Appendix 6.4: Bat Survey Report

EDF Energy Renewables Ltd

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Dunside Wind Farm

Final report
Prepared by LUC
June 2023

EDF Energy Renewables Ltd

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Dunside Wind Farm

Project Number
11838

Version	Status	Prepared	Checked	Approved	Date
1.	Draft for internal review	E. McMurchy	H. Embleton	S. Jackson-Matthews	01.03.2023
2.	For client/legal review			L. McGowan	09.05.2023
3.	Client/Legal review			Legal	15.05.2023
4.	Final	E. McMurchy	H. Embleton	S. Jackson-Matthews	22.05.2023

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Contents

Chapter 1
Introduction

1.1 This appendix details the methods and results of the bat surveys undertaken to inform the Ecological Impact Assessment (EcIA) of the proposed Dunside Wind Farm (hereafter referred to as the 'Proposed Development').

1.2 This appendix has been written to support **Chapter 6: Ecology** of the Environmental Impact Assessment Report (EIA Report) and should be read in conjunction with this chapter and **Chapter 7: Ornithology**.

1.3 This appendix supports the EcIA in addition to the following EIA Report Appendices:

- **Appendix 6.1**: Desk Study and Legal Context.
- **Appendix 6.2**: Habitats and Vegetation (including National Vegetation Classification) Survey Report.
- **Appendix 6.3**: Protected Species Survey Report.
- **Appendix 6.5**: Badger Survey Report (Confidential).
- **Appendix 6.6**: Outline Restoration and Enhancement Plan (OREP).
- **Appendix 6.7**: Shadow Habitat Regulations Assessment.
- **Appendix 6.8**: Peat Condition Assessment.

1.4 This appendix is supported by the following figures:

- **EIA Report Figure 6.1**: Ecology Survey Area.
- **EIA Report Figure 6.7**: Static Bat Detector Equipment Location Plan.
- **EIA Report Figure 6.8**: Bat Activity Map.

Scope

1.5 LUC was appointed by EDF Energy Renewables Ltd to complete a suite of ecological surveys, including protected species surveys, to inform an EIA of the proposed Dunside Wind Farm.

1.6 In March 2022 LUC submitted a Scoping Report[1] (on behalf of the Applicant) as a means of agreeing the full scope of surveys relevant to the EIA. This included undertaking a suite of bat surveys as described below within the Study Area between April 2022 and October 2022.

1.7 Other protected species and ornithology are outwith the scope of this report. Other protected species are included in **EIA Report Appendix 6.3 and 6.5** and ornithology is assessed in **Chapter 7: Ornithology** of the EIA Report.

Site Overview

1.8 The Site is located within the Lammermuir Hills, within the administrative boundary of Scottish Borders Council. The northern Site boundary is also the boundary between the Scottish Borders and East Lothian. The Site is approximately 6 km north of the settlement of Westruther and 7 km to the west of the settlement of Longformacus (to the nearest indicative turbine location).

1.9 The Site consists of a varied topographic setting of heavily managed moorland dominated by heather, with numerous river valleys, steep sloping hillsides and gently sloping hilltop areas which predominately drain into the Dye Water catchment (a tributary of the River Tweed). The Dye Water flows to the east through the centre of the Site and joins the Whiteadder Water downstream of the Site. Notable hills within the Site include: Meikle Law (468 m AOD) in the north-west; Byrecleugh Ridge (440

[1] LUC (2022) Dunside Wind Farm Project. Environmental Impact Assessment – Scoping Report Ecology

m AOD) in the north, Dunside Hill (437 m AOD) in the south-east, and Wedder Lairs (486 m AOD) in the west. The main land uses are sheep grazing and moorland managed for grouse shooting with the adjacent land to the north-west used for renewable energy production (the operational Fallago Rig Wind Farm).

1.10 The majority of the habitats within the Site have been influenced to varying extents by grazing pressure, recent and historical burning and artificial drainage. The Proposed Development is described in greater detail within **Chapter 3: Development Description** within the EIA Report.

Terminology and Survey Areas

1.11 The following terminology will be used throughout this Technical Appendix:

- **Site**
  - All land within the red line boundary (as shown in **Figure 6.1**).
- **Proposed Development**
  - The whole physical process involved in the construction, operation and decommissioning of a Wind Farm at the Dunside Site (i.e. not associated with a particular piece of land).
  - Comprises a windfarm of up to 15 turbines and associated infrastructure. A detailed description of the Proposed Development is included **Chapter 3**).
- **Developable Area**
  - The area where the turbines are proposed to be sited (including all associated infrastructure).
- **Bat Survey Area (BSA)**
  - The area within which bat surveys were undertaken in line with good practice guidelines[2]. The Bat Survey Area was therefore defined as a 200 m buffer plus rotor radius (90 m) of proposed turbine locations (as shown in Figure **6.4.1**).
- **Study Area**
  - The Study Area for habitats and vegetation was defined as the red line boundary plus a buffer of up to 250 m, in line with good practice guidelines. The Study Area is illustrated in **Figure 6.1**.

[2] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].

Chapter 2
Methodology

2.1 NatureScot released survey guidance in January 2019, which was updated with minor revisions in August 2021[3], with a view to standardising windfarm-related bat survey best practice in the UK. This guidance has been followed as far as reasonably practicable.

Desk Study

2.2 A desk study was undertaken to provide information relating to the historical presence of bats within the Site and a 10 km buffer. An account of the method adopted, and findings, is provided in **EIA Report Appendix 6.1: Legislation Context and Desk Study**, which also sets out the legislative provisions afforded to protected species. Where available, data was gathered from existing national surveys and incidental records, identified through publicly available records within the Desk Study Area. Only records from the year 2000 onwards have been included in this study.

Field Surveys

Bat Roost Potential (BRP)

2.3 An assessment for BRP was undertaken on trees and structures within the BSA following assessment criteria set out in standard guidance prepared by the Bat Conservation Trust (BCT)[4].

2.4 The criteria used to categorise BRP are summarised in Table 2.1. The table also summarises what surveys, if any, are required for each category.

Table 2.1: BRP Categories

Category	Roosting Habitat Features	Commuting and Habitat Features	Survey Requirement
Negligible	Negligible habitat features likely to support roosting, commuting or foraging bats.		No surveys required.
Low	Structures in this category offer one or more potential roost sites for individual, opportunistically roosting bats. These sites do not offer the space, shelter or appropriate conditions to support large numbers of bats or maternity roosts. Trees in this category include those of sufficient size and age to support suitable roosting features, but none are visible from the ground.	Habitat on and around the Site could be used by a small number of commuting bats. This category includes densely urbanised landscapes or linear vegetation features poorly connected to the wider landscape (e.g., gappy hedges in an agricultural context).	One dusk or dawn survey required for structures. No surveys required for trees.

[3] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[4] Collins, J. (ed.) (2016). Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edition). The Bat Conservation Trust, London.

Category	Roosting Habitat Features	Commuting and Habitat Features	Survey Requirement
Moderate	Structures and trees in this category offer one or more roost site that, due to their space, shelter or conditions, offer roosting potential for a range of species. Roosts may be more permanent, rather than opportunistic. Small maternity roosts of common species may form in one of these roost sites.	Habitat on and around the Site is well-connected to wider continuous habitat and offers commuting and foraging habitat to a larger number of bats across a number of species (e.g., tree lines or linked gardens in the urban context, or continuous hedge/ tree lines and watercourses in an agricultural setting).	One dusk and one dawn survey required for both structures and trees. Tree-climbing may be an appropriate alternative to dusk and dawn surveys.
High	Structures and trees in this category have one or more potential roost sites that are suitable for large number of bats. Roosts are likely to be permanent and include maternity roosts. Potential roost sites exist for a wide range of species or species of particular conservation interest.	Habitat on and around the Site is diverse, continuous and linked to extensive suitable habitat. This category includes well-vegetated rivers, streams, hedgerows and woodland edge. Habitat is sufficiently diverse to offer opportunities to a wide range of species or those of particular conservation interest.	Three surveys, including both dusk and dawn elements. Tree-climbing may be an appropriate alternative to dusk and dawn surveys.

Ground Level Static Surveys

2.5 In accordance with NatureScot guidance[5], 13 ground-level automated detectors were deployed across the BSA based on the turbine layout at the time of undertaking Scoping. The survey was based on the footprint, oversail and anticipated land take of a 17 turbine layout. However, during the design phase the number of turbines was subsequently reduced to 15. The BSA and survey coverage remains valid for the final 15-turbine layout.

2.6 The BSA consists of undulating hills and valleys dominated by mosaics of heavily modified dry heath and acid grassland habitats. Pockets of disturbed blanket bog are present at the highest points. Agricultural land was present along the banks of the Dye Water, which runs through the centre of the BSA. Agricultural fields containing livestock were comprised of improved and semi-improved grassland. Valley slopes were often dominated by bracken or marshy grassland.

2.7 Detectors were deployed as evenly as possible across the BSA, while also being deployed as close as possible to the proposed turbine locations (based on the Scoping turbine layout under consideration at the time of the surveys).

2.8 Thirteen Wildlife Acoustics full spectrum detectors were deployed, comprising a combination of detector types (Song Meter SM4 and SM Mini).

2.9 In line with best practice guidelines[6], detectors were deployed for a minimum of ten consecutive nights in each of the designated survey 'seasons' of Spring (April-May), Summer (June – mid-August) and Autumn (mid-August – October). Details of survey periods are provided in **Table 2.2**.

[5] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[6] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].

2.10 A Davis 'Vantage View' weather station (Model No: 6120UK) was deployed across all survey seasons at an approximate elevation of 390 m (Grid Reference NT 60451 58664). Data collected from the weather station was used to provide climatic information across the three survey seasons.

Table 2.2: Ground-Level Static Survey Deployment Dates

Season	Dates Deployed	No. of Consecutive Nights
Spring	20 April – 05 May 2022	15
Summer	05 July – 21 July 2022	16
Autumn	29 September – 13 October 2022	14

2.11 **Table 2.3** provides details of detector locations and their proximity to turbines, as well as the surrounding habitat. Detector locations are also shown in **Figure 6.7**.

Table 2.3: Detector Location Details

Detector Number	Grid Reference	Elevation	Nearest Turbine	Proximity to Nearest Turbine	Habitat Type
1	NT 60041 59247	455 m	4	445 m	Dry Dwarf Shrub Heath
2	NT 59901 59845	460 m	1	485 m	Dry Modified Bog
3	NT 61311 59996	425 m	2	215 m	Dry Dwarf Shrub Heath
4	NT 62166 59319	410 m	3	694 m	Dry Dwarf Shrub Heath
5	NT 61471 59159	390 m	5	496 m	Dry Dwarf Shrub Heath
6	NT 61065 58407	380 m	8	251 m	Dry Modified Bog
7	NT 59586 58275	420 m	7	467 m	Dry Dwarf Shrub Heath
8	NT 60119 58012	435 m	7	172 m	Dry Modified Bog
9	NT 60222 57359	465 m	10	127 m	Dry Modified Bog / Acid Grassland
10	NT 61621 57904	365 m	8	556 m	Dry Dwarf Shrub Heath
11	NT 61388 57243	425 m	13	231 m	Dry Modified Bog
12	NT 61374 56548	445 m	14	218 m	Dry Modified Bog
13	NT 62013 56597	42 m	15	142 m	Marshy Grassland

2.12 To allow for temporal comparison, where possible, detectors were deployed at the same locations during each season, however minor changes to the placement of the detector may have occurred as a result of different surveyors undertaking the deployment.

2.13 All detectors were programmed to start recording 30 minutes before sunset and stop recording 30 minutes after sunrise.

Analysis

2.14 Bat passes from SM4, SM mini and Anabat Express detectors were analysed using Kaleidoscope Pro software. Data was first analysed using the 'Auto ID' feature before manual verification was undertaken by suitably experienced ecologists.

2.15 Analysis of bat species data was undertaken using the traditional Bat Activity Index (BAI) calculations. Using knowledge of bat species distribution across Scotland, suitably qualified ecologists evaluated the data based on the geographic location and habitat features of the BSA.

2.16 Ecobat was not used within this report as it was undergoing essential maintenance at the time of writing (see **Constraints and Limitations**).

Bat Activity Index (BAI)

2.17 To allow for an accurate and reliable comparison of bat passes between detector locations and across all three survey seasons, a Bat Activity Index (BAI) was calculated. BAI is calculated by taking the number of bat passes (in this instance per species/genus, per detector location) and dividing it by the number of hours recorded. This will give the number of bat passes per hour[7].

2.18 Full-spectrum sound files are approximately 14 seconds long, so it is not always possible to distinguish if the file contains multiple calls from a single bat or single calls from multiple bats. For this reason, as a measure of standardisation, one individual was recorded for each species recorded in a single sound file and bat 'calls' are referred to as bat 'passes'.

2.19 This calculation of BAI allows relative comparisons between bat species and allows an exploration of patterns of usage within the BSA, as well as use of the BSA across different seasons. It also removes any bias created by the variation in the duration of the static detector deployment periods.

Risk Assessment

2.20 To quantify the risk of the Proposed Development to bats, site-based risk factors are incorporated into the analysis. This consists of a two-stage process. Stage one consists of scoring the predominant habitat based on habitat suitability for bats from Low (1) to High (3) based on the potential to support bats, by assessing the roosting, foraging and commuting opportunities present.

2.21 The second stage is to conduct a three-factor analysis utilising development-related features to score the project size from Low (1) to High (3)[8]. This involves assessing the number of proposed turbines, the height of proposed turbines, and wind developments within 5 km or 10 km (dependent on number of proposed turbines) of the Site, to provide an overall project size score.

2.22 An overall 'Site Risk Level' for the final layout of the Proposed Development can then be determined using the risk assessment matrix from the NatureScot guidance[9].

Constraints and Limitations

2.23 As of January 2023, Ecobat[10] has been offline due to essential maintenance. There is currently no timeline for when the software will be operational. The Mammal Society have highlighted that NatureScot are aware of the maintenance which is preventing users from analysing bat data. Ecobat has become the standardised method of assessing bat activity in relation to collision risk for onshore wind farms. In the absence of Ecobat, NatureScot[11] guidance has been followed as far as reasonably practicable.

2.24 During the Spring deployment, Detector 3 failed to record data due to a technical fault. In Summer and Autumn, Detector 9 also failed to record data due to technical difficulties. This issue may have resulted in bat passes not being recorded. Given that the remaining 11 detectors were deployed in similar habitats and successfully recorded throughout all survey seasons, the failure is unlikely to have had a substantive effect on the validity of survey results.

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[7] Hundt, L. (2012). Bat Surveys: Good Practice Guidelines (2nd Edition). Bat Conservation Trust, London.
[8] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[9] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[10] The Mammal Society (2017). Ecobat. Available at: http://www.ecobat.org.uk/ [Accessed January 2023].
[11] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].

2.25 During field surveys, it was not possible to fully survey all structures for BRP due to access permission limitations. However, it is confirmed that the buildings were avoided through design. BRP only affects buildings which are proposed to be removed for the development.

2.26 It should be noted that the weather station was deployed at an elevation of approximately 390 m, therefore temperatures in general are likely to be lower than at sea level as temperature decreases by approximately 1-3°C with every 300 m in elevation gain[12]. It is also important to consider that wind speed increases with elevation due to changes in the pressure gradient, surface friction and air density[13]. Therefore, wind speeds recorded at the BSA are likely to be higher than at sea level.

2.27 Minor changes to the placement of each detector have occurred as a result of different surveyors undertaking the deployment and the accuracy of GPS equipment which varied by a maximum of 5 m. These differences were minimal and therefore the data recorded during each season was considered suitable to undertake a reliable comparison.

2.28 The timeframe in which a survey is undertaken provides a snapshot of activity within the BSA and will not necessarily detect all evidence of use by a species. Ecological surveys are limited by a variety of factors which affect the presence of flora and fauna such as season, migration patterns and species behaviour. Evidence of species is not always discovered during the survey. This does not mean that a species is absent.

2.29 None of the constraints and limitations are considered material and the data collected through the survey, and subsequently assessed in the EcIA, are robust and reliable.

[12] Let's Talk Science (2020). Weather: Temperature (Online). Available at: https://letstalkscience.ca/educational-resources/backgrounders/weather-temperature [Accessed January 2023].
[13] Haby. J. (n.d.). Wind Speed Increasing with Height (Online). Available at: https://www.theweatherprediction.com/habyhints3/749/ [Accessed January 2023].

Chapter 3
Results

Desk Study

3.1 Historical records identified recordings (4,041 in total) of the following species within the 10 km Desk Study Area:

- Soprano pipistrelle *Pipistrellus pygmaeus* (2,251);
- Common pipistrelle *Pipistrellus pipistrellus (*1,376);
- Daubenton's bat *Myotis daubentonii* (207);
- Noctule bat *Nyctalus noctule* (103);
- Natterer's bat *Myotis nattereri* (50);
- Unidentified *Myotis* species (43);
- Brown long-eared bat *Plecotus auratus* (6);
- Unidentified *Pipistrellus* species (3); and
- Unidentified bat species (2).

3.2 None of the records listed above were from within the BSA.

Field Survey

3.3 Twenty-seven trees were recorded within the Site as having 'Low' to 'Moderate' BRP (**Figure 6.8**). However, only four were located within the BSA. Three structures were recorded within the BSA as having 'Negligible' to 'Low' BRP (**Figure 6.8**). The trees and structures are summarised in **Table 3.1**.

Table 3.1: BRP of Trees and Structures within the BSA

Tree Species	Age	Grid Reference	Features	Category
Within the BSA				
Rowan (*Sorbus aucuparia*)	Granny	NT 60638 59646	■ Decay ■ Limb Wound ■ Loose Bark	Moderate
Birch (*Betula pendula*): three trees	Mature	NT 61615 58674	■ Decay ■ Cavity	Moderate
Birch: four trees	Low	NT 61622 58810	■ Crack ■ Rot Hole	Low
Rowan	Dead	NT 61547 58064	■ Rot Hole	Low
Within the Site				
Birch	Mature	NT 62897 57802	■ Limb Wound ■ Loose Bark	Moderate

Tree Species	Age	Grid Reference	Features	Category
			■ Crevice	
Rowan	Mature	NT 61733 58346	■ Crevice	Moderate
Rowan	Mature	NT 62751 57748	■ Crevice ■ Loose Bark ■ Knot Hole	Moderate
Ash (*Fraxinus excelsior*)	Mature	NT 63020 57915	■ Knot Hole	Low
Rowan	Mature	NT 61720 58353	■ Crevice	Low
Rowan	Mature	NT 62679 58752	■ Fissure ■ Rot Hole	Low
Rowan: three trees	Two Mature One Dead	NT 62706 57788	■ Limb Wound ■ Rot Hole	Low
Rowan	Mature	NT 62823 57787	■ Limb Wound	Low
Rowan	Mature	NT 61654 58263	■ Decay ■ Loose Bark	Low
Silver birch (*Betula pendula*)	Mature	NT 62610 58842	■ Crack	Low
Silver birch	Mature	NT 62649 58825	■ Crack	Low
Silver birch	Mature	NT 62827 57788	■ Fissure	Low
Silver birch	Mature	NT 62869 57796	■ Crack	Low
Silver birch	Mature	NT 62881 57800	■ Rot Hole ■ Crack	Low
Silver birch	Granny	NT 62955 57827	■ Decay	Low
Willow spp. (*Salix*)	Granny	NT 63075 57822	■ Decay	Low
Structure	**Description**	**Grid Reference**	**Features**	**Category**
Wooden Chalet	One-storey wooden chalet with wooden planks.	NT 60704 58435	■ Slate Roof ■ Gaps in Woodwork	Low
Wooden Chalet	One-storey wooden chalet with logs.	NT 61180 58859	■ Gaps in Woodwork	Low
Corrugated Iron Shed	Small shed clad in corrugated iron. Propped up on wooden stilts.	NT 61162 58884	N/A	Negligible

Ground Level Static Surveys

3.4 A total of 419 hours of recording were undertaken across the three survey seasons, as detailed within **Table 3.2** below. Due to individual variations between detector deployment duration across survey seasons, only the average hours recorded, and average number of days are presented. There is also some variation in number of hours due to the changes in night length.

Table 3.2: Recording Hours During Each Survey Season

Season	Average Number of Hours Recorded	Average Number of Consecutive Nights Recorded
Spring	132	14.7
Summer	105	15
Autumn	182	14
Total	**419**	**42**

Weather Data Summary

3.5 Data from an onsite weather station was analysed according to NatureScot guidance[14], and is presented in **Table 3.3**.

Table 3.3: Summary of Weather Data (Averages and Range Provided)

Deployment Dates	Consecutive Nights Recorded	Temperature (°C)	Days Average Temperature Above 8°C	Wind Speed (m/s)	Precipitation (mm)	Days ≤1mm
Spring 2022						
20 April – 05 May	15	11.7 (7.0-19.0)	13	8.9 (5.4-12.5)	0.55 (0.0-2.8)	12
Summer 2022						
06 July – 21 July	14	21.5 (17.0-30.0)	15	10.5 (3.1-18.3)	0.33 (0.0-3.8)	14
Autumn 2022						
30 September – 13 October	13	12.7 (11.0-17.0)	14	15.9 (6.3-21.5)	1.57 (0.0-8.2)	8

Bat Activity Index (BAI) Results

3.6 As stated in **Constraints and Limitations**, it is important to note when interpreting the results that Detector 3 failed to record during the Spring deployment, and Detector 9 also failed to record data in Summer and Autumn due to a technical fault. However, the volume and extent of data collected from all deployed detectors across all three survey periods provides confidence that the dataset is sufficiently robust.

Species Variation

3.7 The following species were recorded during the static surveys:

[14] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].

- Common pipistrelle *Pipistrellus pipistrellus*;
- Soprano pipistrelle *Pipistrellus pygmaeus*;
- Unidentified *Pipistrellus* species;
- Brown long-eared bat *Plecotus auratus*;
- Unidentified *Myotis* species;
- Daubenton's bat *Myotis daubentonii*;
- Leisler's bat *Nyctalus leisleri*;
- Noctule bat *Nyctalus noctule*; and
- Unidentified *Nyctalus* species.

3.8 To allow for a comprehensive assessment, all bats are referred to in terms of their genus (*Pipistrellus* spp., *Plecotus* spp., *Nyctalus* spp. and *Myotis* spp.).

3.9 *Pipistrellus* spp. were dominant during the static surveys, accounting for a total of 78.36% of the total bat passes recorded across all three seasons. *Nyctalus* spp. were the second most dominant species, accounting for 14.97%. *Myotis* spp. and *Plecotus* spp. were occasionally recorded and accounted for 5.65% and 1.02% of bat activity, respectively.

3.10 The BAI for each genus at each location, across each season, is presented in **Table 3.4** below.

Table 3.4: BAI According to Genus per Detector Location Across Survey Seasons

Detector Location	BAI per Survey Season (2 d.p.)		
	Spring	Summer	Autumn
1			
Pipistrellus spp.	0.00	0.04	1.21
Plecotus spp.	0.00	0.00	0.01
Myotis spp.	0.00	0.00	0.12
Nyctalus spp.	0.02	0.00	0.14
2			
Pipistrellus spp.	0.01	0.10	0.00
Plecotus spp.	0.00	0.00	0.00
Myotis spp.	0.00	0.00	0.00
Nyctalus spp.	0.01	0.00	0.00
3			
Pipistrellus spp.	No Data	0.10	0.01
Plecotus spp.	No Data	0.00	0.00
Myotis spp.	No Data	0.00	0.00
Nyctalus spp.	No Data	0.04	0.00

Detector Location	BAI per Survey Season (2 d.p.)		
	Spring	Summer	Autumn
4			
Pipistrellus spp.	0.01	0.25	2.23
Plecotus spp.	0.00	0.00	0.05
Myotis spp.	0.00	0.00	0.18
Nyctalus spp.	0.00	0.02	0.62
5			
Pipistrellus spp.	0.00	0.00	0.12
Plecotus spp.	0.00	0.00	0.00
Myotis spp.	0.00	0.00	0.04
Nyctalus spp.	0.01	0.01	0.01
6			
Pipistrellus spp.	0.02	0.25	0.01
Plecotus spp.	0.00	0.00	0.00
Myotis spp.	0.00	0.00	0.01
Nyctalus spp.	0.00	0.01	0.00
7			
Pipistrellus spp.	0.00	0.16	0.00
Plecotus spp.	0.00	0.00	0.00
Myotis spp.	0.01	0.00	0.00
Nyctalus spp.	0.00	0.01	0.00
8			
Pipistrellus spp.	0.01	0.17	0.00
Plecotus spp.	0.01	0.00	0.00
Myotis spp.	0.01	0.02	0.00
Nyctalus spp.	0.01	0.00	0.00
9			
Pipistrellus spp.	0.01	0.17	0.00
Plecotus spp.	0.01	0.00	0.00

Detector Location	BAI per Survey Season (2 d.p.)		
	Spring	Summer	Autumn
Myotis spp.	0.01	0.02	0.00
Nyctalus spp.	0.01	0.00	0.00
10			
Pipistrellus spp.	0.00	0.00	0.00
Plecotus spp.	0.00	0.00	0.00
Myotis spp.	0.00	0.00	0.00
Nyctalus spp.	0.00	0.00	0.00
11			
Pipistrellus spp.	0.01	0.18	0.00
Plecotus spp.	0.00	0.00	0.00
Myotis spp.	0.00	0.00	0.00
Nyctalus spp.	0.02	0.02	0.00
12			
Pipistrellus spp.	0.00	0.35	0.01
Plecotus spp.	0.00	0.01	0.00
Myotis spp.	0.00	0.00	0.00
Nyctalus spp.	0.02	0.05	0.00
13			
Pipistrellus spp.	0.03	0.55	0.01
Plecotus spp.	0.00	0.00	0.00
Myotis spp.	0.00	0.00	0.00
Nyctalus spp.	0.03	0.02	0.00

Spatial Variation – Total BAI

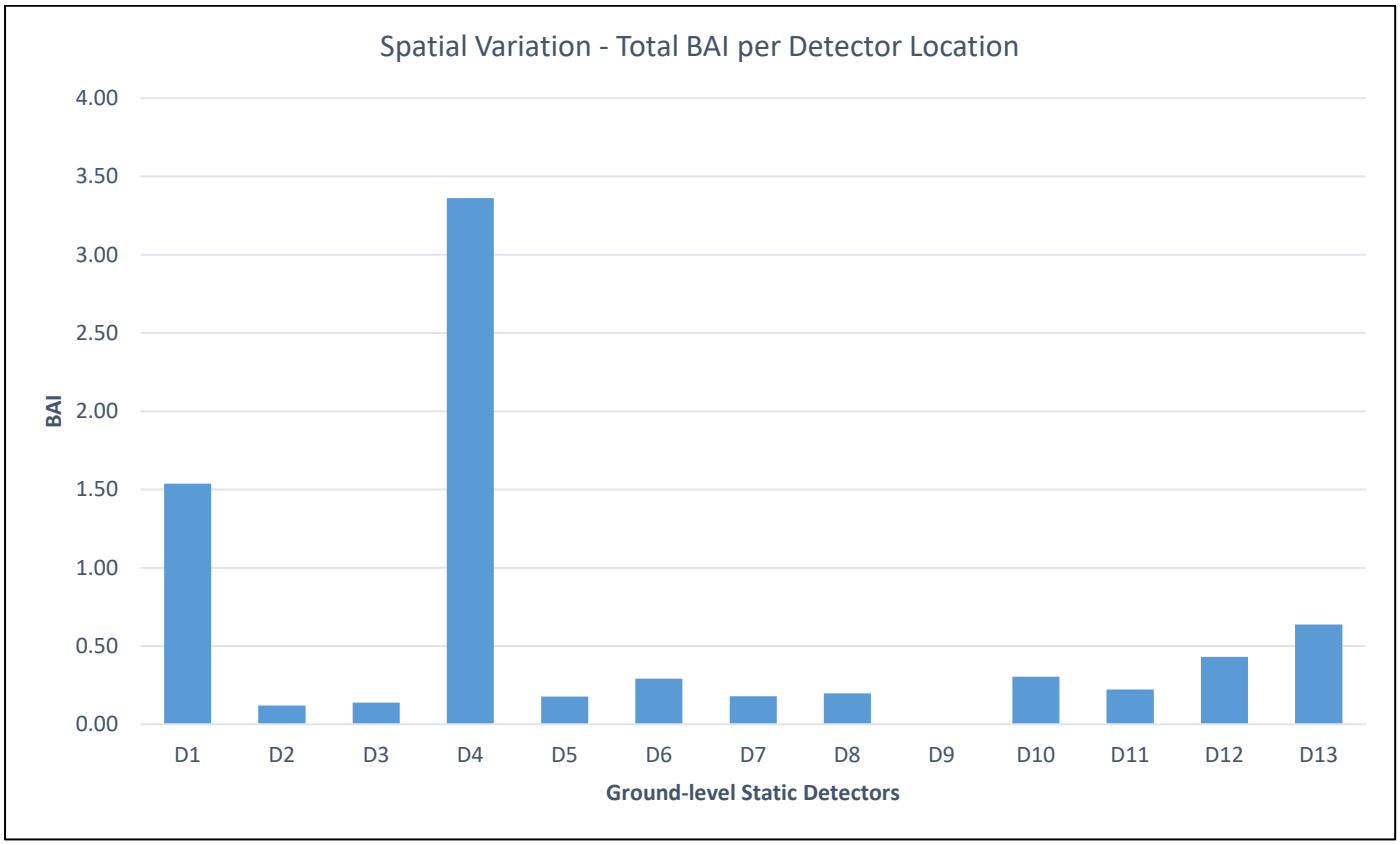
3.11 The results from the 13 detectors are shown in **Figure 6.7**, **Table 3.4** and **Chart 3.1**. The detectors with the highest BAI scores were mostly within the north of the BSA, where there was a higher abundance of broadleaved woodland, scattered trees and semi-improved or improved grassland. Additionally, detectors with the highest BAI scores were often located close to valleys containing small watercourses.

3.12 Detector 4, which was located adjacent to Byrecleugh Burn in the north-east of the BSA and 350 m north-west of broadleaved woodland, recorded the highest BAI (3.36). Detector 1 recorded the second highest BAI (1.54) and was located to the north-west of the BSA within dry dwarf shrub heath at the peak of Meikle Law. It was also located close to the Dye Water and adjacent to a valley which contained the Burn Betwixt the Laws.

3.13 The rest of the detectors recorded significantly lower BAI scores. Detectors 10, 12 and 13 recorded the fifth to third highest BAI scores with BAI scores of 0.30, 0.43 and 0.64 respectively, and were located within the south-east of the BSA. Detector 13 was located within marshy grassland 260 m south of the Hall Burn, Detector 12 was located within blanket bog and Detector 10 was located within dry dwarf shrub heath, 100 m east of the Foul Cleugh.

3.14 Detectors 2, 3, 5, 6, 7, 8, 9 and 11 recorded the lowest BAI scores ranging from 0.00 to 0.29. These detectors were located within the west and centre of the BSA at higher elevations and were located within expanses of dry dwarf shrub heath or modified bog habitats. These areas lacked linear features, trees and foraging opportunities for bat species.

Chart 3.1: Spatial Variation - Total BAI per Detector Location

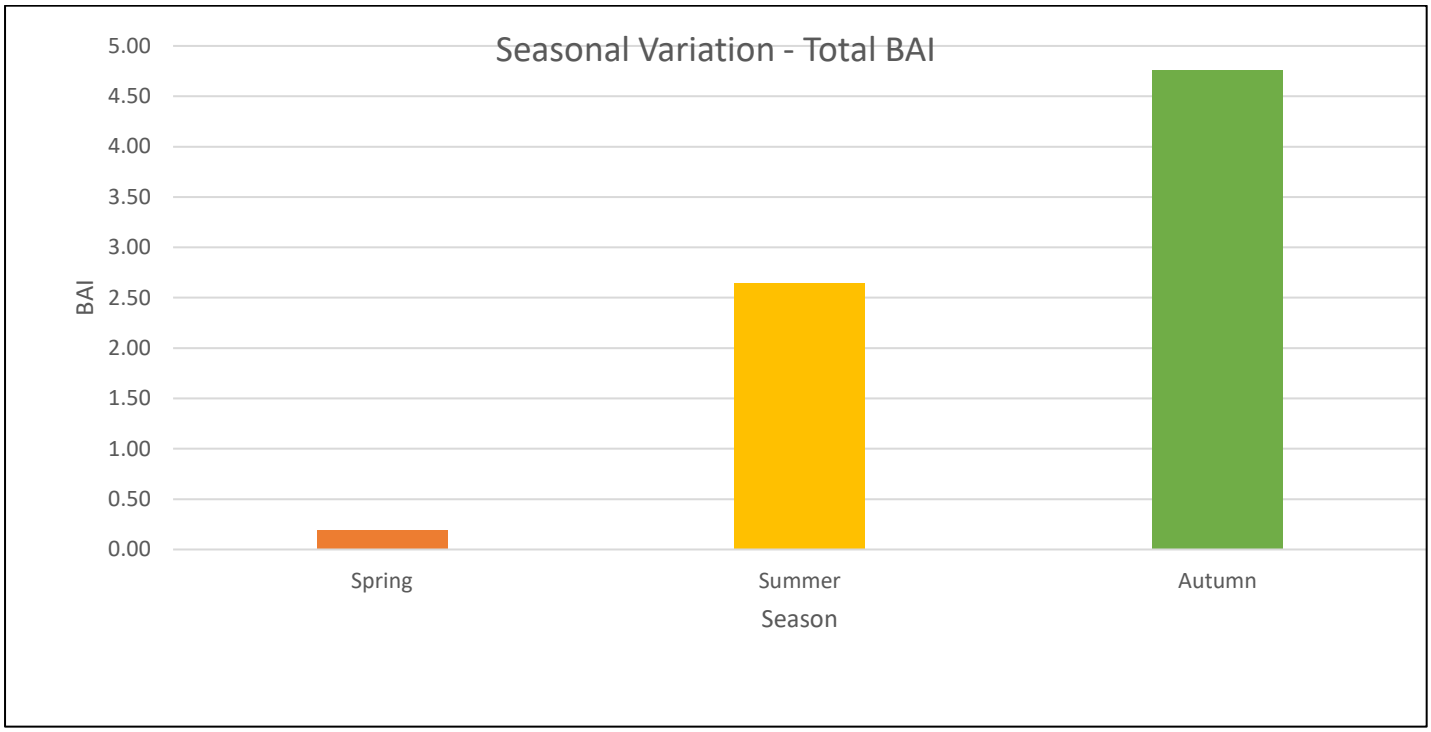


Seasonal Variation – Total BAI

3.15 Total BAI was calculated to allow comparison across the three survey seasons (**Chart 3.2**).

3.16 Activity levels were highest in Autumn (BAI 4.76), second highest in Summer (BAI 2.65) and lowest in Spring (BAI 0.19).

Chart 3.2: Seasonal Variation – Total BAI



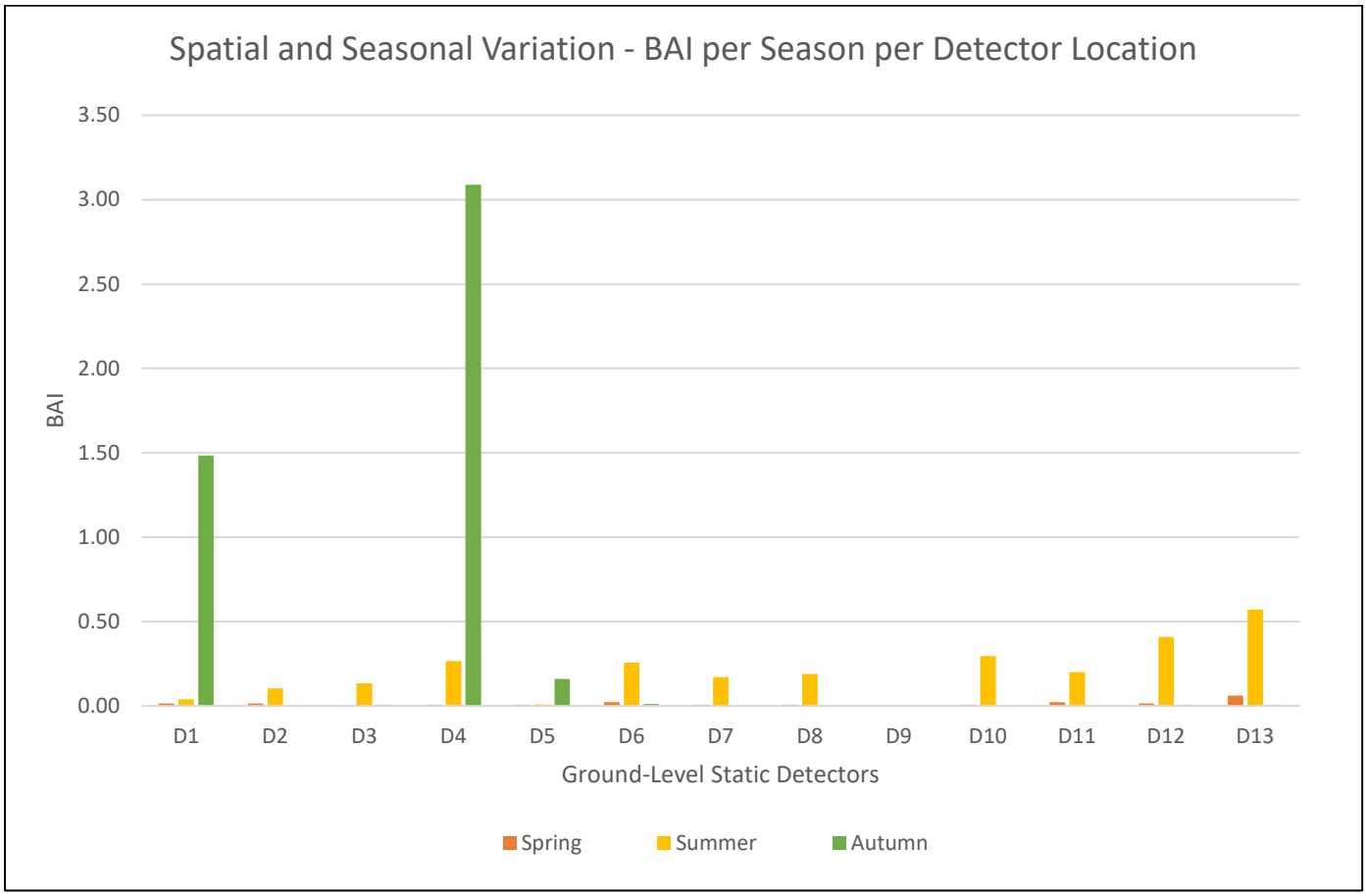
Spatial and Seasonal Variation – BAI per Season per Detector Location

3.17 Seasonal variation across detector locations is shown in b.

3.18 The highest activity was recorded in Autumn, with Detectors 1 and 4 recording the highest BAI scores (BAI 1.48 and 3.09 respectively). Activity levels during the Summer were much lower with BAI scores ranging from 0.01 to 0.57. Detectors 12 and 13 had the highest BAI scores in Summer (BAI 0.41 and 0.57 respectively). BAI scores for Spring were extremely low, ranging from 0.00 to 0.06 across all detectors.

3.19 Excluding Detectors 1 and 4, activity levels across the BSA were very low. The remaining detectors all recorded appreciably lower BAI scores across all three seasons. Detectors 1 and 4 recorded 276 and 591 passes respectively, across the survey period. All other detectors recorded ≤ 69 passes across all three seasons. Excluding Detector 9 (which experienced technical difficulties in Summer and Autumn, see **Constraints and Limitations**), Detector 2 recorded the lowest BAI (BAI 0.12), only recording 13 passes.

Chart 3.3: Spatial and Seasonal Variation – BAI per Season per Detector Location



Seasonal Variation – BAI per Genus

3.20 **Table 3.5** and **Chart 3.4** summarise BAI per genus, across all seasons.

3.21 *Pipistrellus* spp. activity levels followed the same pattern as total bat activity, with the highest levels in Autumn (BAI 3.58), slightly lower levels in Summer (BAI 2.40), and markedly reduced levels in Spring (BAI 0.09).

3.22 *Nyctalus* spp. activity levels followed a similar trend, with peak levels in Autumn (BAI 0.77). Lower levels of activity were recorded in the Spring and Summer (BAI 0.09 and 0.22 respectively).

3.23 *Myotis* spp. activity levels were very low throughout the survey period. Activity was highest in Autumn (BAI 0.35). Spring and Summer activity levels (BAI 0.01 and 0.02 respectively) were very low.

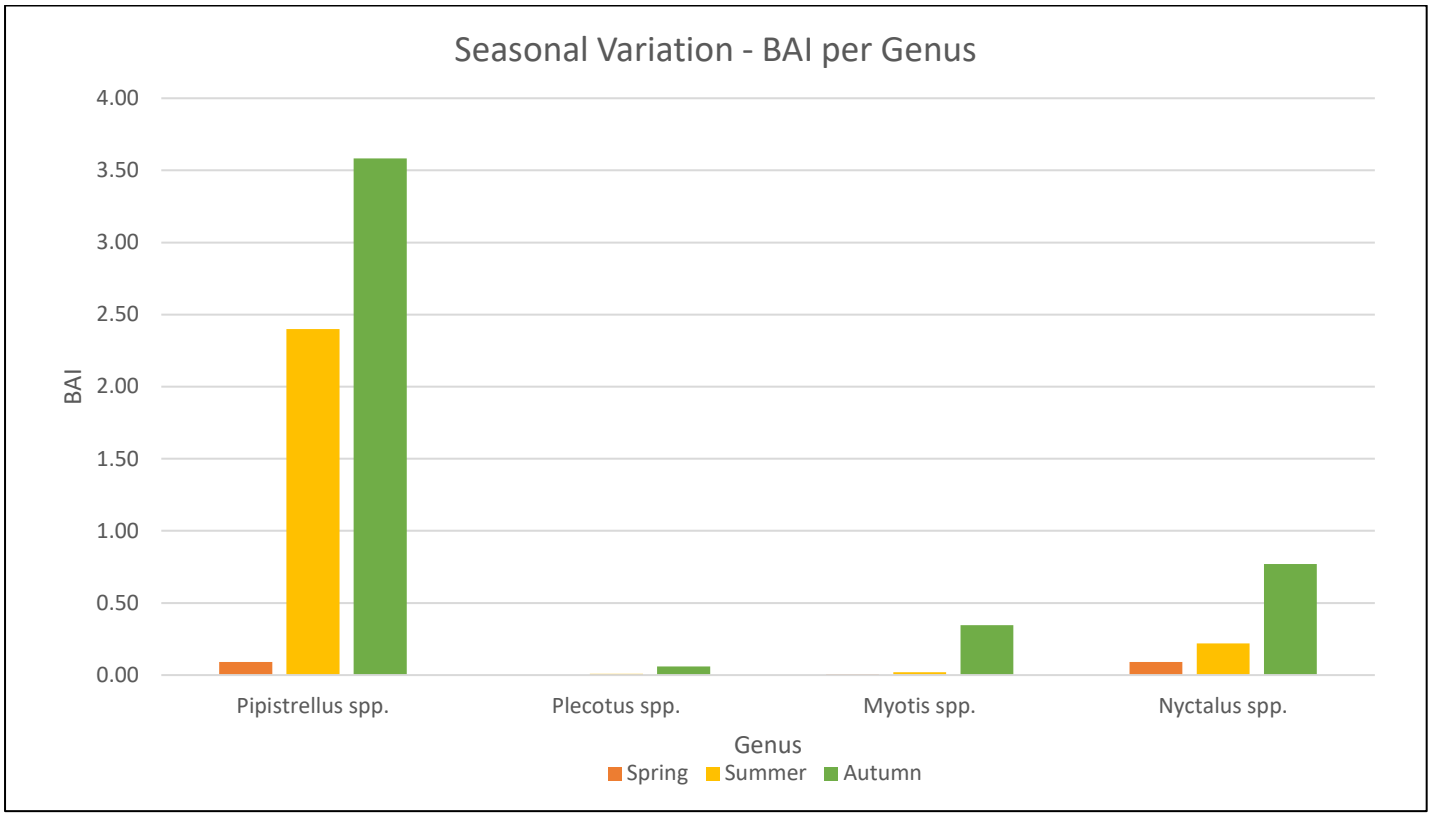
3.24 *Plecotus* spp. activity levels were very low throughout the survey period, with a total of 12 passes recorded across all seasons and detectors. Autumn recorded the highest activity levels (BAI 0.06). Summer activity levels (BAI 0.01) were minimal, and no passes were recorded in Spring.

Table 3.5: Total BAI per Genus per Season

Species	BAI per Survey Season (2 d.p.)		
	Spring	Summer	Autumn
Pipistrellus spp.	0.09	2.40	3.58
Plecotus spp.	0.00	0.01	0.06

Species	BAI per Survey Season (2 d.p.)		
	Spring	Summer	Autumn
Myotis spp.	0.01	0.02	0.35
Nyctalus spp.	0.09	0.22	0.77

Chart 3.4: Seasonal Variation – BAI per Genus



Chapter 4
Discussion and Interpretation

Desk Study

4.1 Of the 4,041 records noted within 10 km of the Site, 3,630 (or 89.83%) were of common and widespread *Pipistrellus* species. There were 207 records (5.12%) of Daubenton's bat, 103 records (2.55%) of Noctule bat, 50 records (1.24%) of Natterer's bat, 43 unidentified *Myotis* spp. (1.06%), 6 (0.15%) brown long-eared bat records and 2 (0.05%) unidentified bat species. Of the species recorded, most are common and fairly widespread species.

4.2 None of the records were located within the BSA. The closest record was located approximately 1.17 km south-west in Westruther.

Bat Roost Potential

4.3 Twenty-seven trees were recorded within the Site as having 'Low' to 'Moderate' BRP. However, only 4 were recorded within the BSA. Three structures were recorded within the BSA as having 'Negligible' to 'Low' BRP.

4.4 Considering the results of the surveys, and that the majority of the BSA does not contain woodland or strong linear features, bat roost potential across the BSA is considered to be very limited.

Ground-Level Static Surveys

Species Variation

4.5 **Figure 6.1**. provides an overview of the genus variation across the Study Area.

4.6 *Pipistrellus* were dominant during the static surveys, accounting for a total of 78.36% of the total bat passes recorded across all three seasons. *Pipistrellus* spp. accounted for 48%, 90.65% and 75.29% of passes in Spring, Summer and Autumn respectively.

4.7 *Nyctalus* spp. were the second most dominant species, accounting for 14.97%. *Myotis* spp. and *Plecotus* spp. were occasionally recorded and accounted for 5.65% and 1.02% of bat activity, respectively.

Spatial Variation

4.8 Spatial variation across detector locations is shown in **Chart 4.1**.

4.9 There was a noticeable difference in overall bat activity across the BSA, with 79.2% of passes recorded in the north (i.e. Dectors 1-5) and 20.8% recorded in the south (I.e. Detectors 6-13). The detectors to the south of the BSA were all located within wet modified bog, dry dwarf shrub heath or marshy grassland habitats with no woodland cover and limited linear features.

4.10 The highest number of passes were recorded at Detector 4, which was located in the north-east of the BSA, close to a small area of broadleaved woodland. Most of these passes (73.27%) were attributed to high *Pipistrellus* spp. activity in Autumn. Across all seasons, Detectors 1 and 13 recorded the second (276 passes) and third (69 passes) highest numbers of total bat passes respectively, although this was considerably lower than the total number of passes (591) recorded at Detector 4.

4.11 *Nyctalus* spp. were the second most dominant species, accounting for 14.97% of total passes. Detector 4 accounted for 65.71% of *Nyctalus* spp. passes.

4.12 Due to the low numbers of *Myotis* and *Plecotus* spp. passes (66 and 12 respectively), it is difficult to extrapolate any conclusions from the dataset. *Myotis* spp. and *Plecotus* spp. were only occasionally recorded and accounted for 5.65% and 1.02% of total bat passes respectively. Detector 4 accounted for 50% of *Myotis* spp. passes and Detector 1 accounted for a further 33.33% of *Myotis* spp. passes. Detector 4 accounted for 10 (83.33%) of the *Plecotus* spp. passes.

4.13 It is likely that *Pipistrellus* and *Nyctalus* spp. are commuting to the BSA using the wide network of minor watercourses within and surrounding the BSA. Whiteadder Reservoir and Hopes Reservoir are located 5 km to the north-west and north-east. The closest waterbody is Watch Water, which lies 500 m east of the access track. Foraging opportunities within the BSA are restricted to minor watercourses and small woodland strips. There are numerous woodland blocks out with the BSA, mainly to the south and east.

Site Risk Assessment

4.14 As per the guidance developed by NatureScot[15], a site risk assessment was conducted to quantify the risk posed to bat habitat by the Proposed Development.

4.15 The habitat is scored from Low to High based on the potential to support bats, by assessing the roosting, foraging, and commuting opportunities present.

4.16 A three-factor analysis is carried out to score the project size from Low (1) to High (3). This involves assessing the number of proposed turbines, the height of proposed turbines, and wind developments within 5 km or 10 km (dependent on number of proposed turbines) of the Site, to provide an overall project size score.

4.17 An overall 'Site Risk Level' for the Proposed Development can then be determined using the risk assessment matrix from the NatureScot guidance[16] (see **Table 4.1**).

Table 4.1: Initial Site Risk Assessment Matrix

	Project Size			
Habitat Risk		Small	Medium	Large
	Low	1	2	3
	Medium	2	3	4
	High	3	4	5

Habitat Risk

4.18 The BSA generally lacks favourable roosting and foraging opportunities for bats. This is due to the lack of structures and trees within the BSA with the suitability to support roosting bats. Woodland areas are scare and fragmented, with only a handful of areas noted to contain trees. Areas of scattered trees or woodland were located to the east of the Site, out with the BSA.

4.19 Regarding foraging opportunities, the numerous minor watercourses present throughout the BSA are likely to provide the most productive invertebrate prey source, with forays into more open habitats during suitable weather conditions. However, the absence of waterbodies, mature broadleaved woodland and prominent linear features (e.g. hedgerows, large watercourses and extensive connected broadleaved woodland, means foraging and commuting opportunities for bats are limited. For the reasons stated, the habitat risk is considered to be **Low**.

Project Size

4.20 The Proposed Development comprises up to 15 turbines. This number equates to a Medium project size[17]. However, the turbine blade tips are up to 220 m in height, which is considered to indicate a Large project size[18].

[15] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[16] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[17] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[18] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].

4.21 As of February 2023[19], there is one operational windfarm within 5 km of the BSA. Fallago Rig windfarm, comprising 48 turbines, is operational and is located directly adjacent to the BSA. As there are no other operational wind energy developments within 5 km, this is considered to be indicative of a Large project size[20].

4.22 The project size is therefore arguably either Medium or Large. A conservative approach is preferred, and therefore a **Large** project size has been applied in the following assessment.

Risk Assessment

4.23 Having evaluated the habitat risk as **Low** and the project size is **Large**, the BSA is assessed as having a Site Risk Level of 3 as per **Table 4.1**, which equates to a **Medium** site risk for collision effects on bats.

Collision Risk Assessment

4.24 Following the steps outlined in the NatureScot guidance[21], the Site Risk Level, determined using **Table 4.1**, was used to determine the overall risk to each species categorised as 'high collision risk'.

4.25 High collision risk species in Scotland include the following species:

- Common pipistrelle *Pipistrellus pipistrellus*;
- Soprano pipistrelle *Pipistrellus pygmaeus*;
- Nathusius' pipistrelle *Pipistrellus nathusii*;
- Noctule *Nyctalus noctula*; and
- Leisler's bat *Nyctalus leisleri.*

4.26 High collision risk species recorded within the BSA were common pipistrelle, soprano pipistrelle, noctule and Leisler. *Pipistrellus* spp. accounted for the majority of activity recorded, with total passes of 612 for soprano pipistrelle, 157 for common pipistrelle, and 147 passes assigned to *Pipistrellus* spp. where recording could only be verified to genus. *Nyctalus* spp. activity was lower, with total passes of 130 for Noctule, 19 for Leisler's bat and 26 passes assigned to *Nyctalus* spp. where recording could only be verified to genus.

Population Level Risk Assessment

4.27 In the absence of Ecobat, BAI provides a suitable alternative to analysing activity levels of bats within the BSA, and the risks posed to each species recorded. When interpretating BAI to determine activity levels, consideration has been given to the geographic distribution of each species, the geographic location of the BSA and the habitats recorded within the BSA.

Pipistrellus spp.

4.28 *Pipistrellus* spp. accounted for 78.36% of all bat species recorded across the entire survey period, which equated to a BAI of 2.19. Taking into account that the Site risk was scored as Medium, it is reasonable to conclude that the Proposed Development poses a moderate risk to individual *Pipistrellus* spp, bats. While the risk to *Pipistrellus* spp. individual is moderate, at a population level, the risk to *Pipistrellus* spp. is considered to be low as common and soprano pipistrelles are the most common bat species within the United Kingdom, with an extensive distribution. In addition, NatureScot do not consider common and soprano pipistrelle to be species of high population vulnerability, and therefore no further assessment of collision risk is required for these species[22].

[19] LUC (2023). Windfarm Database [Accessed February 2023].
[20] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[21] NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].
[22]NatureScot (2021). Bats and Onshore Wind Turbines - Survey, Assessment and Mitigation [Online]. Available at: https://www.nature.scot/doc/bats-and-onshore-wind-turbines-survey-assessment-and-mitigation [Accessed January 2023].

Noctule

4.29 Noctule accounted for a total of 130 passes (BAI 0.31) across the survey period. While the Proposed Development poses a moderate risk to this high collision species, the very low activity levels recorded for Noctule implies that the risk to individuals is low, and very low at a population level. Furthermore, there was distinct seasonal variation with 5 passes in Spring, 22 passes in Summer, and 103 passes in Autumn. The noticeable contrast between Spring and Autumn may imply that Noctule are at greater risk at certain times of year. However, the 103 passes in Autumn equates to a BAI of 0.57, which is still considered to be very low.

Leisler's Bat

4.30 Leisler accounted for a total of 19 passes (BAI 0.05) across the survey period. While the Proposed Development poses a moderate risk to this high collision species, the very low activity levels recorded for Leisler implies that the risk to individuals is low, and negligible at a population level. Furthermore, there was distinct seasonal variation with 3 passes in Spring, 1 pass in Summer, and 15 passes in Autumn. However, the 15 passes in Autumn equates to a BAI of 0.08, which is still considered to be very low.

Nyctalus spp.

4.31 A total of 26 passes were only identified to genus level. Taking into account the passes recorded for Noctule and Leisler, a total of 175 passes were assigned to *Nyctalus* spp. With a total BAI of 0.42, the activity level of *Nyctalus* spp. was considered low across the Proposed Development. Autumn recorded the highest activity (BAI 0.77), followed by Summer (BAI 0.22), then Spring (BAI 0.09). The overall risk to individual *Nyctalus* spp. is considered small due to the very low activity levels. At a population level, the risk is considered to be minimal for the aforementioned reason.