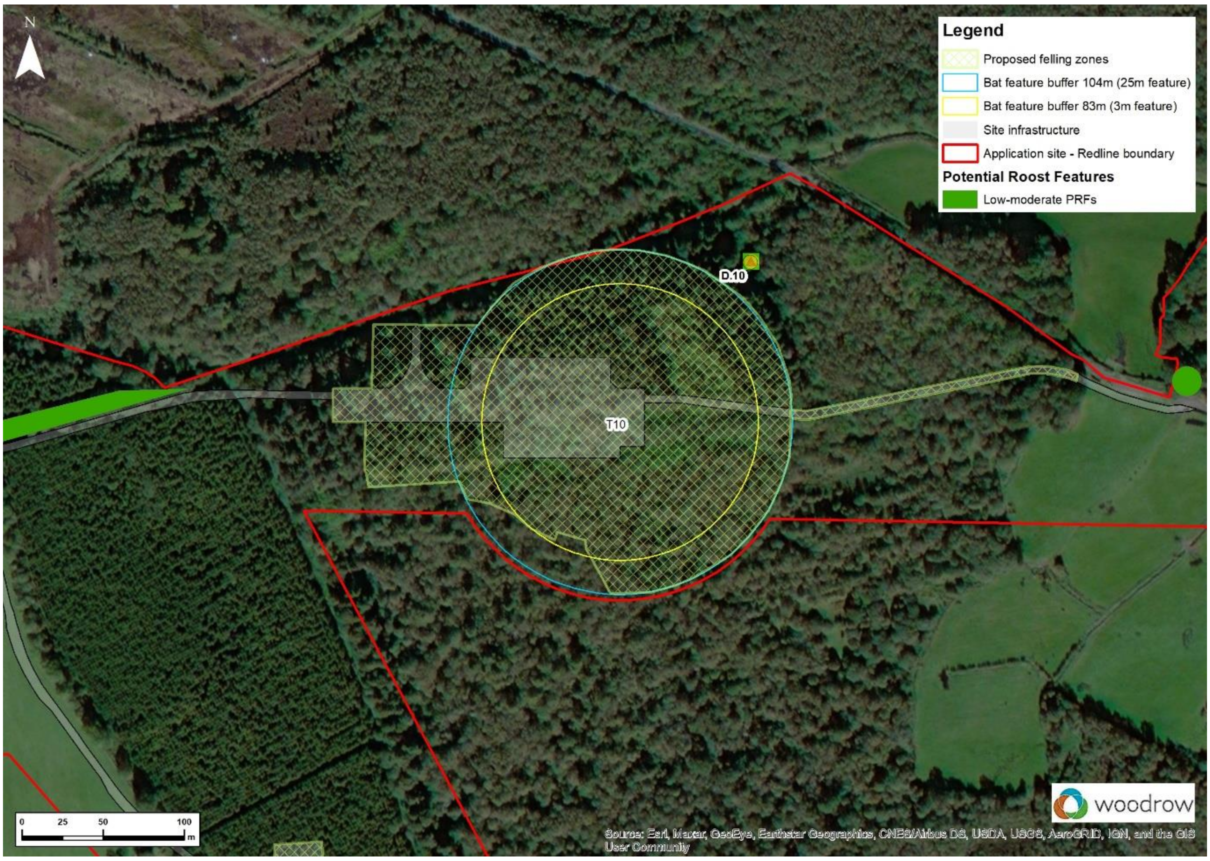
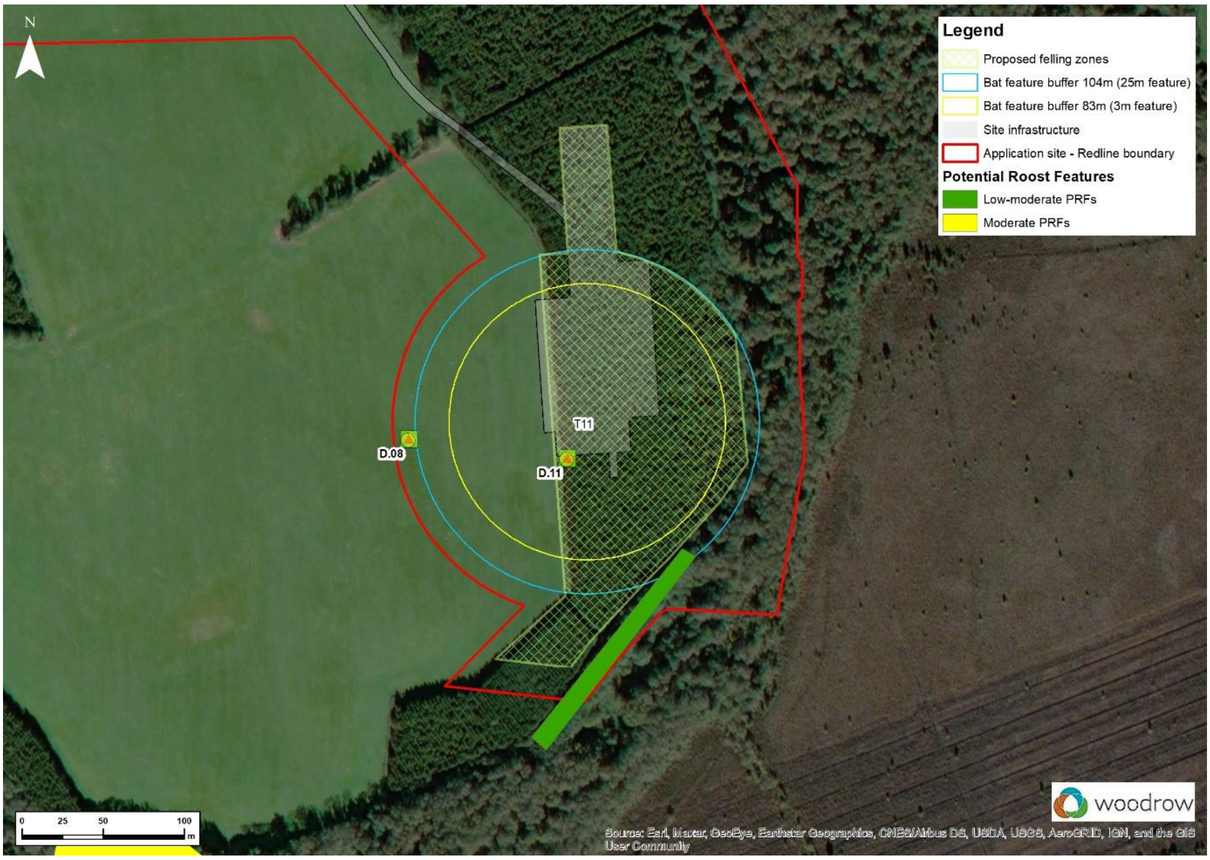
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
T6
D.06
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
T7
D.07
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community


N
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
D.10
T10
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



N
Legend
Proposed felling zones
Bat feature buffer 104m (25m feature)
Bat feature buffer 83m (3m feature)
Site infrastructure
Application site - Redline boundary
Potential Roost Features
Low-moderate PRFs
Moderate PRFs
T11
D.08
D.11
0 25 50 100 m
woodrow
Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

APPENDIX 3

- FELLING AREAS FOR BAT FEATURE BUFFERS & PROPOSED RE-PLANTING SCHEME

Buffers generated using three different feature heights, with 104 m hub height & 162 m rotor diameter

Figure 31 – Felling at substation

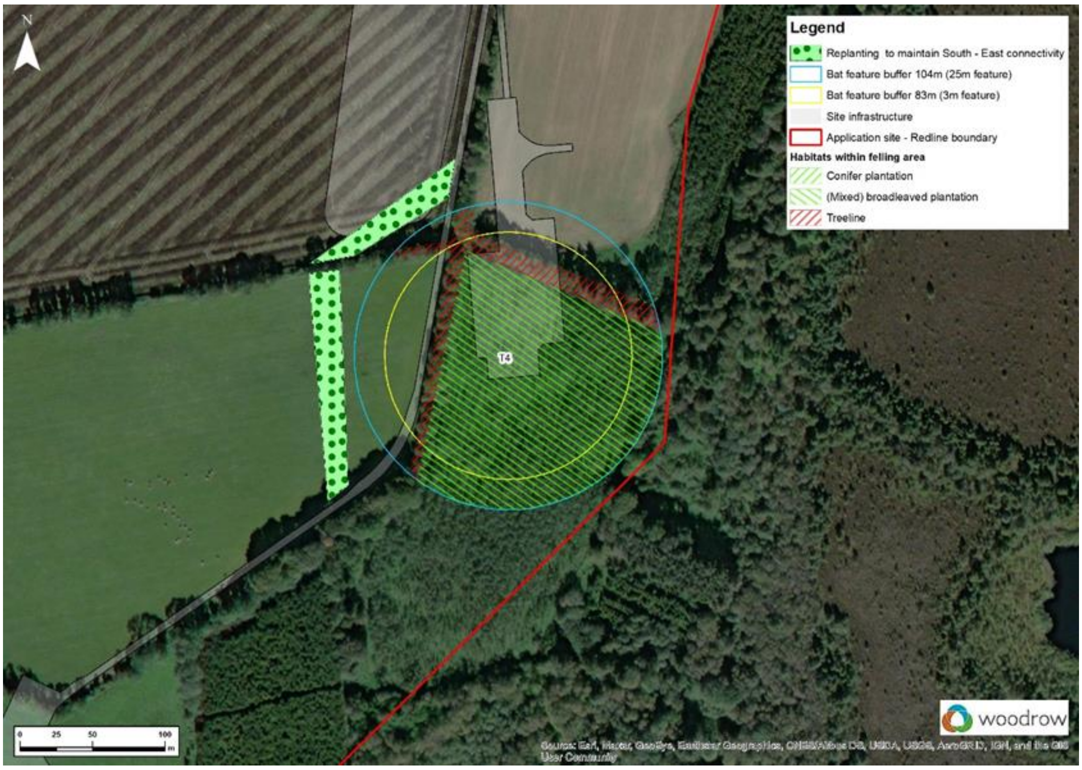


Figure 32 – Felling and replanting at T4

Figure 33 – Felling at T5

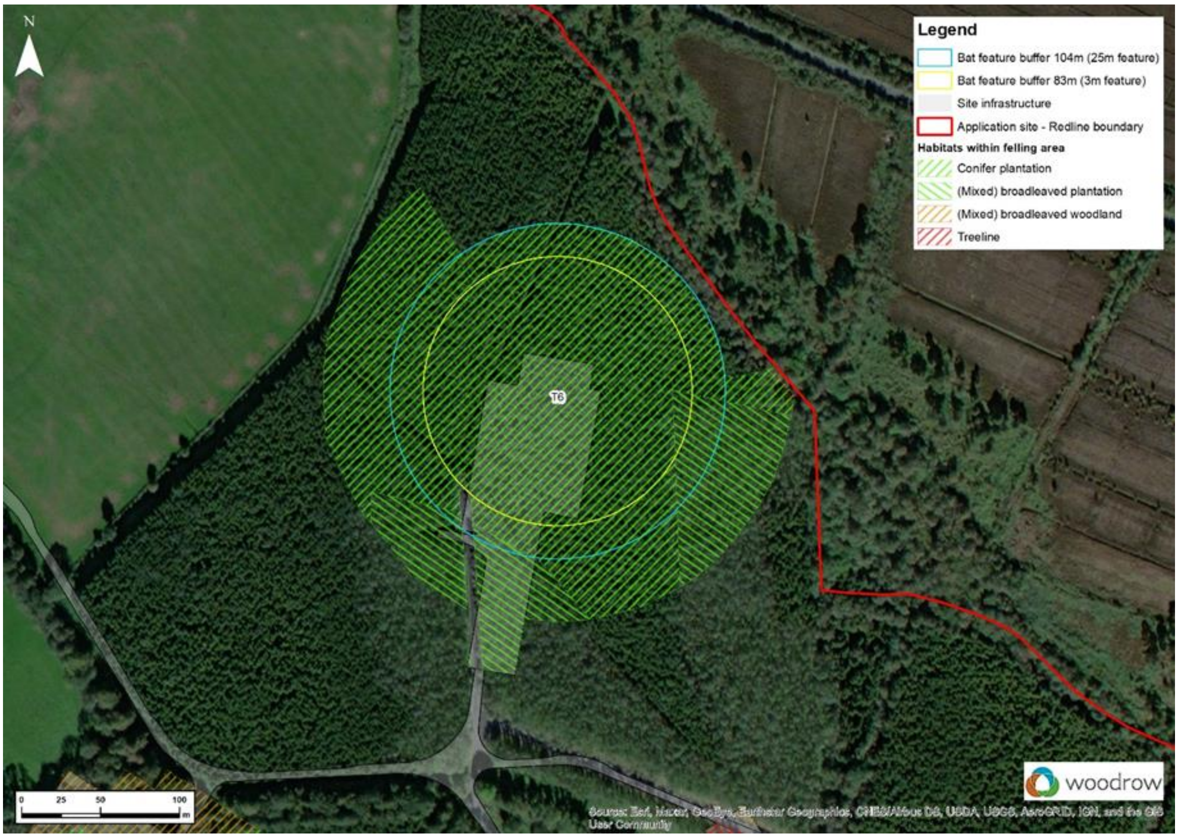


Figure 34 – Felling at T6

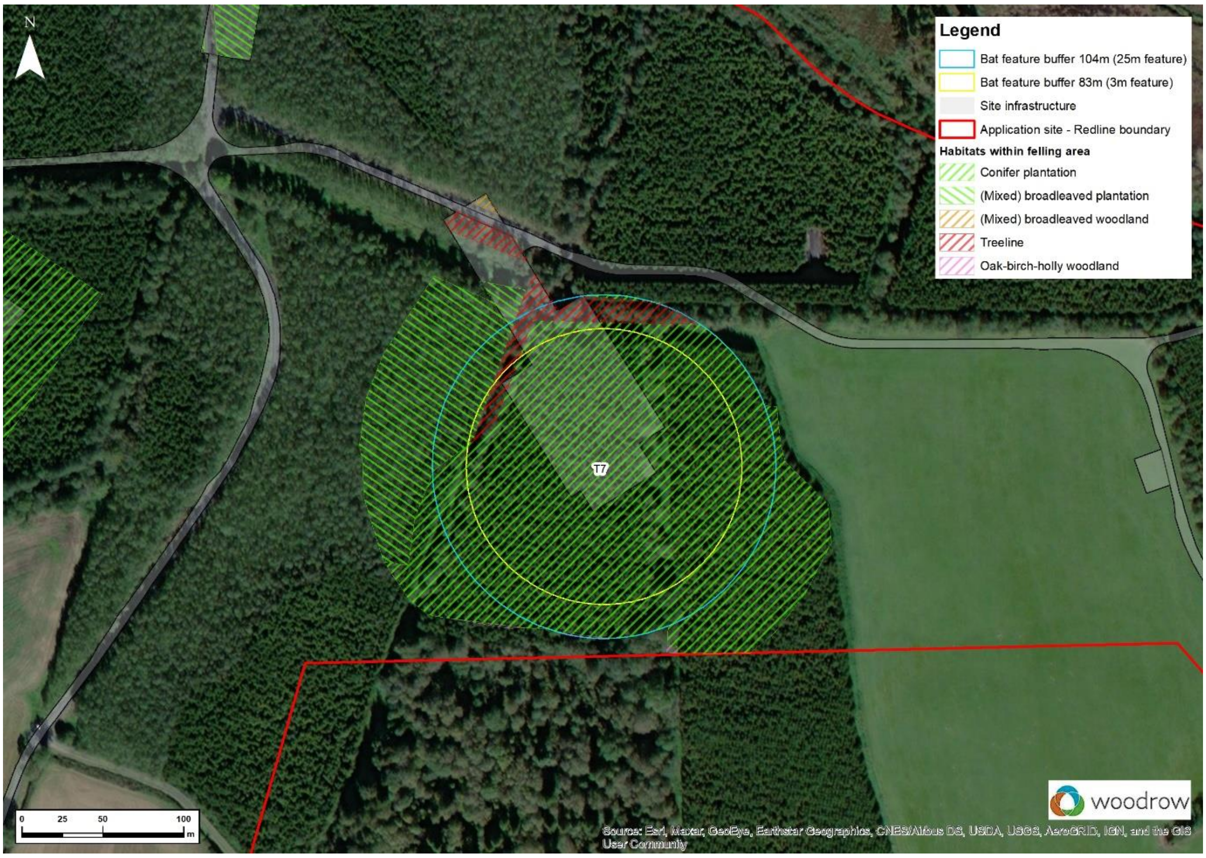


Figure 35 – Felling at T7

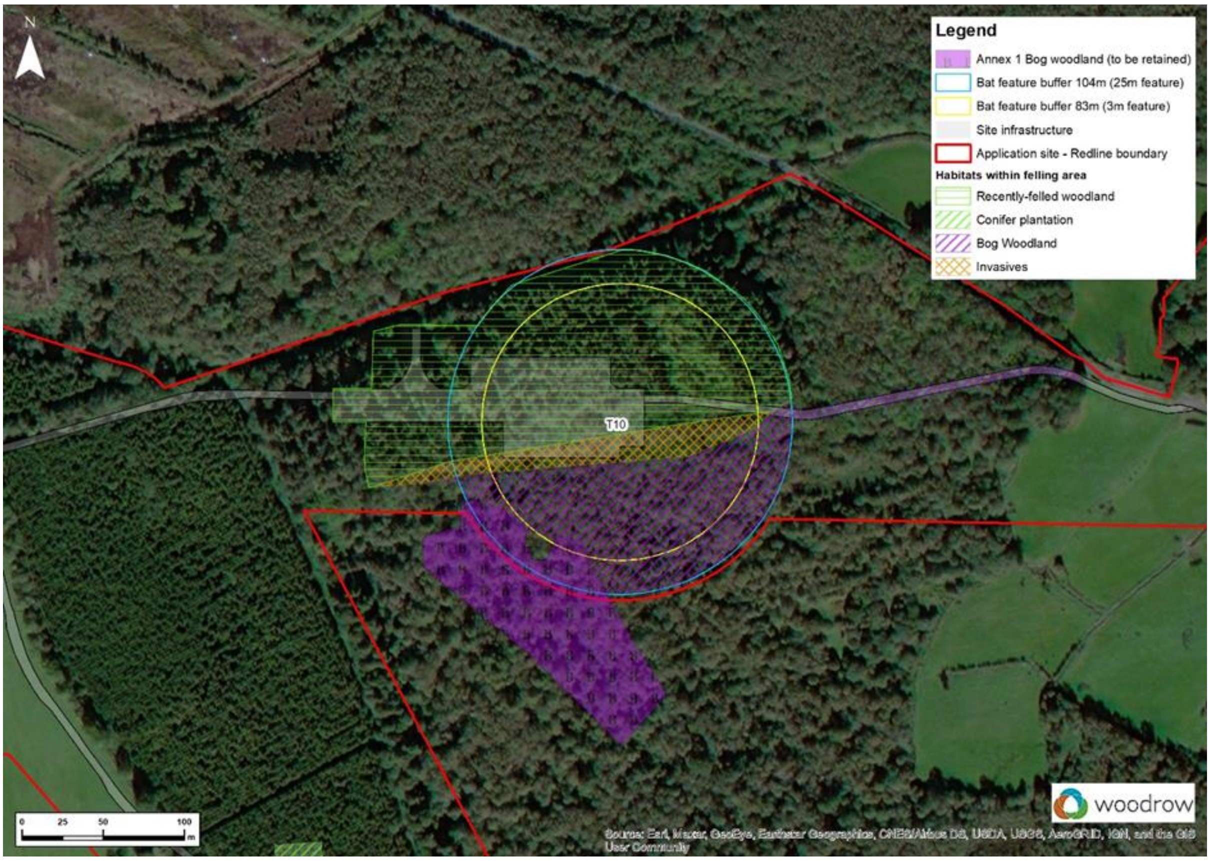


Figure 36 – Felling at T10 with area of bog woodland not to be felled

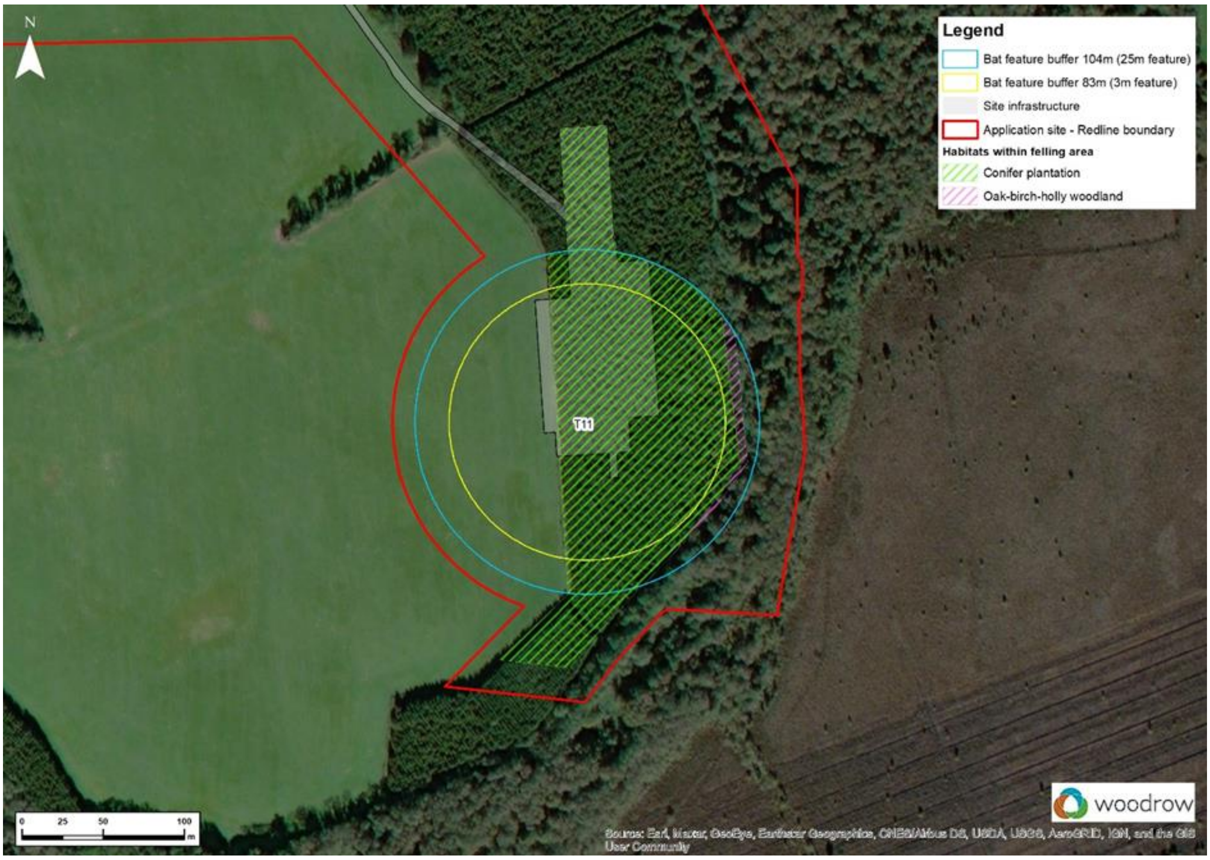


Figure 37 – Felling at T11

APPENDIX 4

- EMERGENCE AND RE-ENTRY SURVEY LOCATIONS

Plate 13 – Derelict cottage

Plate 14 – Mature beech

Plate 15 – Crypt

Plate 16 – Clearing between broadleaf and conifer woodland

Plate 17 – Centre of 'T' shaped mature beech treeline

Note: Sample tree with multiple compression forks.

Plate 18 – Bridge on grid connection route