ARUP

Cardiff Council

Cardiff International Sport Village & Cardiff Peninsula

Bat Activity Report

01 | 4 January 2024

Job number 295462-00

Ove Arup & Partners Limited
4 Pierhead Street
Capital Waterside
Cardiff
CF10 4QP
United Kingdom
arup.com

ARUP

Document Verification

Project title	Cardiff International Sport Village & Cardiff Peninsula
Document title	Bat Activity Report
Job number	295462-00
File reference	4-50

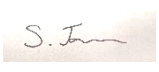
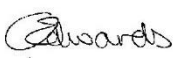
Revision	**Date**		
		Filename	Cardiff International Sport Village & Cardiff Peninsula Bat activity report.docx
01	04/01/2023	**Description**	First draft

	Prepared by	**Checked by**	**Approved by**
Name	S. Jones	C.Edwards	
Signature			

02	**Filename**	Cardiff International Sport Village & Cardiff Peninsula Bat activity report_CE_CDrev. docx
	Description	Review

	Prepared by	**Checked by**	**Approved by**
Name	S. Jones	C. Edwards	C. Delgery
Signature			

Issue	**Filename**	Cardiff International Sport Village & Cardiff Peninsula Bat activity report_Issue.docx
	Description	Issue

	Prepared by	**Checked by**	**Approved by**
Name	S. Jones	C. Edwards	C. Delgery
Signature			

Issue Document Verification with Document ☑

Contents

Tables

Figures

Appendices

1. Introduction

1.1 Background

Ove Arup and Partners Limited (henceforth referred to as 'Arup') has been commissioned by Cardiff Council to undertake a range of design and consultancy services, including environmental, to inform the proposed development/redevelopment of land at Cardiff International Sport Village (ISV) and Cardiff Peninsula (henceforth referred to as the 'site'). This includes the completion of a suite of ecological surveys to determine presence/likely absence of certain targeted species groups that the site was assessed as being suitable to support, of which bats are one.

This report presents the findings of bat activity surveys undertaken at the site and has been prepared to identify any specific constraints and licensing requirements associated with the proposed development in relation to bats. It will also be used to inform the design and construction process by outlining appropriate mitigation measures.

1.2 The Site

The site is located within the ISV area in Cardiff Bay, Cardiff. The site area equates to 16 ha with a central National Grid Reference of ST 18070 73031. The site location is shown on Figure 5.

The site is within an urban setting and comprises of existing ISV facilities, former retail premises, car parking facilities associated with residential premises, brownfield parcels to the east and west of Olympian Drive, and amenity areas associated with commercial and residential facilities within and surrounding the site. The existing ISV infrastructure includes Cardiff International Pool & Gym and Ice Arena Wales on the east of Olympian Drive, and commercial development in form of the former Toys R Us building to the west.

Large areas of hard standing in the form of roads and car parking for the existing infrastructure are present within the site. Areas of amenity grassland and introduced shrub are associated with the existing developed land. The brownfield parcels east and west of Olympian Drive consist of a mosaic of habitats including short perennial, neutral grassland, tall ruderal, reedbed and scrub with areas of bare ground. An area of semi-natural broadleaved woodland borders the northwest of the site located between the site and the A4055 Viaduct. The A4055 Viaduct is a box girder highway bridge that crosses the River Ely, the viaduct has two internal viaduct chambers (referred to as northern and southern chambers in this report) accessed from abutment chambers at either end (referred to as west end and east end within this report). The A4055 Viaduct is approximately 300m in length. The A4055 Viaduct is designated as a Site of Importance for Nature Conservation (SINC) designated for presence of lesser horseshoe bats (*Rhinolophus hipposideros*), roosting within the viaduct chambers. The SINC is named Cogafn Spur, but is referred to as A4055 Viaduct within this report. The eastern end of the viaduct entrance (east abutment chamber) is within 10m of the northwest site boundary.

1.3 The Proposed Development

The proposed development would likely come forward in the form of a hybrid planning application to include:

- Full details in relation to the proposed closed road cycling circuit, activity zones, highway changes and public realm works (hard and soft landscaping);
- Change of use of the former Toys R Us building; and
- Outline details for a future Multi-Storey Car Park (MSCP).

These works form the final stages of the proposed 'Sport Zone' as part of the wider vision for the ISV and following planning permission which was granted in 2022 for the proposed outdoor velodrome.

1.3.1 Full Application

The full element of the application would include a number of proposals which seek to add to the sporting offer within this part of the ISV, or bring together existing and proposed uses, creating a high-quality public space at the centre of the sports zone. The proposals include:

- Closed Road Circuit – proposed around the perimeter of the sports zone, this facility would provide a traffic-free cycling circuit for training and race events;
- Off-road bike track – providing opportunities for mountain bike and BMX style riding within a safe, designed environment; and
- Public Realm works – including soft and hard landscaping, biodiversity enhancements and the installation of informal sporting spaces / urban parks.

1.3.2 Change Of Use

The former Toys R Us building is located in the centre of the site and to the south of the proposed Velodrome. The building has more recently been used as a COVID 19 vaccination centre, but this use has now ceased.

Exact proposals for the building are currently being finalised with discussions ongoing with potential end users. The vision for the building includes the introduction of more sport related activities, some retail space as well as office provision to serve sporting governing bodies.

1.3.3 Outline Application

The outline element of the application would include proposals for a MSCP in the northeast corner of the masterplan site. The car park would have a capacity of circa 1,000 spaces and would be located to service the ISV development with access proposed off International Drive.

1.4 Previous Surveys at the Site

A Preliminary Ecological Appraisal (PEA)[1] was undertaken at the site on 17 August 2022 to identify and map the habitats present within the site and up to 30m. The survey also provided an assessment of the potential for those habitats present to support legally protected or otherwise notable species, including bats, and made recommendations on further actions to be undertaken. Following an extension of the site boundary in 2023 an updated ecological appraisal[2] was undertaken on 3 May 2023.

The original PEA and update ecological appraisal assessed habitat on site as offering good foraging and commuting opportunities for bats. I line with best practice guidelines[3], which was the latest edition at time of survey, the site has been assessed as offering moderate suitability for foraging and commuting bats. A newer version of BCT Bat Surveys for Professional Ecologists: Good Practice Guidelines (4th Edition)[4] has since been released, however these latest guidelines were not followed as they were published after surveys were carried out. The PEA and update ecological appraisal recommended further activity surveys to identify important foraging and commuting features on site. Further surveys in the form of automated/ static bat activity surveys and manual/transect bat activity surveys were recommended. This report outlines the results of these activity surveys.

[1] Arup (2022) Cardiff International Sport Village Preliminary Ecological Appraisal.

[2] Arup (2023). Cardiff International Sport Village & Cardiff Peninsula. Ecological Appraisal.

[3] Collins, J. (2016). Bat Surveys: Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd edn.). The Bat Conservation Trust, London.

[4] Collins, J. (2023). Bat Surveys: Bat Surveys for Professional Ecologists: Good Practice Guidelines (4th edn.). The Bat Conservation Trust, London.

Table 1: Habitat suitability for bat activity including foraging and commuting

Potential Suitability	Description
Negligible	Negligible habitat features on site likely to be used by foraging or commuting bats.
Low	Habitats that could be used by small numbers of bats as flightpaths such as a gappy hedgerow or unvegetated stream, but isolated. Suitable, but isolated habitat that could be used by small numbers of foraging bats such as a lone tree or patch of scrub.
Moderate	Continuous habitat connected to the wider landscape that could be used by bats for flightpaths such as lines of trees and scrub or linked back gardens. Habitat that is connected to the wider landscape that could be used by bats for foraging such as trees, scrub, grassland, or water.
High	Continuous high-quality habitat that is well connected to the wider landscape that is likely to be used regularly by bats for flight-paths such as river valleys, streams, hedgerows, line of trees and woodland edge. High-quality habitat that is well connected to the wider landscape that is likely to be used regularly by foraging bats such as broadleaved woodland, tree-lined watercourses and grazed parkland. Site is close to and connected to known roost.

As part of the original PEA and updated ecological appraisal, a Preliminary Bat Roost Assessment was undertaken using survey methods based on those outlined in guidance at the time[3]. Structures and trees within the site were assessed (from the ground and externally only) for their suitability to support breeding, resting and hibernating bats. Three structures were identified as offering suitable roosting potential for bats within the 'study area' (including the site boundary and 30m buffer), with two structures identified as offering high suitability (one being a known roost) and one building offering moderate suitability. The locations of these structures are shown on Figure 6. Further surveys were recommended for these structures. The results of these surveys are discussed where relevant within this report, but are presented in detail within a separate bat presence/likely absence survey report[5].

During the original PEA[1] it was noted that Cogan Spur SINC is within 10m of the site boundary, located to the north east of the site. The SINC is a highways bridge or viaduct over the River Ely. The viaduct is 300m in total length. The SINC is referred to as the A4055 Viaduct within this report. The qualifying feature of this SINC is the presence of lesser horseshoe bat roost. This structure is one of the three structures identified as offering suitable roosting opportunities for bats, and results of presence/ likely absence surveys are covered in detail within a separate report[5]. This report will assess whether any features on site are of importance to lesser horseshoe bats and other bat species, in terms of foraging and/or commuting.

1.5 Objectives

This report addresses the recommendations regarding bat activity, including automated and manual bat activity surveys undertaken through the active season (May – October). This document reports the results of these surveys, and makes initial recommendations on mitigation, licensing requirements, further surveys, and potential enhancements.

[5] Arup, (2023). Bat Presence Absence Survey Report. Cardiff International Sport Village & Cardiff Peninsula.

2. Legislative and Policy Context

All UK bat species are afforded protection under both European and national law. All bats are listed as European Protected Species (EPS) under the provisions of The Conservation of Habitats and Species Regulations 2017 (as amended) (known as the 'Habitats Regulations'). Additionally, all bat species are afforded protection under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended) (WCA).

- Together this legislation makes it an offence to:
- Intentionally or recklessly kill, injure or capture a bat;
- Intentionally or recklessly disturb a bat such as to affect its ability to survive, breed or rear its young;
- Damage, destroy or obstruct access to a breeding site or resting place (e.g. roost) used by a bat, or disturb bats while they are using such a place; and
- Possess or control a live or dead bat, or any part of a bat.

The following bat species are listed as Annex II species within the EU Habitats Directive 1992[6], and therefore are given additional protection: barbastelle *Barbastella barbastellus*, Bechstein's bat *Myotis bechsteinii*, greater horseshoe *Rhinolophus ferrumequinum* and lesser horseshoe *Rhinolophus hipposideros*, this means that these species have been assessed as meeting the criteria for site selection of Special Areas of Conservation (SAC), to specifically observe them. Site selection is based on evidence of a large and robust population of one or more of these bat species. Various bat species are also listed as Species of Principal Importance for the conservation of biodiversity in Wales, under the provisions of Section 7 of the Environment (Wales) Act 2016 (Section 7 species). The Act includes a duty on all public authorities to have regard for the conservation of biodiversity in the exercise of their functions. Under this Act, it is Welsh Ministers duty to take reasonable steps to maintain and enhance the species listed, and to encourage others to do so. This duty applies to government bodies, local authorities and statutory undertakers. In addition, under Technical Advice Note (TAN) 5 of Planning Policy Wales[7], planning authorities are required to ensure enhancement for biodiversity is secured wherever possible.

Five species of bats found in the UK are also identified within the Cardiff Local Biodiversity Action Plan (LBAP)[8]. These are soprano pipistrelle *Pipistrellus pygmaeus*, noctule *Nyctalus noctula*, brown long-eared bat *Plecotus auritus*, greater horseshoe and lesser horseshoe.

Actions that are prohibited by legislation can be made lawful on the approval and granting of a licence from Natural Resources Wales (NRW), subject to conditions.

[6] Council directives 92/43/EEC of 21 May 1992on the conservation of natural habitats and of wild fauna and flora.

[7] https://www.gov.wales/planning-policywales [accessed October 2023]

[8] Cardiff Local Biodiversity Action Plan (2008) https://www.outdoorcardiff.com/wp-content/uploads/Cardiff-LBAP-2008.pdf

3. Methodology

3.1 Desk Study

The Multi-Agency Geographic Information for the Countryside (MAGIC) website[9] was reviewed for information on statutory designated sites of nature conservation importance, specifically notified for their populations of bats within 10 km of the site. The search included Special Areas of Conservation (SACs), Sites of Special Scientific Interest (SSSIs) and National Nature Reserves (NNRs).

Ecological records were obtained from the South East Wales Biodiversity Records Centre (SEWBReC) on 18 August 2022 as part of the original PEA[1], further records were purchased on 12 July 2023 to inform the updated ecological appraisal[2]. The records included non-statutory sites such as Sites of Importance for Nature Conservation (SINCs) and protected/priority species within 2km of the site recorded within the last 10 years. Records of bat species returned, along with sites notified for their bat populations, have been included within this report for completeness.

3.2 Automated/ Static Activity Surveys

3.2.1 Data Collection

Four static detectors were deployed across the site between September to October 2022 and May to October 2023. The static detectors used were Song Meter SM4BAT Full Spectrum Ultrasonic Recorders, static detectors. They were set up to begin recording bat calls 30 minutes before sunset continuing 30mins after sunrise, collecting data on five consecutive nights per deployment month in appropriate (or best available) weather conditions.

The locations the statics were deployed are shown on Figure 7. The strategy to determine locations for deployment was based on subjectively selecting features likely to be of importance to bats in terms of both as flight lines and foraging habitat, using professional judgement. The locations were primarily selected to focus on the existing connectivity between the A4055 flyover tunnel (Cogan Spur SINC) and Cardiff Bay. A description of the habitat at each deployment location and rationale for selection is detailed in Table 2 below.

Table 2: Automated static detector location description

Location	British National Grid X and Y coordinates	Habitat description	Rationale for selection
Location 1	317774, 173054	Semi-natural broadleaved woodland at northwest perimeter of site. Linear feature connecting to A4055 flyover. Adjacent to damp sparse grassland. The woodland separates the site from the A4055 highway. The A4055 side of the woodland is subject to high levels of artificial lighting.	Linear feature that forms part of an existing green corridor running along the western and northern perimeter of site. To identify if the feature is important for commuting and / or foraging bats on site.
Location 2	317970, 173167	Scrub belt at north boundary of site. To the North of the location is hard standing in the form of roads and paths, to the south is a mosaic of habitats including damp closed grassland/tall ruderal mosaic, closed sward dry grassland and, scattered scrub. With an area of reedbed habitat within 50m. The north side of the scrub belt has high levels of artificial lighting from the street lights along the road.	Linear feature that forms part of an existing green corridor running along the northern perimeter of site. To identify if the feature is important for commuting and / or foraging bats on site.

[9] https://magic.defra.gov.uk/ [Accessed: 25/10/2023].

Location	British National Grid X and Y coordinates	Habitat description	Rationale for selection
Location 3	318222, 173032	Scattered scrub belt at eastern boundary of site, adjacent to Cardiff Bay. To east is boardwalk with continuous scrub below, growing at the edge of the bay. To the west is damp sparse grassland. This habitat has low levels of artificial lighting relative to the other locations.	To identify if edge habitat on site adjacent to open waterbody of Cardiff Bay is an important foraging features for bats on site. One of two Cardiff Bay edge habitats selected to measure a difference in activity between different habitats onsite.
Location 4	318310, 172745	Scrub belt at southeastern boundary of site, adjacent to the River Ely at its confluence with Cardiff Bay to the south and area of closed sward dry grassland and sparse damp grassland to the north. This habitat has low levels of artificial lighting, primarily from the apartment blocks to the west.	To identify if edge habitat on site adjacent to open waterbody of Cardiff Bay/River Ely is an important foraging feature for bats on site. One of two Cardiff Bay edge habitats selected to measure any differences in activity between different habitats onsite.

The aim of the survey was for the static detectors to collect data on five consecutive nights per deployment month (May to October) in appropriate weather conditions, with reference to BCT guidance[3]. However, due to various factors and limitations (as discussed later in Section 3.4), this could not be fully achieved. The information of surveys dates deployed for each location between May – October is shown below in Table 3.

Table 3: Automated static detector deployment dates

Month	Date	Location 1	Location 2	Location 3	Location 4
September 2022	Start	14/09/2022	14/09/2022	N/A	N/A
	End	19/09/2022	19/09/2022	N/A	N/A
	Number of nights	5	5	N/A	N/A
October 2022	Start	N/A	19/10/2022	N/A	N/A
	End	N/A	24/10/2022	N/A	N/A
	Number of nights	N/A	5	N/A	N/A
May 2023	Start	04/05/2023	04/05/2023	07/05/2023	03/05/2023
	End	09/05/2023	09/05/2023	12/05/2023	08/05/2023
	Number of nights	5	5	5	5
June 2023	Start	21/06/2023	21/06/2023	21/06/2023	No data
	End	26/06/2023	26/06/2023	24/06/2023	No data
	Number of nights	5	5	3	0
July 2023	Start	07/07/2023	07/07/2023	No data	17/07/2023
	End	12/07/2023	12/07/2023	No data	22/07/2023
	Number of nights	5	5	0	5
August 2023	Start	27/08/2023	27/08/2023	27/08/2023	27/08/2023
	End	01/09/2023	01/09/2023	30/08/2023	01/09/2023

Month	Date	Location 1	Location 2	Location 3	Location 4
	Number of nights	5	5	3	5
September 2023	Start	N/A	N/A	13/09/2023	13/09/2023
	End	N/A	N/A	14/09/2023	18/09/2023
	Number of nights	N/A	N/A	1	5
October 2023	Start	19/10/2023	N/A	19/10/2023	19/10/2023
	End	24/09/2023	N/A	24/09/2023	24/09/2023
	Number of nights	5	N/A	5	5

A summary of weather conditions during the nights that statics were deployed each month is shown in Table 4 below. Full weather conditions are presented in Appendix A.

Table 4: Weather conditions during nights automated static detectors were deployed

Month deployed	Average temperature during nights recorded (Max and Min) (°C)	Number of nights of rain per nights deployed (& total rainfall in mm)	Average Humidity during night deployed (Max and Min) (%)	Average wind speed during nights deployed (mph)
September 2022	14 (19 - 7)	1/5 (0.5)	79 (94 - 67)	8
October 2022	14 (16 – 11)	3/5 (29.7)	92 (100 - 82)	10
May 2023	11 (14 - 8)	2/5 (42.3) &, 1/5 (23.8) &, 2/5 (38.1)	90 (100 - 59)	10
June 2023	17 (22 - 14)	1/5 (1.51)	85 (100 – 57)	8
July 2023	15 (22 – 10)	1/5 (31.8) &, 1/5 (35.1)	83 (100 – 47)	9
August 2023	12 (15 – 11)	1/5 (10.19)	91 (100 – 77)	5
September 2023	16 (18 – 14)	2/5 (37.4)	90 (100 – 77)	7
October 2023	10 (15 – 7)	2/5 (56.46)	91 (100 – 71)	8

3.2.2 Data Analysis

The parameter settings of the static detectors was as follows:

- Sample rate 256 kHz
- Minimum duration 1.5ms
- Trigger level 12 dB
- Minimum trigger frequency 16kHz
- Maximum length of recording: 15 seconds
- Monitoring schedule 30 minutes before sunset and 30 minutes after sunrise

The detectors record bat calls, and produce a .wav file containing a sequence of calls within a short time duration (15 seconds max was set as parameter). Each file can be considered a time a bat passed the recorder. For this report results of activity are shown in terms of bat passes.

Data was analysed using the British Trust of Ornithology (BTO) Acoustic Pipeline. The Acoustic Pipeline allows automated bat sound analysis through a cloud server where data was uploaded. The Acoustic Pipeline carries out data extraction and analysis using full spectrum data processing. The analysis considers the identification of multiple species where present in a recording. The analysis provides an independent estimate of error in species identification, through a confidence score for each species identified.

Results from the BTO Acoustic Pipeline where then manually processed and subjected to Quality Assurance (QA) checks. The QA process involved initially manually reviewing each species identified and different confidence levels, this allowed for an assessment for the accuracy of the Acoustic Pipeline ID for different species at different levels to be assessed. Following this initial QA process, a threshold of confidence was set for each species and anything below these species-specific threshold was not accepted and was not carried through the QA process. Species-specific thresholds for acceptance are shown below in Table 5.

Table 5: Confidence thresholds for species/species groups identified by the Acoustic Pipeline

Species	Confidence Threshold
Pipistrelle species	0.5
Myotis species	0.72
Nyctalus species	0.8
Serotine *Eptesicus serotinus*	0.8
Barbastelle	0.8
Horseshoe species	0.8
Plecotus species	0.8

A second QA process was undertaken for less common species above the set thresholds. Due to the high number of pipistrelle calls and generally higher levels of accuracy, further QA of identifications above the set threshold was not undertaken and any identification above the threshold was accepted. For all other species that were less common relative to pipistrelle calls (e.g *Myotis* sp, *Nyctalus* sp., serotine), a certain number of identifications above the thresholds were manually checked to ensure the thresholds were accurate. Any species that was less commonly identified by the Acoustic Pipeline (e.g horseshoe species, barbastelle, and *Plecotus* sp.) that were above the threshold were all manually checked to ensure accuracy.

Although the Acoustic Pipeline did identify all calls to species levels, to increase the accuracy of the results certain species are grouped to genus level. The species that have been grouped were those more difficult to ID down to species levels with large overlap in diagnostic features. All *Myotis* species were grouped as *Myotis* sp. as were *Nyctalus* sp.

The automated static record bat calls each time a bat passes, therefore number of bats cannot be determined from this data, as it is unknown whether the same bat is being recorded passing multiple times or whether every pass is a different individual bat; guidelines[3] suggest it is likely somewhere between these two. Therefore, the data should be viewed as a recording of activity rather than number of bats recorded.

3.3 Manual/ Transect Activity Surveys

3.3.1 Data Collection

Transect surveys were undertaken by both Arup and Wildwood Ecology Ltd (henceforth referred to as Wildwood) between May to October 2023. The first months transect survey in May 2023 was undertaken by Arup, the remaining transect surveys between June to October 2023 were carried out by Wildwood. The

methodology and survey results can be found in Appendix C (transect report produced by Wildwood), but are included within the main body of this report also.

A transect route covering the whole site was walked by a pair of ecologists, stopping at 13 predetermined stopping points for 5 minutes during the survey. The transect route and stopping points are shown on Figure 8. The starting point of the transect was randomised for each survey in order to increase temporal coverage of the different habitats encountered. Bat calls were recorded using Elekon Batlogger M/M2 detectors, and relevant observation such as number of bats and behaviour of bats was noted during the survey. The survey effort consisted of six-monthly dusks surveys beginning at sunset and continuing for three hours after sunset, between May – October. An additional transect was undertaken at dawn in August with the survey starting three hours before sunrise and continuing up to sunrise.

The date, survey start time and weather conditions for each transect survey is shown in Table 6 below.

Table 6: Weather conditions during transect activity surveys

Date	Start time & end time	Weather conditions				
		Temperature at start (ºC)	Temperature at end (ºC)	Cloud cover (Okta)	Wind speed (Beaufort scale)	Rain
15/05/2023	20:57 - 12:00	15	14	1	3	Nil
19/06/2023	21:33 - 00:18	20	19	4	1	Nil
12/07/2023	21:26 – 00:12	20	16	1	4	Nil
08/08/2023	20:49 – 23:43	16	15	2	6	Nil
09/08/2023	02:48 – 05:36	14	16	0	1	Nil
11/09/2023	19:37 – 22:37	19	17	3	0	Nil
10/10/2023	18:31 – 21:31	18	16	6	3	Nil

3.3.2 Data Analysis

Data analysis was undertaken by Wildwood. The transect report (Appendix C) outlines that the data was analysed using a combination of Bat Explorer and Kaleidoscope Pro. *Myotis* species were analysed to genus level only.

Transect surveys allow surveyors to make visual observations, while the data is collected. But it is only a snapshot in time and the surveyors are only in one location at any given time so could miss activity elsewhere. The detectors record bat calls, and produce a ZC file. containing a sequence of calls within a short time duration. Each file can be considered a time a bat passed the recorder. For this report results of activity are shown in terms of bat passes.

Heat Maps were produced using Bat Explorer to illustrate activity across the route, allowing for an assessment to be made on areas of higher activity.

3.4 Limitations

Both the automated and manual activity surveys were undertaken between May- October inclusive. For both methods no surveys were undertaken early in the active season of April. Early in the active season can be an important time to pick up activity of bats as they transition from hibernation roosts to maternity/summer day roosts.

A potential limitation of the automated/static surveys was related to incomplete data collection for certain statics some months. Four statics were deployed for five nights each month between May – October. Based on this a total of 24 data sets should have been produced. However due to technical issues and failed recordings a total of 19/24 full data sets (containing 5 consecutive nights of data) were produced, 3/24 partial data sets (less than five consecutive nights of data), and 2 data sets with no nights of data. However sufficient

information was collected to allow an assessment of bat activity on site, and therefore limitations associated with data collection are not considered significant.

A limitation associated with analysis of the automated static detectors, is related to the confidence thresholds set for each species. Due to the large number of calls, certain calls were not accepted based on the confidence of identification that was provided by the auto analysis through the BTO Acoustic pipeline. This has meant that a number of calls were not accepted and are not shown in the results of this report. Also calls above the confidence threshold were accepted without manually checking all, this could have resulted in a degree of inaccuracy in the results of the automated statics. However, as the methodology was the same for each static location the results should still provide a reliable assessment on activity across the site, also all species included within the results have been QA'd therefore the results provide a reliable assessment of species/species groups (*Myotis* sp. and *Nyctalus* sp.) present on site.

A limitation associated with the heat map (Figure 9) that illustrates bat activity across the site during the transect surveys, is that heat maps are inherently biased based on stopping points therefore the heatmaps should be read with caution with this limitation considered.

The findings presented in this report represent those at the time of survey and reporting, and data collected from available sources. Ecological surveys can be limited by factors affecting the presence of protected species, such as the time of year, migration patterns and behaviour.

The results taken from bat detector recordings are biased towards bats that use louder echolocation calls. Therefore, quiet species such as long-eared bats and bats with directional calls such as horseshoe bats may be under recorded due to the limited recording range of the equipment. This is an unavoidable limitation for all surveys using bat detectors, the implications of which have been considered when analysing the results. Bat calls of *Myotis* and *Plecotus* genus were not identified to species level. Bats in this genus cannot reliably be separated on calls alone due to the overlap in call characteristics between the species.

The absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it will not be present in the future.

4. Results and Interpretation

4.1 Desk Study

One designated site relating to bats was identified within the parameters of the desk study (as described in section 3.1), Cogan Spur SINC (Referred to as A4055 Viaduct within this report). Cogan Spur is a local non-statutory designated site, covering the internal chambers of the A4055 Viaduct. Cogan Spur SINC comprises a box girder bridge which supports lesser horseshoe bats. The Cogan Spur SINC/A4055 Viaduct was surveyed as part of this report.

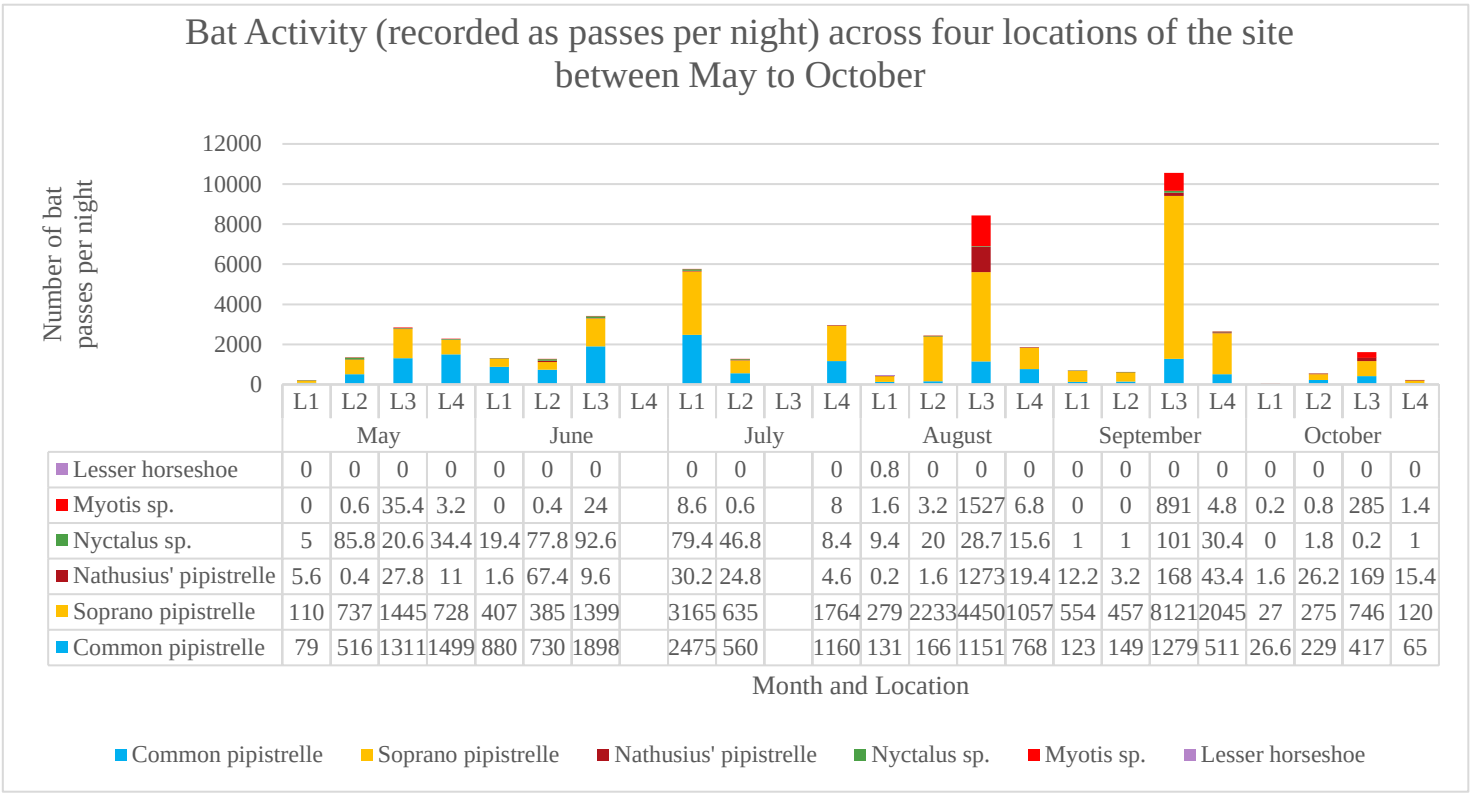
The desk study returned 393 records of bats within 2km of the site. A total of eight species were recorded these included common pipistrelle *Pipistrellus pipistrellus*, soprano pipistrelle, Nathusius' pipistrelle *Pipistrellus nathusii*, brown long-eared, lesser horseshoe, Daubenton's *Myotis daubentonii*, whiskered *Myotis mystacinus* and noctule.

The nearest roost recorded within the last 10 years was a common pipistrelle roost located 0.7km from the site. The roost was likely a day roost as three bats were recorded using the roost. There are records from 2010 of lesser horseshoes roosting within the A4055 Viaduct internal chambers, although these records are over 10 years old they can still be considered relevant.

4.2 Automated/ Static Activity Surveys

Full results of automated static detectors are presented in Appendix B are are discussed within the following section. The automated bat static detectors recorded a total of six species or species groups. These are soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle, lesser horseshoe, *Nyctalus* sp, and *Myotis* sp.. Activity of these species at the four locations each month is shown in Figure 1 below, in the form of bat passes per night. Bat passes are described in Section 3.2.2.

Figure 1: Bat activity for species recorded at location 1 to 4 between May to October[10]



	May				June				July				August				September				October			
	L1	L2	L3	L4	L1	L2	L3	L4	L1	L2	L3	L4	L1	L2	L3	L4	L1	L2	L3	L4	L1	L2	L3	L4
Lesser horseshoe	0	0	0	0	0	0	0		0	0		0	0.8	0	0	0	0	0	0	0	0	0	0	0
Myotis sp.	0	0.6	35.4	3.2	0	0.4	24		8.6	0.6		8	1.6	3.2	1527	6.8	0	0	891	4.8	0.2	0.8	285	1.4
Nyctalus sp.	5	85.8	20.6	34.4	19.4	77.8	92.6		79.4	46.8		8.4	9.4	20	28.7	15.6	1	1	101	30.4	0	1.8	0.2	1
Nathusius' pipistrelle	5.6	0.4	27.8	11	1.6	67.4	9.6		30.2	24.8		4.6	0.2	1.6	1273	19.4	12.2	3.2	168	43.4	1.6	26.2	169	15.4
Soprano pipistrelle	110	737	1445	728	407	385	1399		3165	635		1764	279	2233	4450	1057	554	457	8121	2045	27	275	746	120
Common pipistrelle	79	516	1311	1499	880	730	1898		2475	560		1160	131	166	1151	768	123	149	1279	511	26.6	229	417	65

As is demonstrated in Figure 1 above and more clearly in Figure 2 below the most common species on site are soprano pipistrelle and common pipistrelle. Across all months with the exception of June, soprano pipistrelle had the highest activity of all species recorded on site, in June common pipistrelle had the highest activity and across all other months was second to soprano pipistrelle. Soprano pipistrelle and common pipistrelle were recorded at all sampling locations, but were most commonly recorded at location 3, this was the case for all months although in July both species were more commonly recorded at Location 1 and in May common pipistrelle was most commonly recorded at Location 4.

Lesser horseshoe was the least frequently recorded species on site with the only 4 passes all recorded at Location 1 in August.

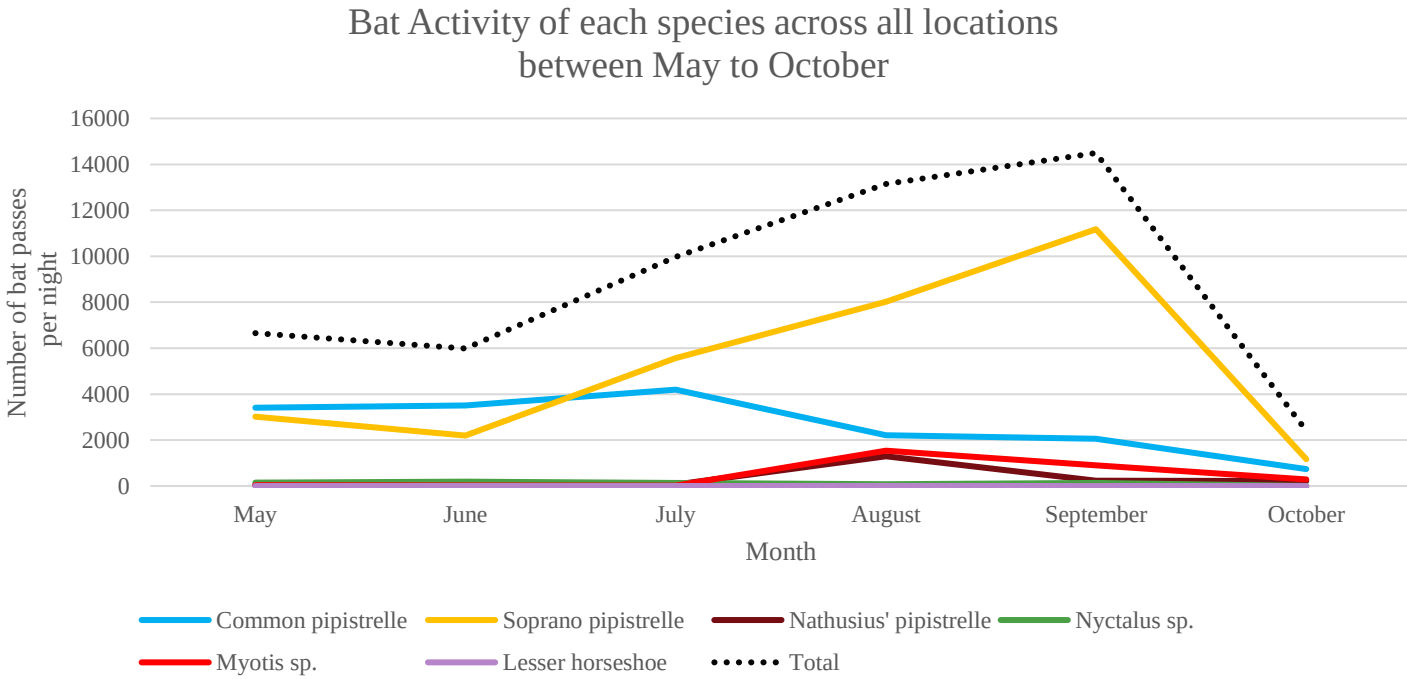
Nyctalus sp. activity throughout the site was low and fairly stable with little variation between month or location.

Relative to all species recorded, Nathusius' pipistrelle and *Myotis* sp. had moderate activity, below common and soprano pipistrelle and above lesser horseshoe and *Nyctalus* sp. The activity of both these species varied across months, where activity greatly increased in August, both species were most commonly recorded at Location 3 during this month. Nathusius' pipistrelle was recorded at all locations through the site over the season, and most commonly was recorded at Location 3 although this varied and was most commonly recorded at Location 2 and Location 1 in June and July respectively.

When looking at the total bat activity by month (as shown in Figure 2 below) it can be seen that total activity increases between June to September where it peaks before decreasing in October, however this trend is not representative of all species as it largely resembles soprano pipistrelle activity. *Myotis* sp. and Nathusius' pipistrelle activity follow a similar pattern although activity peaks in August, these species were most commonly associated with Location 3. The activity of common pipistrelle is highest between May to July where it peaks before dropping of through August to October. *Nyctalus* species activity had little variation across months. Lesser horseshoe are uncommon onsite and are not recorded across all months.

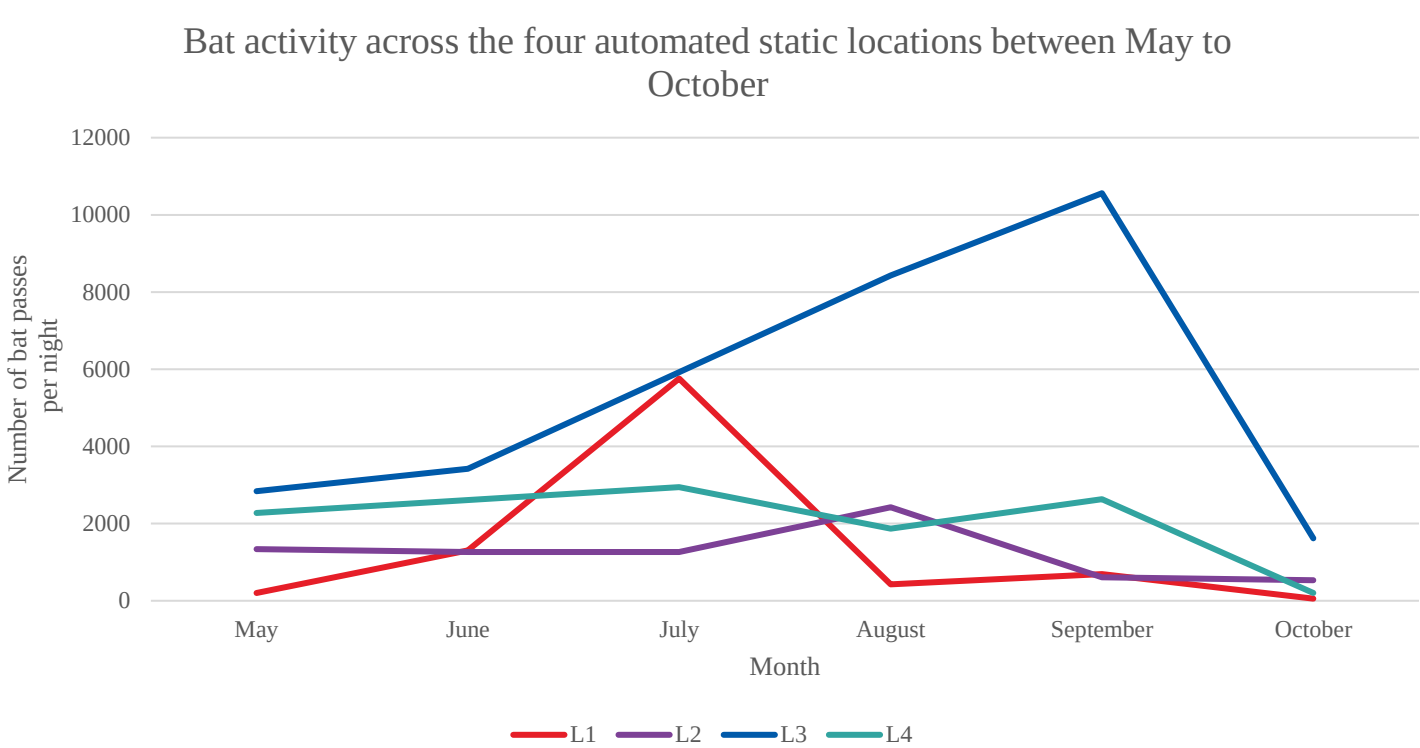
[10] Blank columns within the table are where no data was recorded due to failed data collection

Figure 2: Bat activity of each species across all locations between May to October



As demonstrated in Figure 1 and more clearly in Figure 3 below, across all months Location 3 had the highest activity, this is largely representative of all species recorded on site. The activity at location 1 was generally the lowest relative to the other location, however during July activity was high caused by an increase in activity of a mix of bat species but primarily driven by increase in soprano pipistrelle and common pipistrelle activity. This should be viewed with consideration with limitations as stated in Section 3.4 as no data was recorded at Location 3 in July, therefore activity at this location may have been higher than at Location 1. Regardless of this limitation the increase in activity at Location 1 in July relative to other months is still notable. Location 2 had fairly constant activity throughout the season, as did location 4.

Figure 3: Bat activity at each of the four locations between May to October



The first call in relation to sunset and the last call before sunrise at each location is shown in Table 7 below. The results show that generally the earliest call and latest calls in relation to sunset/sunrise were recorded at Locations 1 and 2, with earliest records after sunset coming from Location 1. However, timing of earliest/latest record varied between nights at each location. Soprano pipistrelle and common pipistrelle bats the most common species recorded first/last particularly at locations 1 and 2. Table 7 below shows the first and last species record (abbreviations used in Table 7: common pipistrelle (c.pip), soprano pipistrelle (s.pip), Nathusius pipistrelle (n.pip), nyctalus sp. (nyc), myotis sp. (myo)), with time given in minutes in relation to sunset (+) or sunrise (-). Nights in Table 7 don't necessarily all correspond to the same date, as some months static detectors were deployed at different locations at different dates, therefore the results should be viewed in light of this demonstrating general trend in timings rather than comparing night by night. Gaps within the table are where no bats were recorded, and N/A is used where no data was recorded as shown in Table 3 in Section 3.2.1.

Table 7: First and last call relative to sunset/sunrise

Month	Night	First call relative to sunset – species and minutes after sunset				Last call relative to sunrise species and minutes before sunrise			
		Location 1	Location 2	Location 3	Location 4	Location 1	Location 2	Location 3	Location 4
May	1		c.pip (+39)	nyc (+25)	Nyc (+20)		s.pip (-67)	c.pip (-60)	s.pip (-63)
	2		nyc (+17)	nyc (+31)	n.pip (+36)		c.pip (-62)	s.pip (-61)	s.pip (-61)
	3		nyc (-24)	nyc (+29)	c.pip (+24)		s.pip (-60)	c.pip (-60)	s.pip (-61)
	4		nyc (+10)	c.pip (+34)		c.pip (-61)	s.pip (-60)	c.pip (-60)	
	5	c. pip, (+23)	c.pip (+13)	nyc (+21)	s.pip (+51)	s.pip (-63)	s.pip (-62)	s.pip (-93)	c.pip (-60)

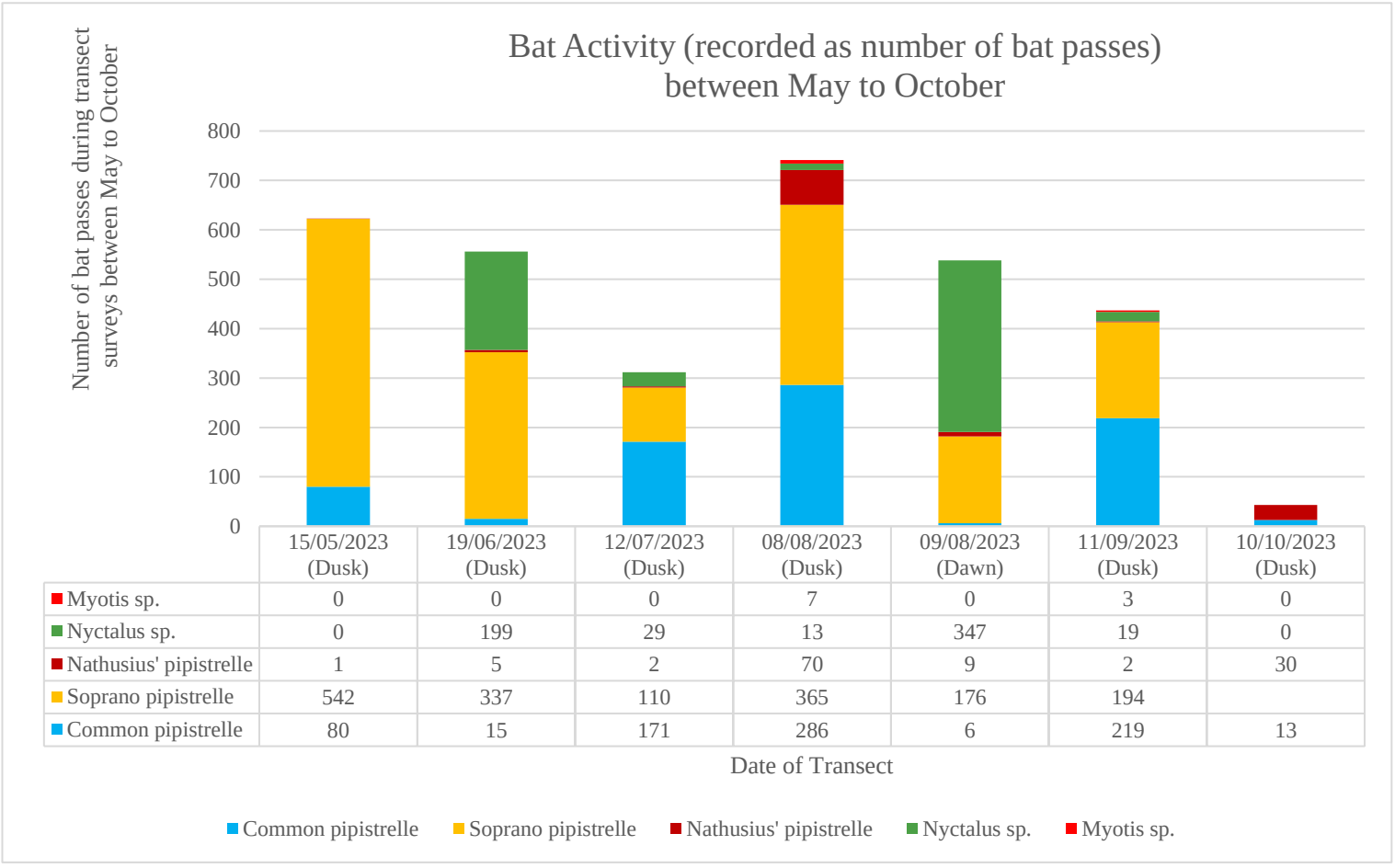
Month	Night	First call relative to sunset – species and minutes after sunset				Last call relative to sunrise species and minutes before sunrise			
June	1	s.pip (+27)		s.pip (+34)	N/A	s.pip (-31)	c.pip (-32)	c.pip (-43)	N/A
	2	s.pip (+30)	c.pip (+29)	s.pip (+38)	N/A	s.pip (-36)	c.pip (-35)	c.pip (-43)	N/A
	3	s.pip (+27)	c.pip (+27)	s.pip (+32)	N/A	s.pip (-34)	c.pip (-33)	c.pip (-153)	N/A
	4	s.pip (+36)	s.pip (+39)		N/A	c.pip (-42)	c.pip (-40)		N/A
	5	c.pip (+28)	c.pip (+33)		N/A	s.pip (-39)	c.pip (-34)		N/A
July	1	s.pip (+26)	s.pip (+32)	N/A	s.pip (+29)	s.pip (-41)	nyc (-33)	N/A	s.pip (-31)
	2	s.pip (+4)	s.pip (+29)	N/A	c.pip (+40)	c.pip (-30)	s.pip (-31)	N/A	
	3	s.pip (+22)	c.pip (+28)	N/A	c.pip (+100)	c.pip (-30)	c.pip (-32)	N/A	c.pip (-31)
	4	c.pip (+40)	s.pip (+42)	N/A	s.pip (+34)	c.pip (-37)	c.pip (-51)	N/A	s.pip (-36)
	5	s.pip (+13)	s.pip (+30)	N/A	c.pip (+29)	s.pip (-33)	s.pip (-33)	N/A	c.pip (-30)
August	1	c.pip (+33)	s.pip (+27)	nyc (+32)	c.pip (+29)		s.pip (-33)		s.pip (-36)
	2	c.pip (+21)	s.pip (+23)	s.pip (+33)	nyc (+25)	s.pip (-32)	s.pip (-31)	s.pip (-36)	c.pip (-31)
	3	s.pip (+16)	s.pip (+26)	nyc (+26)	c.pip (+32)	s.pip (-31)	s.pip (-35)	s.pip (-61)	s.pip (-38)
	4	s.pip (+16)	s.pip (+27)		c.pip (+29)	s.pip (-50)	s.pip (-31)		
	5	s.pip (+22)	s.pip (+23)		c.pip (+24)		s.pip (-30)		nyc (-30)
September	1	c.pip (+8)		nyc (+18)	nyc (+19)	c.pip (-29)		nyc (-37)	nyc (-40)
	2	s.pip (+12)	s.pip (+39)	nyc (+10)	nyc (+15)	s.pip (-44)	s.pip (-30)		s.pip (-36)
	3	c.pip (+21)	s.pip (+14)		nyc (+27)	s.pip (-47)	s.pip (-26)		nyc (-30)
	4	s.pip (+16)	s.pip (+19)		nyc (+23)	s.pip (-26)	s.pip (-26)		s.pip (-54)
	5	s.pip (+19)	s.pip (+20)		s.pip (+31)	s.pip (-31)	s.pip (-29)		s.pip (-49)
October	1	c.pip (+20)	n.pip (+33)	s.pip (+27)	s.pip (+32)	s.pip (-47)	s.pip (-124)	c.pip (-39)	s.pip (-31)

Month	Night	First call relative to sunset – species and minutes after sunset				Last call relative to sunrise species and minutes before sunrise			
	2	c.pip (+21)	c.pip (+14)	s.pip (+32)	s.pip (+29)	s.pip (-286)	c.pip (-127)	Myo (-118)	s.pip (-189)
	3	s.pip (+37)	s.pip (+36)	s.pip (+10)	s.pip (+27)		s.pip (-208)	s.pip (-104)	s.pip (-39)
	4	c.pip (+20)	c.pip (+59)	c.pip (+20)	s.pip (+31)		c.pip (-383)	Myo (-134)	c.pip (-138)
	5	s.pip (+25)	c.pip (+3)	s.pip (+29)	c.pip (+31)	s.pip (-277)	s.pip (-385)	s.pip (-83)	c.pip (-44)

4.3 Manual/ Transect Activity Surveys

Across all months that transect surveys were undertaken, a total of five species/species groups of bats were identified. These included soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle, *Nyctalus* sp., and *Myotis* sp.. Pipistrelle species were recorded during all seven surveys, *Nyctalus* sp. was recorded on five, and *Myotis* sp. was recorded on two of the surveys. Across all months, activity was highest for soprano pipistrelle bats, while common pipistrelle and noctule activity was also high in certain months as is shown in Figure 4 below. Activity of all bat species was fairly consistent through the active season with activity decreasing in October at the end of the active season. Activity was recorded as bat passess, using the same measure as used for the statics but with a handheld detectors, recorded regardless is bats were observed or not.

Figure 4: Bat activity during Transects undertaen between May to October.



	15/05/2023 (Dusk)	19/06/2023 (Dusk)	12/07/2023 (Dusk)	08/08/2023 (Dusk)	09/08/2023 (Dawn)	11/09/2023 (Dusk)	10/10/2023 (Dusk)
Myotis sp.	0	0	0	7	0	3	0
Nyctalus sp.	0	199	29	13	347	19	0
Nathusius' pipistrelle	1	5	2	70	9	2	30
Soprano pipistrelle	542	337	110	365	176	194	
Common pipistrelle	80	15	171	286	6	219	13

Recorded bat activity is spatially presented on Figure 9 which shows a heatmap to indicate high and low levels of bat activity throughout the survey period (May – October) across the site. The heatmap shows that activity was highest at the northwest corner of the site along the broadleaved woodland, and the east of the site adjacent to Cardiff Bay.

Observations of bat behaviour and activity during the surveys is described in Table 7 below.

Table 8: Observations during transect activity surveys (table to be read in conjunction with Figure 8 which shows stopping point locations)

Survey date	Observations during surveys
15/05/2023	Soprano pipistrelles and common pipistrelles were observed foraging and commuting along the woodland and scrub linear features along the northern boundary of the site. Generally commuting direction was from west to east. Foraging activity was noted to be highest over the broadleaved woodland, ruderal vegetation at the north of the site, and along the edge of Cardiff Bay. Activity was notably highest at stopping points 2,3,4, and 5. Artificial lighting was high at the northern boundary of the site near stopping point 5; foraging and commuting activity was high here, with both common and soprano recorded.
19/06/2023	Soprano pipistrelle and common pipistrelle were observed foraging and commuting along woodland and scrub along northern boundary of site, commuting west to east. Soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle, and noctule were observed foraging over water and along the eastern edge of site. Activity was highest at stopping 3, 5, 8 and 11.
12/07/2023	Activity was highest at stopping point 3 and 5. Soprano pipistrelle were recorded foraging above woodland, scrub and water. Nathusius' pipistrelle were recorded foraging above the water and the scrub boundary at eastern site boundary.
08/08/2023	Activity was highest at eastern site boundary. Soprano and common pipistrelle recorded foraging and commuting along woodland. Noctule and soprano and common pipistrelle foraging over scrub at north perimeter of site. Nathusius' pipistrelle and common pipistrelle foraging over water and scrub border.
09/08/2023	Activity was highest along eastern site boundary, at stopping point 7 next to the Cardiff Bay edge habitat.Soprano, common and Nathusius' pipistrelle recorded foraging.
11/09/2023	Activity highest at the broadleaved woodland corridor and Cardiff Bay edge habitat on the eastern site boundary. Pipistrelle species were foraging above woodland.
10/10/2023	Activity was high across site, with highest activity at the woodland corridor and- Cardiff Bay edge habitat at the eastern site boundary . Bats were observed foraging above woodland, scrub and Cardiff Bay east of site.

4.4 Presence/ Absence Surveys

The results of presence absence surveys are presented in detail in a separate report[5], but a summary is provided here, to aid interpretation of the activity results. Evidence of roosting bats was recorded during surveys on the A4055 Viaduct which is within 10m of the site perimeter. The roost is used by lesser horseshoe, common pipistrelle, soprano pipistrelle over summer and winter, while *Myotis* sp. are known to roost/hibernate in the structure over winter. The roost is considered a maternity and hibernation roost for lesser horseshoe bats, which are the qualifying feature species of the site that is designated as a SINC. Activity was higher at the west end on the viaduct than the east end closest to site. All emerging lesser horseshoe bats were recorded emerging from the west end of the viaduct, while soprano and common pipistrelle were recorded emerging from both ends of the viaduct.

Bats are considered likely absent from the Toys R Us building, with no evidence returned during emergence surveys.

No surveys were undertaken on the Watermark building due to uncertainty about the site boundary and the scope of works. Therefore, no assessment of presence/likely absence of roosting bats within the building can be made. Although the building has been assessed as high suitability within the ecological appraisal[2] and further surveys are recommended.

4.5 Interpretation

The results of the automated static detectors demonstrate that the site is an important foraging and commuting site, with the open water of Cardiff Bay being the most important foraging feature on/near the site. This was supported by the transect activity survey results, which also demonstrated that the northern and eastern perimeter of the site including the green woodland and scrub border and the Cardiff Bay edge habitat are important foraging and commuting habitats for bats present on site.

The site provides relatively undisturbed habitat, which is likely uncommon within the urban setting of the site. Therefore, the site provides important habitat within the Core Sustenance Zone (CSZ)[4,11] of any roosts within the wider landscape, including those which support the foraging and commuting bats recorded on site. Core Sustenance Zones the different species recorded on site are detailed in Table 8 below.

Table 9: Core Sustenance Zone[4] for Species recorded on site

Species	CSZ radius (Km)	Confidence in Zone size[12]
Common pipistrelle	2	Poor
Soprano pipistrelle	3	Good
Nathusius' pipistrelle	3	Poor
Nyctalus sp	4/3	Poor/Moderate
Myotis sp.	1-4	Poor/Moderate
Lesser horseshoe	2	Good

Variations within activity through the active season can be affected by a number of factors including sampling error, weather conditions, prey availability and distribution, and species behaviour e.g mating behaviours, dispersing maternity colonies, pups foraging etc. Based on weather data as shown in Table 4, there was variation in weather conditions between sampling dates however there was no extreme variation in temperature, rainfall or wind conditions during the sampling dates. However variation in weather conditions during days not sampled also has potential to impact the activity of bats, during the dates sampled. However based on weather data no correlation can be made between weather conditions and activity.

The increase in activity of soprano pipistrelle, Nathusius' pipistrelle and *Myotis* sp, could indicate maternity roosts within the wider landscape, or could also indicate a mating roost or swarming site (with reference to *Myotis* sp) nearby. Soprano pipistrelle was frequently recorded first and last relative to sunset/sunrise throughout the active season which could indicate a roost nearby, although weather this is a maternity roost is difficult to make without further surveys of the roost structures. Myotis sp and Nathusius' pipistrelle species were not frequently recorded first or last relative to sunset/sunrise and this was the case throughout the active season with no change to this during the maternity season which would have been expected if there was a maternity roost nearby.

4.5.1 Northern boundary Green Corridor

The northern perimeter of the site includes a woodland corridor and scrub border, and associated wet grassland, ruderal grassland mosaic. The automated static activity surveys demonstrated these habitats had moderate activity (relative to other areas of the site) of soprano pipistrelle and common pipistrelle, and lower levels of activity for Nathusius' pipistrelle, *Myotis* sp. and irregular use by lesser horseshoe. During transect

[11] BCT defined CSZ for different bat species. CSZ refers to the area surrounding a communal roost within which the habitatavailability and quality will have a significant influence on the resilience and conservation status of the colony using the roost.

[12] Confidence is based on number of bats and number of studies used to inform the calculation of CSZ's.

surveys it was observed that bats species, primarily common and soprano pipistrelle, used these habitats for both foraging and commuting, where these species were observed commuting west to east along the woodland corridor. The green corridor along the northern permitter of the site is likely an important flight corridor between the A4055 viaduct (known maternity roost and hibernation roost for lesser horseshoe, day roost for common and soprano pipistrelle bats, and also used over winter by common pipistrelle, soprano pipistrelle and *Myotis* sp.) and Cardiff Bay (important foraging habitat as demonstrated by activity surveys) which was shown by both automated static and transect activity surveys to be an important foraging area on site. First and last record relative to sunset/sunrise support the interpretation that the green corridor is an important corridor for bats emerging from the A4055 viaduct.

At the north east corner of the green corridor, next to Cardiff Bay, the watermark building has been assessed as offering high suitability for roosting bats. Although no surveys have been undertaken to date, it is possible that this building is used by roosting bats including potentially common pipistrelle, soprano pipistrelle and Nathusius' pipistrelle based on the potential roosting features noted.

4.5.2 Cardiff Bay edge habitat

The open water of Cardiff Bay and the scrub border and wet sparse grassland that runs along the eastern site boundary adjacent to the Bay has been demonstrated by both automated Static and transect activity surveys to be an important foraging habitat for species recorded on site as previously listed, with the exception of lesser horseshoe bats.

4.5.3 River Ely/Cardiff Bay confluence

Activity was relatively high along the River Ely/Cardiff Bay confluence and associated damp grassland. The River Ely is likely an important flight path connecting Cardiff Bay and the wider landscape including large area of woodland, bridges and other structures within the wider landscape, which could be roosts for *Myotis* sp and *Nyctalus* sp, as well as pipistrelle species. The damp grassland, and River Ely/Cardiff Bay also provide good foraging resource on site for bats.

5. Recommendations

5.1 Mitigation

The proposed design should take these findings into consideration to avoid impacts wherever possible following the stepwise approach[13] to achieve net benefit for biodiversity, and to embed mitigation within the design of the development.

Linear features on site and in proximity to site, including the green corridor on the northern boundary of the site which is an important commuting corridor connecting the known roost within the A4055 Viaduct with Cardiff Bay, and scrub border along the River Ely and Cardiff Bay edge should be retained and enhanced where possible. If habitat loss cannot be avoided to the green corridor, compensation will be required. Foraging habitat on site should be retained and where removal is required like for like replacement habitat should be provided. The proposed design should aim to create an enhanced green corridor along the northern and eastern perimeter of the site, including a range of habitats such as diverse woodland, scrub, and open water habitat.

A lighting strategy should be produced, with the aim to limit light spill onto important commuting and foraging habitat including woodland, the scrub belt, and the open water of Cardiff Bay to the east of the site boundary and River Ely to the south. Avoidance of artificial lighting should be prioritised during detailed design, and if/where lighting is required a lighting strategy should be in accordance with published guidance[14] to mitigate for impacts from artificial lighting. The lighting strategy should aim to create a dark corridor along the northern boundary of the site and the eastern site boundary bordering Cardiff Bay.

5.2 Enhancement Options

To comply with Section 6 duty of the Environment (Wales) Act in seeking to maintain and enhance biodiversity and ecosystem resilience, enhancement options must be delivered. A CIEEM briefing paper (2022)[15] outlines 'Welsh Government's Approach to Net Benefits for Biodiversity and the DECCA (Attributes of ecosystem resilience - Diversity, Extent, Condition, Connectivity, and Aspects of Ecosystem Resilience) Framework in the Terrestrial Planning System' sets out that any development must demonstrate that it has both maintained and enhanced biodiversity and built resilient ecological networks. Recent changes[16] to Chapter 6 of Planning Policy Wales provide clarity on Biodiversity Net Benefit through the application of the stepwise approach) and the need for enhancement at each step.

Details and specific enhancement opportunities relating to bats will be reported on along with the results of further surveys recommended within this section, but may include:

- Creation of woodland and scrub habitat on site, with a mix of native trees. Woodland creation should focus on northeast corner of the site, where woodland currently exists. Over time as the planted trees develop will act to buffer light onto the A4055 Viaduct roost. Woodland and scrub will also provide suitable foraging habitat for bats on site. Woodland and scrub creation should also aim to improve connectivity across the site.
- Enhancement and creation of linear features around and within the site to increase the connectivity of the site to the wider landscape. Linear features dominated by non-native species including cotoneaster should be replaced with a diverse range of native shrub and tree species. Created and enhanced habitats on site should focus on improving connectivity across the northern perimeter of the site between the A4055 Viaduct roost and Cardiff Bay;

[13] approach of avoiding, minimising, mitigating and as a last resort, compensating for adverse effects (also referred to as the mitigation hierarchy)

[14] BCT & ILP, (2023). Bats and artificial lighting at night. Guidance note 08/23.

[15] CIEEM, 2022. Welsh Government's Approach to Net Benefits for Biodiversity and the DECCA Framework in the Terrestrial Planning System.

[16] Welsh Government, (2023). Addressing the Nature Emergency Through the Planning System: Updated National Planning Policy for Chapter 6 of Planning policy Wales. https://www.gov.wales/sites/default/files/publications/2023-10/addressing-the-nature-emergency-through-the-planning-system.pdf [accessed 08/11/2023]

- Planting and lighting strategy should focus on creating dark corridors through the site, a dark corridor along the northern and eastern boundary should be created connecting A4055 Viaduct roost and Cardiff Bay. Opportunities for reducing existing light spill from residential apartment block onto the east end access to the A4055 Viaduct structure should be explored;
- Nature based solutions for drainage, looking to incorporate areas of open water across the site, with native mix of planted macrophytes. This will increase foraging resource across the site by increasing invertebrate abundance;
- Creation of wildflower meadows on site, planting regime should aim to increase invertebrate species richness and abundance, therefore increasing foraging resource to bats. Planting regime of grasslands/green roofs to include a good mixture of flowers that vary in colour, fragrance and shape including flowers with insect friendly landing platforms and short florets;
- Replanting of any removed vegetation with fruiting species to provide a food source for invertebrates, birds and mammals. Suitable species include hazel (*Corylus avellana*); wild cherry (*Prunus avium*); and dog rose (*Rosa canina*); (further species are recommended in the Bat Conservation Trust (BCT) document 'Landscape and Urban Design for bats and biodiversity'[17]);
- Opportunities to incorporate bat features into the design of new buildings or structures, such as bat access tiles, bat tubes for integration into brickwork, access to roof voids or bat boxes as below, bat features should be suitable for soprano pipistrelle, common pipistrelle, *Myotis* sp. and lesser horseshoe bats; and
- The installation of bat boxes on retained trees and buildings within the site, bat boxes should be of a design suitable for use by soprano pipistrelle, common pipistrelle, and *Myotis* sp. They should be orientated to receive full/partial sunlight, typically facing south-west to south-east where possible and positioned a minimum of 2m above ground as advised in the BCT document 'Landscape and Urban Design for bats and biodiversity'[17]; and/or
- Veteranisation of trees within woodland on site to create suitable roosting features for bats within existing mature trees within woodland;
- Consideration of reducing the number of streetlights or changing the type of lightbulbs as detailed in the BCT/Institute of Lighting Professionals (ILP) guidance document[18]. Alternatively, cowls/hoods could be added to limit light spill;

[17] Gunnell, K., Grant, G. and Williams, C. 2012. Landscape and urban design for bats and biodiversity. Bat Conservation Trust.

[18] Bat Conservation Trust & Institute of Lighting Professionals (2018) Guidance Note 08/18. Bats and artificial lighting in the UK.

6. Conclusion

Cardiff Council are proposing to develop land at Cardiff International Sport Village which includes a sport zone which seeks to add to the sporting offer within this part of the ISV.

All bat species are afforded strict protection under the Habitats Regulations and Wildlife and Countryside Act. This includes protection from killing, injury and disturbance. Further protection is afforded to their roost sites / resting places under the Regulations.

Six species/species groups were all recorded on site to varying degrees during the activity surveys, this were: soprano pipistrelle, common pipistrelle, Nathusius' pipistrelle, lesser horseshoe, *Nyctalus* sp. and *Myotis* sp.. Soprano and common pipistrelle bats had the highest activity across the site between May to October, while lesser horseshoe was recorded the least frequently. Activity was high across all sampled areas of the site which included the woodland and scrub border forming a green corridor along the northern perimeter of the site and the scrub border along the eastern border of the site bordering Cardiff Bay and the River Ely. Bat activity was higher at these edge habitats of the site relative to other non-edge habitats across the site. The results showed that of all these edge habitats, activity was highest at the eastern edge of the site bordering Cardiff Bay.

Detailed and informed mitigation and enhancement measures include:

- Embedded design consideration to retain and enhance important commuting and foraging features along the northern and eastern boundary of the site, with the aim to create an enhanced green corridor connecting the A4055 Viaduct with Cardiff Bay;
- Lighting strategy to avoid impacts to commuting and foraging bats, creating a dark corridor along the northern and eastern boundary of the site. Avoidance of artificial lighting should be prioritised during detailed design, and if/where lighting is required a lighting strategy should be in accordance with guidance[14] and
- Retaining, enhancing and creating a range of habitats on site, including woodland, scrub, closed sward grassland and open water habitats.

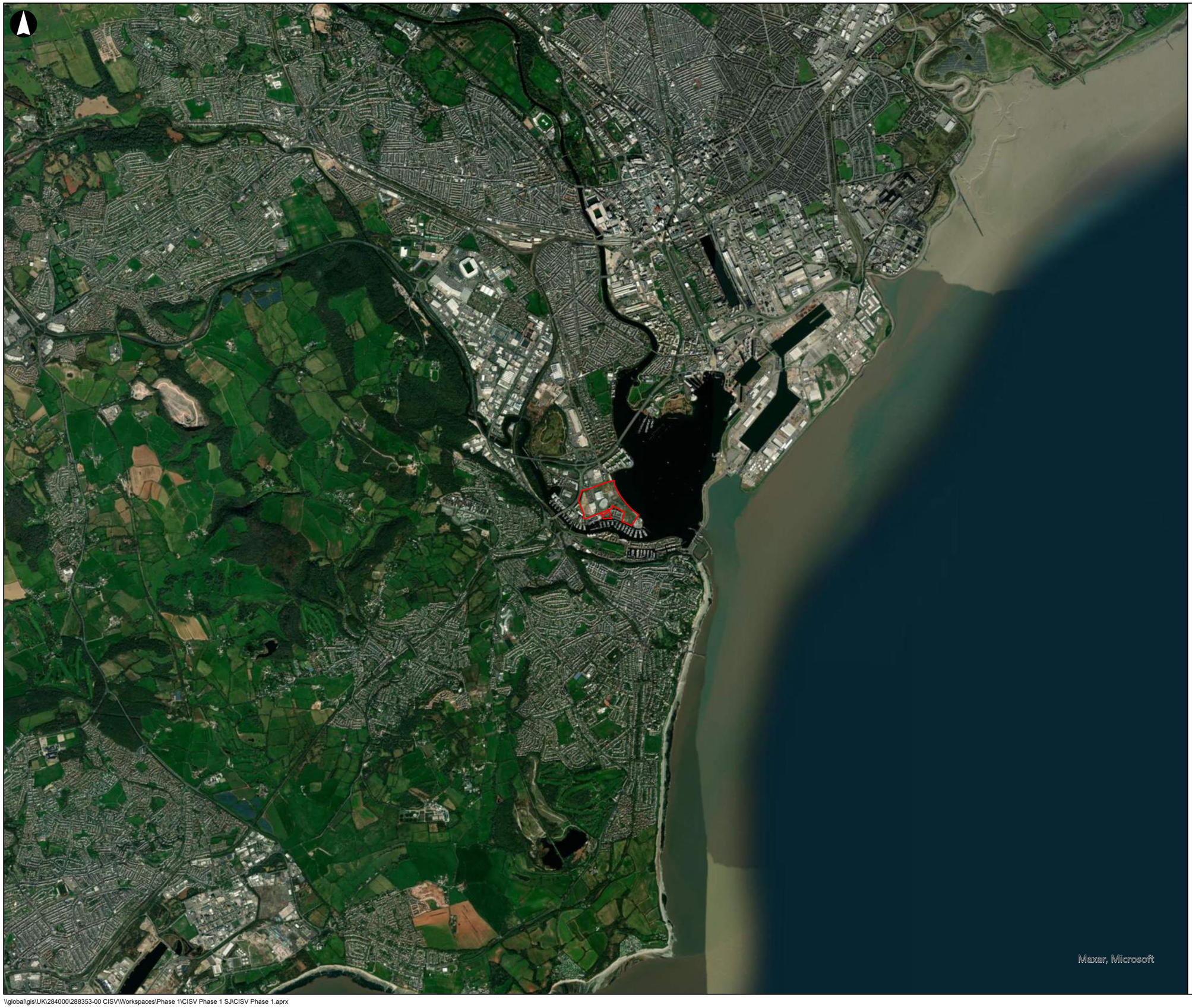
6.1 Report Validity

This report is the result of survey work undertaken between September 2022 – October 2023. This report refers, within the limitations stated, to the condition or proposed works of the site at the time of the surveys. Changes in legislation, guidance, best practice, etc. may necessitate a re-assessment/survey. No warranty is given as to the possibility of future changes in the condition of the Site.

The results and conclusions presented in this report are considered valid for a maximum of 18 months, after which time a suitably experienced ecologist should review the report and consider whether repeat surveys are required, in line with CIEEM advice .

This report is produced solely for the benefit of Cardiff Council and no liability is accepted for any reliance placed on it by any other party. This report is prepared for the proposed uses stated in the report and should not be used in a different context.

Figure 5: Site location



Site boundary

A3

12/07/2023 15:49

Coordinate System: British National Grid

Metres

0 500 1,000 2,000

Rev	Date	By	Chkd	Appd	Authd
02	12/07/2023	SJ	CE	PC	--

ARUP

4 Pierhead Street
Cardiff CF10 4QP
Tel +44 20 7636 1531
www.arup.com

Client

Cardiff Council

Project Name

Cardiff International Sport Village and Cardiff Peninsula

Drawing Title

Site location

Scale at A3

1:40,000

Role

Suitability

Project Number

295462-00

Rev

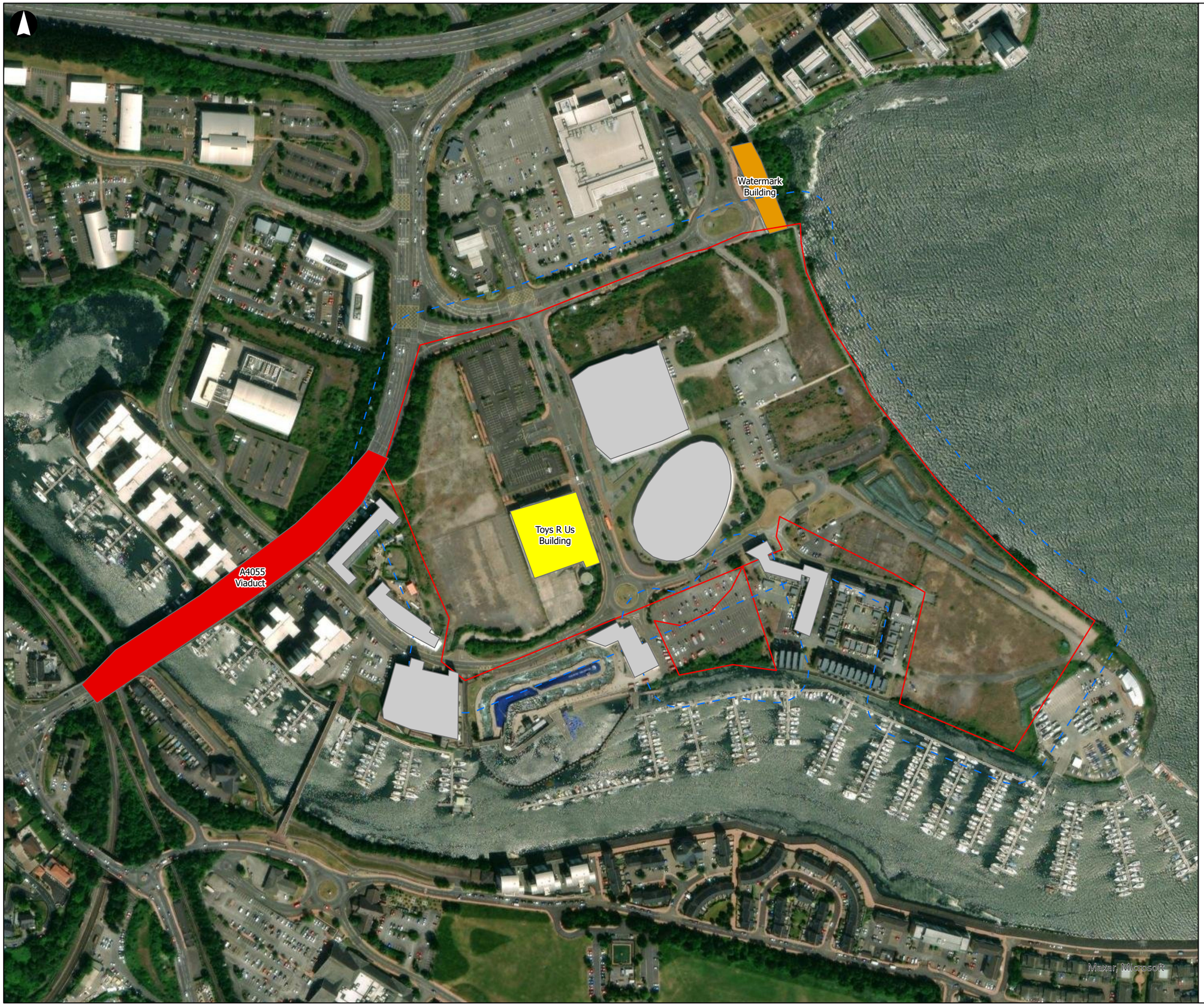
02

Drawing Number

Figure 5

\\global\gis\UK\284000\288353-00 CISV\Workspaces\Phase 1\CISV Phase 1 SJ\CISV Phase 1.aprx

Figure 6: Roosts and potential roosts within site and 30m boundary



A3

23/01/2024 12:43

Legend

- Site boundary
- Survey area (30m buffer of site)
- Negligible roost suitability
- Moderate roost suitability
- High roost suitability
- Confirmed roost

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

Metres
0 50 100 200

Rev	Date	By	Chkd	Appd	Authd
P01	20/11/2023	SJ	CE	CD	

ARUP

4 Pierhead St.
Cardiff, CF10 4QP
Tel +44 29 2047 3727
www.arup.com

Client
Cardiff Council

Project Name
Cardiff International Sport Village & Cardiff Peninsula

Drawing Title
Roost suitability and known roosts

Scale at A3
1:5,500

Role

Suitability

Project Number
295462-00

Rev
P01

Drawing Number
Figure 6

\\global\gis\UK\284000\288353-00 CISV\Workspaces\bats\MyProject\MyProject.aprx

Figure 7: Static Locations

A3

20/11/2023 14:25

Legend

- Site boundary
- Static detector

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

Metres

0 50 100 200

Rev	Date	By	Chkd	Appd	Authd
P01	20/11/2023	SJ	CE	CD	

ARUP

4 Pierhead St.
Cardiff, CF10 4QP
Tel +44 29 2047 3727
www.arup.com

Client
Cardiff Council

Project Name
Cardiff International Sport Village & Cardiff Peninsula

Drawing Title
Static detector locations

Scale at A3
1:4,000

Role

Suitability

Project Number
295462-00

Rev
P01

Drawing Number
Figure 7

\\global\gis\UK\284000\288353-00 CISV\Workspaces\bats\MyProject\MyProject.aprx

Figure 8: Transect route

A3

20/11/2023 18:03

Legend

- Site boundary
- Transect route
- Stopping point

Coordinate System: WGS 1984 Web Mercator Auxiliary Sphere

Metres

0 50 100 200

Rev	Date	By	Chkd	Appd	Authd
P01	20/11/2023	SJ	CE	CD	

ARUP

4 Pierhead St.
Cardiff, CF10 4QP
Tel +44 29 2047 3727
www.arup.com

Client
Cardiff Council

Project Name
Cardiff International Sport Village & Cardiff Peninsula

Drawing Title
Transect route

Scale at A3
1:4,000

Role

Suitability

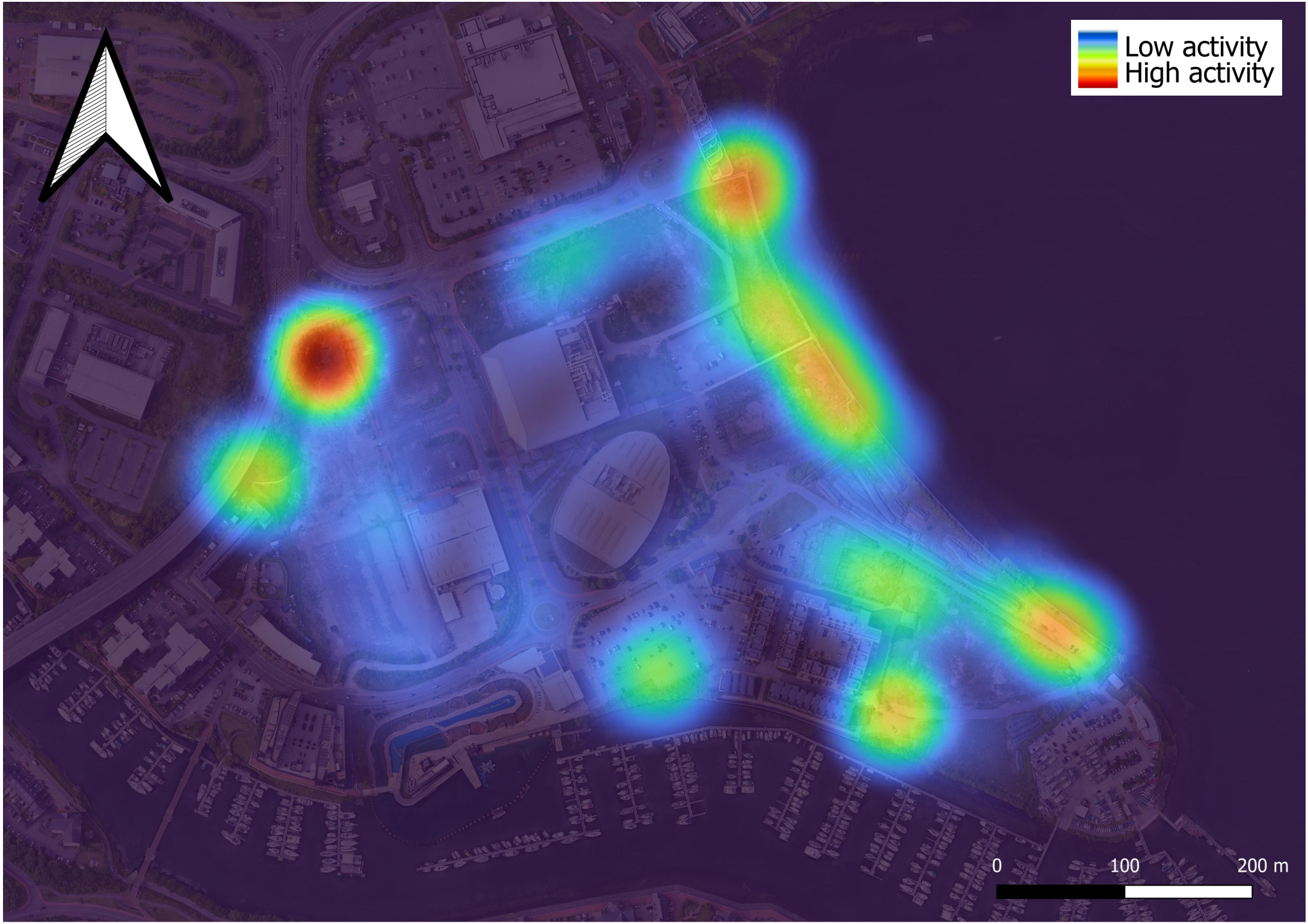
Project Number
295462-00

Rev
P01

Drawing Number
Figure 8

\\global\gis\UK\284000\288353-00 CISV\Workspaces\bats\MyProject\MyProject.aprx

Figure 9: Transect activity heat map


Low activity
High activity
0
100
200 m

Appendix A

A.1 Static weather conditions

Weather conditions during static deployment dates between September 2022 to October 2023 (November 2022, December 2022, January 2023, February 2023, March 2023, and April 2023 excluded)

Date	Temperature range during night of (ºC)	Total precipitation (mm)	Humidity range during night of (%)	Average wind speed during night off (mph)
	September 2022			
14/09/2022	19 - 12	0.38	88 - 82	9
15/09/2022	15 - 9	0.15	94 - 82	9
16/09/2022	14 - 7	0.00	81 - 59	7
17/09/2022	15 - 6	0.00	93 - 67	9
18/09/2022	16 - 10	0.02	88 - 63	6
	October 2022			
19/10/2022	16 - 14	0.82	100 - 83	8
20/10/2022	14 - 13	0.41	94 - 88	13
21/10/2022	15 - 13	7.90	100 - 82	11
22/10/2022	15 - 14	1.90	100 - 94	8
23/10/2022	13 - 11	13	100 - 88	8
	May 2023			
03/05/2023	14 - 8	0.00	87 - 59	18
04/05/2023	13 - 12	3.40	94 - 88	6
05/05/2023	13 - 12	6.90	100 -94	6
06/05/2023	11 - 9	8.80	100 - 94	11
07/05/2023	12 - 11	0.00	94 - 88	4
08/05/2023	12 - 11	19.00	100	8
09/05/2023	11	4.20	100 - 94	12
10/05/2023	11 - 9	0.49	94 - 88	9
11/05/2023	11 - 9	0.10	94 - 88	4
12/05/2023	15 - 10	0.00	87 - 59	13
	June 2023			
21/06/2023	17 - 15	0.25	100 - 94	7
22/06/2023	17 - 14	0.00	100 - 88	7
23/06/2023	19 - 18	0.02	88 - 78	5

Date	Temperature range during night of (ºC)	Total precipitation (mm)	Humidity range during night of (%)	Average wind speed during night off (mph)
24/06/2023	22 - 17	0.00	83 - 57	9
25/06/2023	16 - 14	0.16	88 - 77	10
	July 2023			
07/07/2023	22 - 19	0.00	60 - 47	8
08/07/2023	16 - 14	6.00	100 - 83	5
09/07/2023	16 - 14	3.90	94 - 82	7
10/07/2023	16 - 15	10.00	100 - 88	15
11/07/2023	16 - 14	10.00	88 - 77	11
17/07/2023	15 - 13	9.40	94 - 77	6
18/07/2023	16 - 15	1.30	94 - 88	10
19/07/2023	15 - 10	0.30	100 - 88	7
20/07/2023	15 - 10	0.02	82 - 77	7
21/07/2023	16 - 15	0.02	82 - 77	10
	August 2023			
27/08/2023	14	1.10	100 - 88	7
28/08/2023	14 - 13	0.29	94 - 77	4
29/08/2023	12 - 11	2.30	94 - 88	7
30/08/2023	14 - 11	0.00	88 - 82	5
31/08/2023	15 - 14	4.20	100	2
	September 2023			
13/09/2023	17 - 14	0.00	88 - 77	5
14/09/2023	17 - 15	0.04	100 - 88	4
15/09/2023	18 - 14	0.30	94 - 82	6
16/09/2023	17 - 15	9.60	94 - 88	13
17/09/2023	18 - 14	26.00	100 - 88	5
	October 2023			
19/10/2023	15 - 13	14.00	100 - 94	7
20/10/2023	14 - 10	6.70	94 - 88	12
21/10/2023	10 - 7	2.40	93 - 71	7
22/10/2023	12 - 10	0.56	94 - 82	5
23/10/2023	13 - 8	8.80	100 - 94	8

Appendix B

B.1 Automated Static Results

Total number of bat passes for each species at each location between May to October

		Common pipistrelle	Soprano pipistrelle	Nathusius' pipistrelle	Nyctalus sp	Myotis sp	Lesser horseshoe
May	L1	395	552	28	25	0	0
	L2	2581	3684	2	429	3	0
	L3	6553	7224	139	103	177	0
	L4	7496	3642	55	171	16	0
June	L1	4399	2035	8	97	0	0
	L2	3648	1927	337	389	2	0
	L3	5693	4196	29	275	72	0
	L4	0	0	0	0	0	0
July	L1	12377	15823	151	395	43	0
	L2	2800	3173	124	232	3	0
	L3	0	0	0	0	0	0
	L4	5798	8820	23	42	40	0
August	L1	657	1395	1	47	8	4
	L2	831	11163	8	100	16	0
	L3	3454	13350	3820	86	4581	0
	L4	3839	5284	97	78	34	0
September	L1	615	2770	61	5	0	0
	L2	746	2287	16	5	0	0
	L3	1279	8121	168	101	891	0
	L4	2553	10226	217	152	24	0
October	L1	133	135	8	0	1	0
	L2	1143	1374	131	9	4	0
	L3	2085	3732	847	1	1425	0
	L4	325	599	77	5	7	0

Appendix C

C.1 Transect survey Report (Wildwood Ecology Ltd, 2023)

ISSUING OFFICE:
Britannia House
Caerphilly Business Park
Van Road
Caerphilly
CF83 3GG

T: 029 2002 2320

E: info@wildwoodecology.com
W: www.wildwoodecology.com

BAT SURVEY REPORT

CARDIFF INTERNATIONAL SPORTS VILLAGE

ARUP

DOCUMENT REF: WWE22123 BAT SURVEY REPORT FINAL | 21/12/2023

Director: Richard Dodd, BSc (Hons), CEcol, MCIEEM
Wildwood Ecology Limited. Registered in England & Wales, Company No. 6646654 VAT No. 938019610
Registered Office: Wildwood Ecology Ltd, Suite 1, Ground Floor, Mill Building, Brimscombe Mill Business Park, Stroud, GL5 2QG

Client:	Arup
Site/Job:	Cardiff International Sports Village
Report title:	Bat Survey Report
Report reference:	WWE22123 Bat Survey Report FINAL

Grid Reference:	ST179730
Survey date(s):	19/06/2023, 12/07/2023, 08/08/2023, 09/08/2023, 11/09/2023, 10/10/2023
Surveyed by:	Jack McCormack, Dr Amy Williams Schwartz, Beth Lewis, Hannah Humphreys, Alice Thorne, Emma Murray
Planning reference:	N/A

VERSIONING AND QUALITY ASSURANCE

Rev	Status	Date	Author(s)	Reviewed by	Approved by
A	Final	21/12/2023	Jack McCormack Assistant Consultant Ecologist	Dr Amy Williams Schwartz ACIEEM Senior Ecologist	Dr Amy Williams Schwartz ACIEEM Senior Ecologist

DISCLAIMER

This document has been prepared by Wildwood Ecology Limited for Arup solely as an Bat Survey Report. Wildwood Ecology Limited accepts no responsibility or liability for any use that is made of this document other than by the client for the purposes for which it was originally commissioned and prepared.

The evidence which we have prepared and provided is true and has been prepared and provided in accordance with the guidance of The Chartered Institute of Ecology and Environmental Management's Code of Professional Conduct. We confirm that the opinions expressed are our true and professional bona fide opinions.

SUMMARY

Purpose	• Wildwood Ecology was commissioned by Arup (the client) to undertake bat activity transects monthly between June and October 2023. • This report details the methodology and results of surveys undertaken.
Methodology	• Activity transect surveys were undertaken monthly from June to October, following best practice in line with the Bat Surveys for Professional Ecologists: Good Practice Guidelines, 3rd edn (Collins 2016). • In August, a dusk and dawn transect was undertaken on successive days. • An activity transect survey was undertaken in May by Arup, with the results provided to Wildwood Ecology for inclusion in this report.
Conclusions	• The following species were identified: common pipistrelle, soprano pipistrelle, Nathusius' pipistrelle, noctule, myotis sp. • This ecological report will remain valid for a period of 18 months from the date of the last survey – i.e. until April 2025.

CONTENTS

1 METHODOLOGY

Bat transect surveys

1.1 The transect routes were plotted to cover the whole of the site area. The chosen route was provided Arup (see Figure 1).

1.2 Within the pair, one surveyor recorded each bat echolocation call using an Elekon Batlogger M/M2 (which enabled them to be linked to a specific location (GPS) and time). The other surveyor noted down any relevant observations, for example, numbers of bats, flight direction, flight height and behaviour (commuting or foraging). Both surveyors identified bat species, where possible, during the transect surveys.

1.3 During the survey, surveyors stopped for five minutes at each point marked in Figure 1 in order to record bat activity.

1.4 The starting point and direction of each transect can be seen in Table 1.

Table 1 - Starting point and direction of each transect.

Transect date	Starting point	Direction
15/05/2023	1	Clockwise
19/06/2023	1	Clockwise
12/07/2023	12	Anti-clockwise
08/08/2023	10	Anti-clockwise
09/08/2023	7	Anti-clockwise
11/09/2023	5	Anti-clockwise
10/10/2023	8	Clockwise

1.5 The survey effort consisted of six monthly dusk surveys between May and October and one dawn survey in August. As there was a Site of Importance to Nature Conservation (SINC) onsite designated for supporting a lesser horseshoe roost (Stop 2), the transects lasted three hours.

Figure 1 - Route for bat activity transect surveys.

Data analysis

1.6 The transect data was analysed using Bat Explorer and Kaleidoscope Pro.

1.7 Myotis species were grouped as a genus.

1.8 Whilst analysing data, all files labelled as "noID", horseshoe species, non-UK resident species or barbastelle manually checked, and with a minimum of 10% of all "noise files" and other species labelled files also manually checked.

Surveyor information

1.9 The surveys were led by Jack McCormack, assisted by Amy Williams Schwartz, Beth Lewis, Hannah Humphreys and Alice Thorne. See Table 2 for further information.

Table 2 - Surveyor information

Surveyor	Licences	Ecological experience
Jack McCormack M.Res., B.Sc (Hons) Assistant Ecologist Qualifying CIEEM	-	Holds a 1st class honours degree in Zoology and a Masters of Research in Biosciences. Experience in undertaking bat surveys and assisting in other protected species surveys gained through working with Wildwood Ecology.

Surveyor	Licences	Ecological experience
Dr Amy Williams Schwartz PhD, MSc, B.Sc. (Hons), ACIEEM Ecologist	Bat GCN	Experienced in surveying for a wide range of protected species including great crested newt, reptiles, and bats within a consultancy and volunteer capacity. PhD thesis on wildlife/road interactions in the UK, and experienced in performing academic ecological research projects, as well as species identification.
Beth Lewis B.Sc. (Hons) Assistant Ecologist	GCN Level 1 (NE)	Holds a 2:1 honours degree in Zoology with Conservation. Has 2 years' experience in protected species surveys including bats, reptiles, dormouse and GCN, as well as habitat surveys.
Hannah Humphreys B.Sc.(Hons) Seasonal Assistant Ecologist	-	Holds a BSc Zoology degree with experience in bat surveys, reptile translocation, and ECoW. Have assisted with multiple protected species surveys while working with Wildwood Ecology.
Survey assistants Alice Thorne Emma Murray	-	All survey assistants received training in use of bat detectors and survey methodologies. Deemed competent and confident to use bat detectors to observe bats in flight and conduct an emergence/re-entry survey in conjunction with a licenced ecologist. Assistants backed up by experienced surveyors and/or recording detectors where possible.

Limitations and assumptions

1.10 No limitations were encountered, or assumptions made, and it is considered that, with the access gained and recording undertaken, an accurate assessment of the site's ecological value was made.

2 RESULTS

Survey conditions

2.1 The weather conditions during each survey can be seen in Table 3.

Table 3 - Survey conditions

Date	Weather conditions					
	Sunrise / Sunset time	Start temp [°C]	End temp [°C]	Cloud cover [Oktas]	Wind speed [Beaufort scale]	Rain
15/05/2023	21:00	15	*Data not available*	1	3	Nil
19/06/2023	21:33	20	19	4	1	Nil
12/07/2023	21:27	20	16	1	4	Nil
08/08/2023	20:49	17	15	2	6	Nil
09/08/2023	05:48	14	16	0	1	Nil
11/09/2023	19:37	19	17	3	0	Nil
10/10/2023	18:31	18	16	6	3	Nil

Bat activity transect surveys

2.2 The results of the bat transect surveys can be seen in Table 3. The heat map from each survey can be seen following Table 4.

2.3 It should be noted that the number of records refers to the number of separate recordings of each species throughout the course of the transect, and the number of calls refers to the count of individual echolocation calls detected throughout the survey.

Table 4 - Bat transect survey results

Species scientific name	Species common name	Number of records	Number of calls
15/05/2023 (dusk)			
Pipistrellus nathusii	Nathusius' pipistrelle	1	21
Pipistrellus pipistrellus	Common pipistrelle	80	2249
Pipistrellus pygmaeus	Soprano pipistrelle	542	8461
Pipistrellus sp.	Pipistrelle sp.	67	583
19/06/2023 (dusk)			
Pipistrellus nathusii	Nathusius' pipistrelle	5	59
Pipistrellus pipistrellus	Common pipistrelle	15	75
Pipistrellus pygmaeus	Soprano pipistrelle	337	5289
Nyctalus noctula	Noctule	199	2814
12/07/2023 (dusk)			
Pipistrellus nathusii	Nathusius' pipistrelle	2	2
Pipistrellus pipistrellus	Common pipistrelle	171	2736
Pipistrellus pygmaeus	Soprano pipistrelle	110	1943

Nyctalus noctula	Noctule	29	66
08/08/2023 (dusk)			
Pipistrellus nathusii	Nathusius' pipistrelle	70	581
Pipistrellus pipistrellus	Common pipistrelle	286	3802
Pipistrellus pygmaeus	Soprano pipistrelle	365	5504
Nyctalus noctula	Noctule	13	170
Myotis sp.	Myotis sp	7	446
09/08/2023 (dawn)			
Pipistrellus nathusii	Nathusius' pipistrelle	9	132
Pipistrellus pipistrellus	Common pipistrelle	6	104
Pipistrellus pygmaeus	Soprano pipistrelle	176	2223
Nyctalus noctula	Noctule	347	4359
11/09/2023 (dusk)			
Pipistrellus nathusii	Nathusius' pipistrelle	2	30
Pipistrellus pipistrellus	Common pipistrelle	219	3938
Pipistrellus pygmaeus	Soprano pipistrelle	194	3658
Nyctalus noctula	Noctule	19	92
Myotis sp.	Myotis sp	3	5
10/10/2023 (dusk)			
Pipistrellus nathusii	Nathusius' pipistrelle	30	665
Pipistrellus pipistrellus	Common pipistrelle	13	256
Pipistrellus pygmaeus	Soprano pipistrelle	74	1402

Heat maps and behavioural observation

2.4 The following results show heat maps of bat activity during the transects, with the below table detailing the behaviours observed. It should be noted that bats were often heard but not seen – these instances were not included in behavioural results tables.

Figure 2 - Heat map from transect survey on 15/05/23.

Table 5 - Behavioural observations from the transect on 15/05.

Transect point	Observation
2	5 soprano pipistrelles foraging over scrub. Individuals emerged from bridge and commuted along woodland corridor.
2 – 3	Soprano pipistrelle foraging along woodland
3	3 soprano pipistrelles foraging over woodland.
4	4 soprano pipistrelles commuting north to south along scrub line. Continuous foraging along scrub.
5	Soprano pipistrelles foraging and commuting over water. Individuals seen commuting along building edges and foraging under streetlights.
6	Soprano pipistrelle foraging
7	Soprano pipistrelle foraging
8	Soprano and common pipistrelles commuting and foraging along scrub and water.
9	Soprano pipistrelles commuting edges

Figure 3 - Heat map from transect survey on 19/06/23.

Table 6 - Behavioural observations from the survey on 19/06.

Transect point	Observation
2	2 soprano pipistrelles and 1 common pipistrelle foraging under bridge.
2 – 3	2 common pipistrelles foraging along tree line.
3	2 common pipistrelles and 1 soprano pipistrelle foraging around tree line.
3 – 4	Common pipistrelle and soprano pipistrelle foraging around scrub, after which they commuted west to east.
4	2 soprano pipistrelles foraging around scrub.
5	Soprano pipistrelle and noctule foraging over water
6	Soprano and common pipistrelle foraging over water.
8	Nathusius pipistrelle foraging along scrub and water.
9	Several common pipistrelles foraging around scrub.

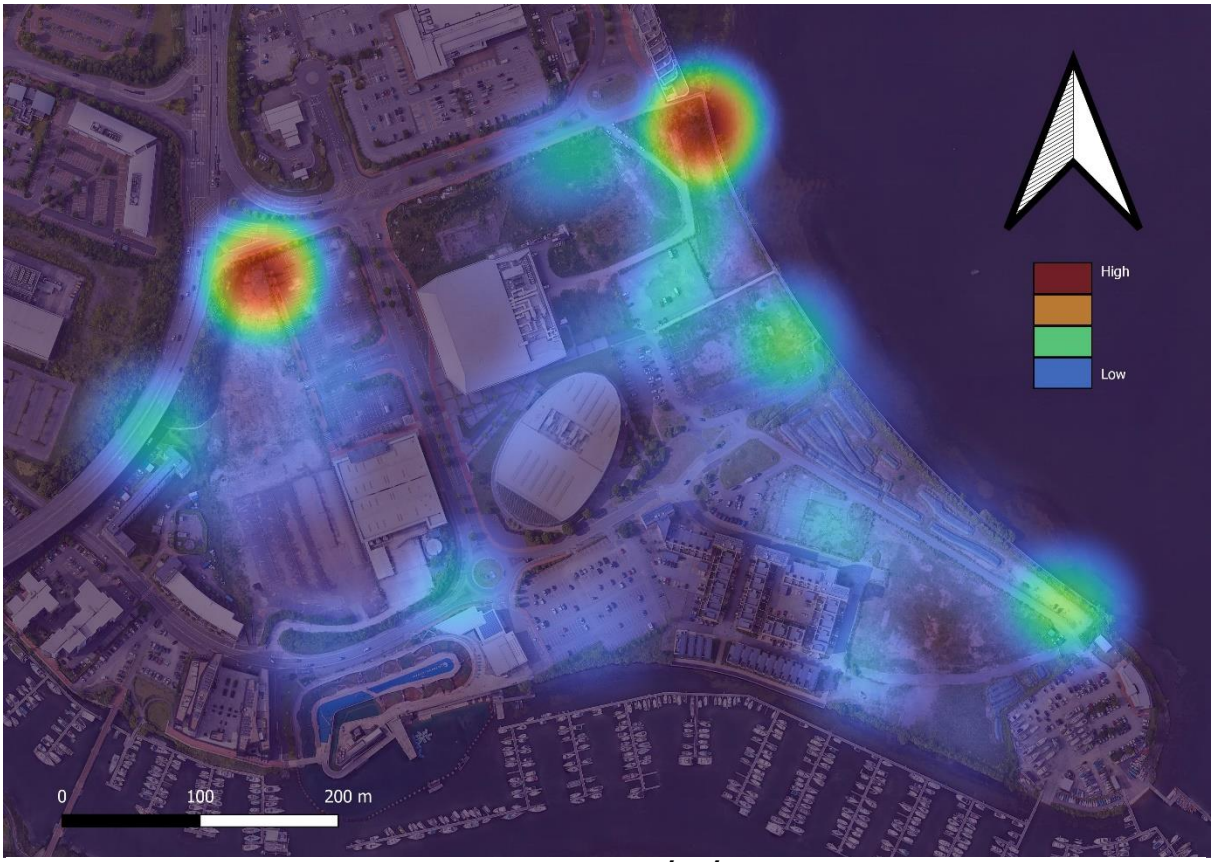


Figure 4 - Heat map from transect survey on 19/06/23.

Table 7 - Behavioural observations from the survey on 19/06.

Transect point	Observation
3	Soprano pipistrelle foraging along tree line.
4	Soprano pipistrelle foraging around scrub.
5	Soprano pipistrelle foraging over water
8	Nathusius pipistrelle foraging along scrub and water.
9	2 common pipistrelle and 1 soprano pipistrelle foraging along scrub/water.

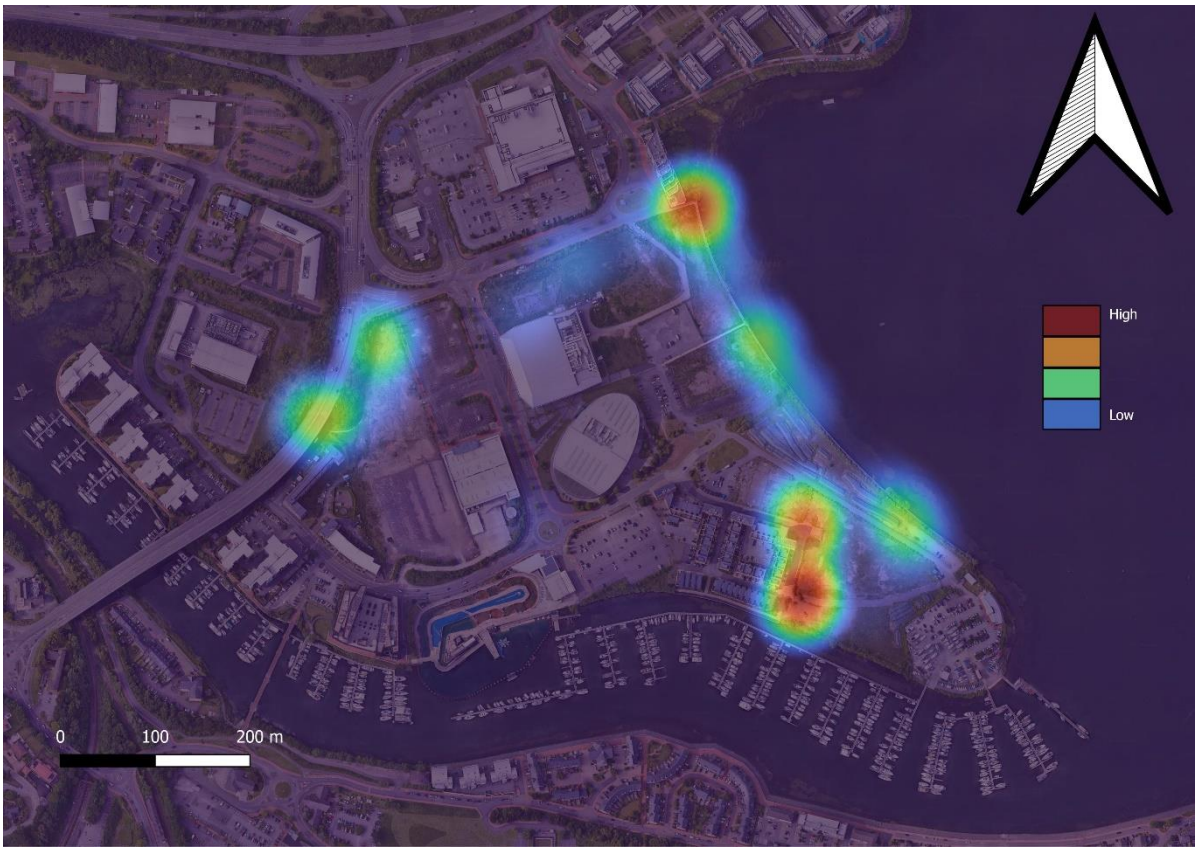


Figure 5 - Heat map from transect survey on 08/08/23.

Table 8 - Behavioural observations from the transect on 08/08.

Transect point	Observation
1	Common pipistrelle commuting east long tree line to the south.
2	Soprano pipistrelle foraging under bridge
3	Soprano pipistrelle and common pipistrelle foraging along tree line.
4	Common and soprano pipistrelle and noctule foraging around scrub. Common pipistrelle and soprano pipistrelle commuting west to east.
5	Several common and soprano pipistrelle foraging over water.
6	Noctule and common pipistrelle commuting south-east.
7	Common pipistrelle around scrub
7 - 8	Nathusius pipistrelle commuting along scrub.
8	Common pipistrelle foraging above water. Noctule commuting along scrub.
9 - 10	Common pipistrelle foraging around scrub.

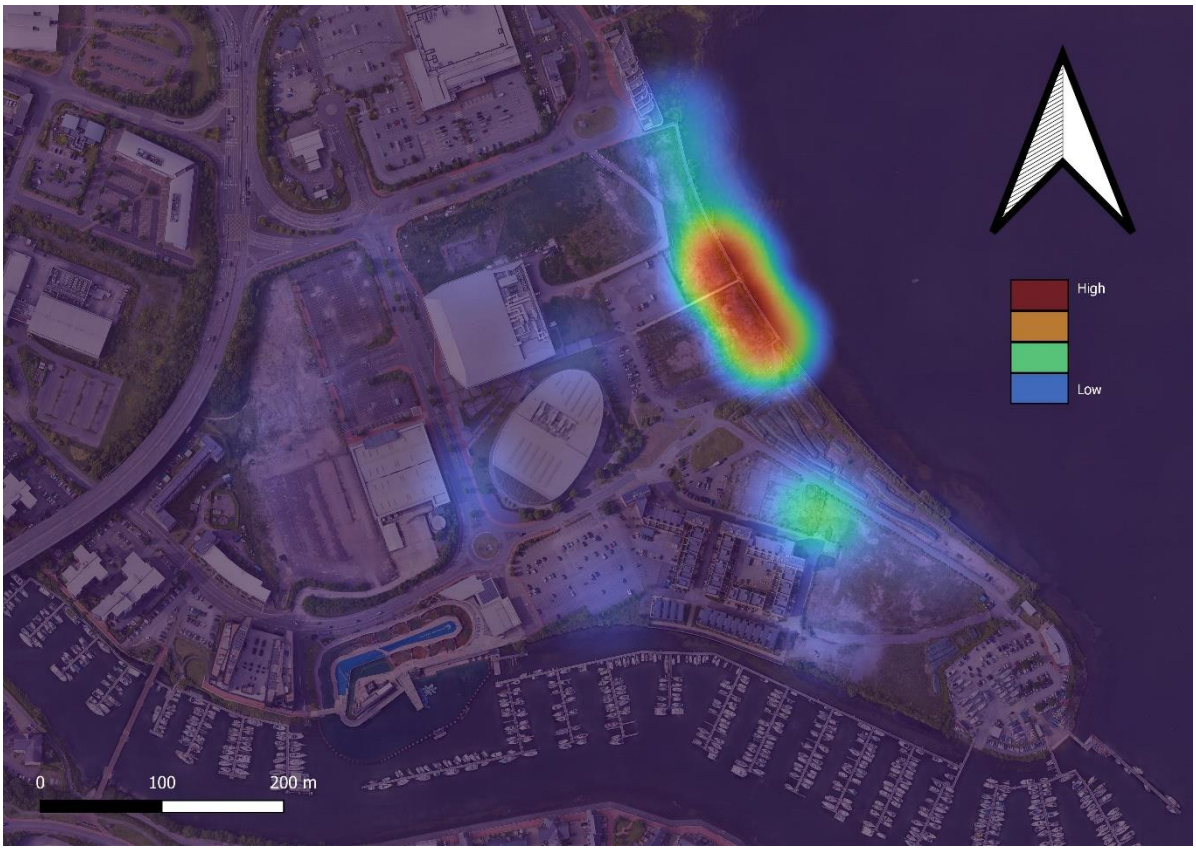


Figure 6 - Heat map from transect survey on 09/08/23.

Table 9 - Behavioural observations from the transect on 09/08.

Transect point	Observation
2	Soprano pipistrelle foraging around tree line.
3	Soprano pipistrelle and common pipistrelle foraging along tree line.
3-4	Common pipistrelle and soprano pipistrelle commuting west to east along tree line.
4	Common and soprano pipistrelle foraging around scrub.
5	Common and soprano pipistrelle and noctule foraging over water.
6	Common, soprano and Nathusius pipistrelle foraging around scrub.
7	Common and soprano pipistrelle foraging over water.
10	3 soprano pipistrelle foraging around scrub
10-11	Common pipistrelle and 3 soprano pipistrelle commuting south.
11	Common pipistrelle commuting north-west.
12	Soprano pipistrelle commuting east.

Figure 7 - Heat map from transect survey on 11/09/23.

Table 10 - Behavioural observations from the transect on 11/09.

Transect point	Observation
1	Soprano pipistrelle foraging
1-2	Soprano and common pipistrelle foraging along tree lines
2	Soprano pipistrelle, Nathusius pipistrelle, common pipistrelle and noctule foraging around tree line.
2-3	Noctule commuting west to east. Soprano pipistrelle foraging around scrub.
3	Noctule, soprano pipistrelle and common pipistrelle foraging around scrub.
3-4	Noctule foraging around scrub
6	Common pipistrelle foraging around scrub.
7	3 soprano pipistrelle and a common pipistrelle foraging around scrub and over water.
7-8	3 soprano pipistrelle and a common pipistrelle foraging around scrub and over water.
8	2 soprano pipistrelle, a common pipistrelle and a noctule foraging over water.
8-9	Soprano pipistrelle, common pipistrelle and noctule foraging around scrub.
9	2 soprano pipistrelle, a common pipistrelle and a noctule foraging around scrub.
9-10	Soprano pipistrelle and common pipistrelle foraging around scrub.
10	2 soprano pipistrelle and a Nathusius pipistrelle foraging around scrub.
10-11	Noctule, common pipistrelle and soprano pipistrelle foraging around scrub.
11-12	Soprano and common pipistrelle foraging.

Figure 8 - Heat map from transect survey on 10/10/23.

Table 11 - Behavioural observations from the transect on 10/10.

Transect point	Observation
2	Soprano pipistrelle foraging around tree line
2-3	Soprano pipistrelle foraging along tree line,
3	Soprano pipistrelle foraging along tree line,
3-4	Nathusius and soprano pipistrelle foraging around scrub.
4	A Nathusius pipistrelle, 2 soprano pipistrelles and a common pipistrelle foraging around scrub.
4-5	Soprano, Nathusius and common pipistrelle foraging around scrub.
5	Soprano, Nathusius and common pipistrelle foraging around scrub.
5-6	Soprano and Nathusius pipistrelle foraging over water.
6	Nathusius pipistrelle foraging around scrub.
7	Soprano pipistrelle foraging.
10-11	Soprano pipistrelle foraging.
11	Soprano pipistrelle foraging.

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