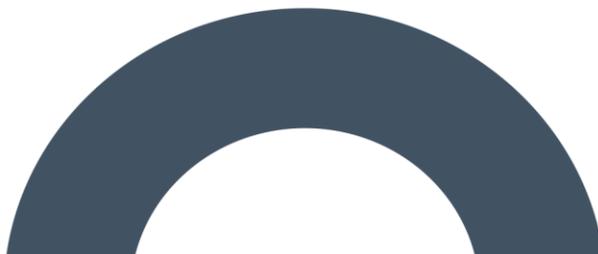


Bat Survey Report

Knocknacarra District
Centre LRD





DOCUMENT DETAILS

Client: **Glenveagh Living Ltd.**

Project Title: **Knocknacarra District Centre LRD**

Project Number: **210206**

Document Title: **Bat Survey Report**

Document File Name: **BR F2 – 2023.08.24 – 210206**

Prepared By: **MKO
Tuam Road
Galway
Ireland
H91 VW84**



Rev	Status	Date	Author(s)	Approved By
01	Final	16/12/2022	NC	AJ
02	Final	24/08/2023	NC	AJ

Table of Contents

1.	INTRODUCTION.....	1
1.1	Policy and Legislation	1
1.2	Statement of Authority	1
2.	CHARACTERISTICS OF PROPOSED DEVELOPMENT.....	2
3.	METHODS.....	4
3.1	Desktop Study	4
3.1.1	National Bat Database of Ireland	4
3.1.2	Designated Sites	4
3.1.3	Galway City Transport Project (2015) and Galway City Ring Road EIAR (2018).....	5
3.2	Ecological Appraisal (Bats).....	5
3.3	Bat Surveys	5
3.3.1	Roost Assessment	5
3.3.2	Dusk and Dawn Activity Surveys	5
3.3.3	Static Detector Surveys	8
3.4	Survey Limitations	9
4.	RESULTS.....	10
4.1	Desktop Study	10
4.1.1	National Bat Database of Ireland	10
4.1.2	Designated Sites	10
4.1.3	Galway City Transport Project (2015) and Galway City Ring Road EIAR (2018).....	11
4.1.4	Conclusion of Desktop Study	13
4.2	Bat Habitat Appraisal.....	13
4.3	Bat Surveys	15
4.3.1	Roost Assessment	15
4.3.2	Dusk and Dawn Activity Surveys	15
4.3.3	Static Detector Survey Results	20
4.4	Importance of Bat Population Recorded at the Site.....	22
5.	ASSESSMENT OF LIKELY EFFECTS.....	23
5.1	Loss of Roosting Habitat.....	23
5.2	Loss of Foraging and Commuting Habitat	23
5.3	Disturbance	23
6.	CONCLUSION	25
7.	BIBLIOGRAPHY	26

TABLE OF PLATES

<i>Plate 3-1 Sonogram of Echolocation Pulses of Common pipistrelle (Peak Frequency 45kHz)</i>	8
<i>Plate 4-1 Area of scrub on the north section of the development</i>	14
<i>Plate 4-2 Scattered Trees and Parkland (WD5) adjacent to public access road Buildings and Artificial Surfaces (BL3)</i>	14
<i>Plate 4-3 View of Amenity grassland (GA2) with Scattered Trees and Parkland (WD5) in background and Buildings and Artificial Surfaces (BL3) in right middle</i>	14
<i>Plate 4-4 View of Spoil and bare ground (ED2) in the south section of the development area</i>	14
<i>Plate 4-5 Dusk and Dawn Activity Survey Total Bat Species Composition</i>	15
<i>Plate 4-6 Total Bat Passes Per Night</i>	16
<i>Plate 4-7 Species Composition – Static Detectors</i>	20
<i>Plate 4-8 Total Bat Passes Per Detector</i>	21
<i>Plate 4-9 Total Bat Passes per Night</i>	21

TABLE OF TABLES

<i>Table 3-1 Bat Activity Survey Effort 2021</i>	5
<i>Table 4-1 NBDC Bat Records</i>	10
<i>Table 4-2 Roosts identified within 2.5km of Proposed Development (2015)</i>	11
<i>Table 4-3 Roosts identified within 2.5km of Proposed Development (2018)</i>	12
<i>Table 4-4 Habitats recorded within and adjacent to the Proposed Development</i>	13
<i>Table 4-5 Manual Transect Bat Pass Results Per Survey</i>	15
<i>Table 5-1 Assessment of Potential Impacts on Commuting/Foraging Bats</i>	23
<i>Table 5-2 Assessment of Potential Impacts from Disturbance on Bats</i>	23

TABLE OF FIGURES

<i>Figure 2-1 Site Location</i>	3
<i>Figure 3-1 Manual Transect Routes</i>	7
<i>Figure 4-1 Dusk 27th July 2021 - Manual Transect Results</i>	17
<i>Figure 4-2 Dawn 10th August 2021 - Manual Transect Results</i>	18
<i>Figure 4-3 Dusk 24th August 2021 - Manual Transect Results</i>	19

1. INTRODUCTION

MKO was commissioned to undertake a bat survey with regards to a proposed largescale residential development (LRD) at Knocknacarra, Co. Galway.

MKO undertook two dusks and one dawn bat activity surveys in 2021, within the site of the Proposed Development (Grid Reference: M 26884 25143). The main objective of the surveys was to gather information on roosting, commuting, and foraging bats using the site and to identify any important features for bats. Two full spectrum bat detectors, Song Meter Mini (Wildlife Acoustics, Maynard, MA, USA), were deployed for two weeks to record bat activity at two fixed locations. After two weeks, the detectors were then moved to alternative locations within the site where they stayed for further two weeks.

The bat survey and assessment were informed by a desk study and with reference to the following guidelines:

- *Bat Surveys for Professional Ecologists – Good Practice Guidelines (3rd edn.) (Collins, 2016)*
- *Bat Roosts in Trees (Andrews, 2018)*
- *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes (NRA, 2006a)*
- *Guidelines for the Treatment of Bats during the Construction of National Road Schemes (NRA, 2006b)*
- *British Bat Calls: A Guide to Species Identification (Russ, 2012)*
- *Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 134. (Marnell, Kelleher & Mullen, 2022)*
- *Guidance Note 08/18: Bats and Artificial Lighting in the UK (ILP, 2018)*

1.1 Policy and Legislation

All Irish bats are protected under European legislation, namely the Habitats Directive (92/43/EEC). All Irish species are listed under Annex IV of the Directive, requiring strict protection for individuals, their breeding sites and resting places. The lesser horseshoe bat (*Rhinolophus hipposideros*) is further listed under Annex II of the Directive, requiring the designation of conservation areas for the species. Under this Directive, Ireland is obliged to maintain the favourable conservation status of Annex-listed species. This Directive has been transposed into Irish law through the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. No. 477/2011).

In addition, Irish species are further protected by national legislation (Wildlife Acts 1976-2022). Under this legislation, it is an offence to intentionally disturb, injure or kill a bat or disturb its roost. Any work at a roost site must be carried out with the agreement of the National Parks and Wildlife Service (NPWS) and a derogation licence must be granted before works commence.

1.2 Statement of Authority

The bat surveys were undertaken by MKO ecologists Keith Costello (BSc.), Ellen Tusk (BSc.) and Kevin McElduff (B.Sc.). Donal Folan, who was a student participating in an internship program in MKO at the time the surveys were carried out, also accompanied the surveyors. All staff have relevant academic qualifications to complete the surveys and assessments that they were required to do. This report was prepared by Neil Campbell (B.Sc., M.Sc.) and was reviewed by Aoife Joyce (BSc., MSc.). Neil has 2 years' experience and Aoife has over 3 years' experience in ecological assessment.

2.

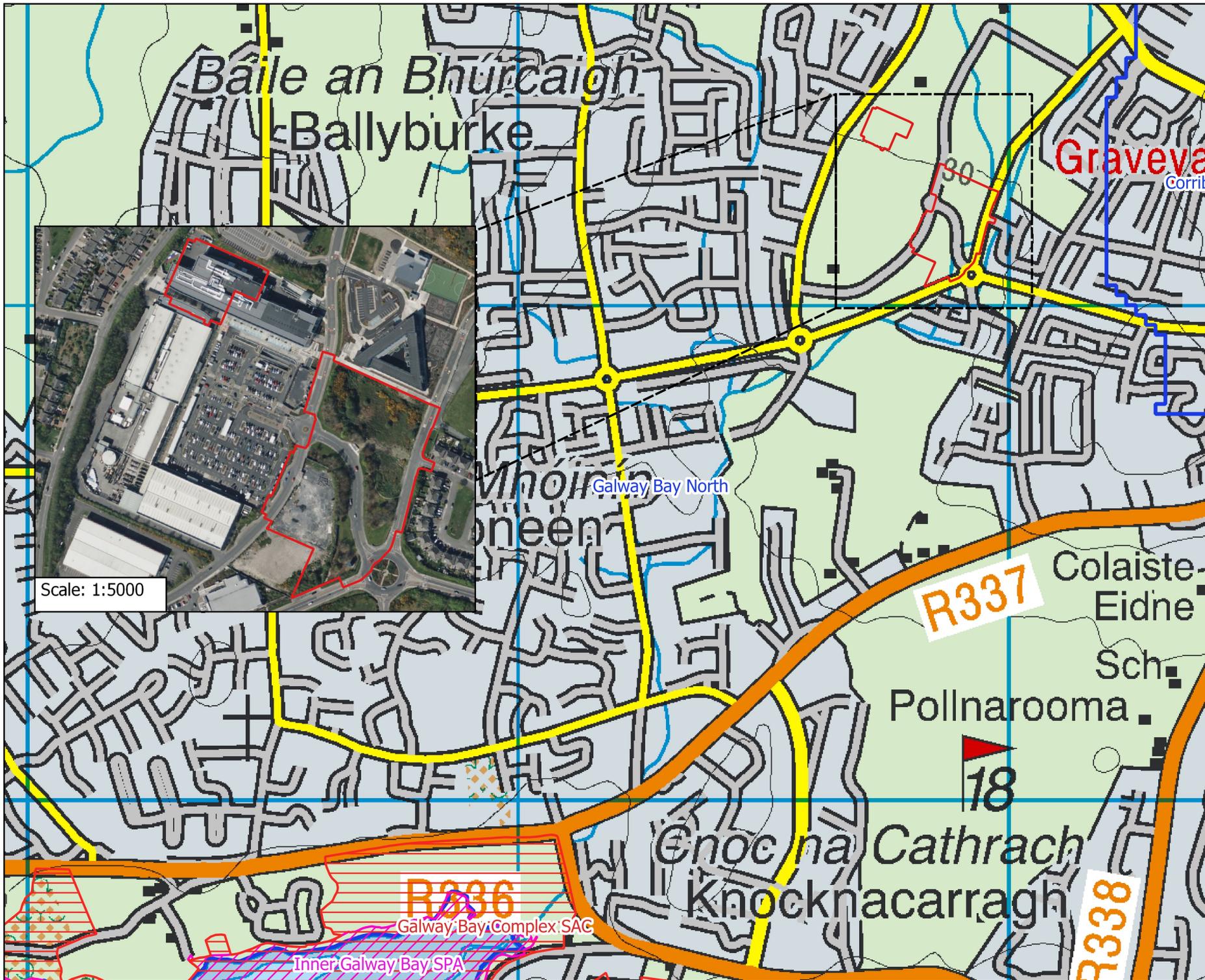
CHARACTERISTICS OF PROPOSED DEVELOPMENT

The subject site is bounded by Gaelscoil Mhic Amhlaigh to the north and the Western Distributor Road to the south. Gateway Retail Park is located approximately 200m to the west of the site. At the eastern boundary of the site there are existing low-density residential housing units. (Grid Reference: M 26903 25141).

A site location map is presented in Figure 2-1.

The Proposed Development will consist of the following:

1. *Provision of ~~227~~ 216 no. residential apartments in 7 no. blocks comprising the following:*
 - *Block A1: ~~14~~ 8 no. 1 bed apartments & ~~24~~ 22 no. 2 bed apartments in a block ranging between 3-5 storeys in height;*
 - *Block A2: 25 no. 1 bed apartments & 15 no. 2 bed apartments in a block ranging between 1-5 storeys in height;*
 - *Block B1: 3 no. 1 bed apartments, 18 no. 2 bed apartments & 3 no. 3 bed apartments in a block ranging between 3-4 storeys in height;*
 - *Block B2: 13 no. 1 bed apartments & 21 no. 2 bed apartments in a block ranging between 4-5 storeys in height.*
 - *Block B3: 5 no. 1 bed apartments, 22 no. 2 bed apartments & 1 no. 3 bed apartment in a block ranging between 3-5 storeys in height;*
 - *Block B4: 11 no. 1 bed apartments & ~~26~~ 23 no. 2 bed apartments in a block ranging between 3-5 storeys in height;*
 - *Block B5: 13 no. 1 bed apartments & 13 no. 2 bed apartments in a block ranging between 3-5 storeys in height.*
2. *Provision of ~~1,009.7~~ 867.4 sq.m of ground floor commercial units as follows:*
 - *Unit A101: 411.7 sq.m;*
 - *~~Unit A102: 138.2 sq.m;~~*
 - *Unit B201: ~~99.7~~ 95.6 sq.m;*
 - *Unit B202: 133.9 sq.m;*
 - *Unit ~~B301-3~~ B301: 226.2 sq.m.*
3. *Provision of a Community Facility (~~117.8~~ 204.7 sq.m);*
4. *Provision of Tenant Amenity Facilities (99.4 sq.m);*
5. *Provision of a Childcare Facility (~~561.3~~ 476.3 sq.m) including an external secure play area;*
6. *Provision of ~~49~~ 40 no. surface car parking spaces including EV charging spaces;*
7. *Provision of bicycle parking comprising ~~114~~ 172 no. short stay and ~~436~~ 386 no. long stay spaces;*
8. *Provision of realigned road between Gort na Bró and Gateway Retail Park Road;*
9. *Change of use of existing underground void to 181 bay underground car park;*
10. *Provision of shared communal and private open spaces, bin storage, public lighting, site landscaping, services, signage, substation, and all associated site development works required to accommodate the Proposed Development.*



Scale: 1:5000

- Map Legend**
- Site Boundary
 - Special Area of Conservation (SAC)
 - Special Protection Area (SPA)



Microsoft product screen shots reprinted with permission from Microsoft Corporation
© Ordnance Survey Ireland. All rights reserved. Licence number CYAL50267517

Drawing Title
Site Location

Project Title
Knocknacarra District Centre LRD

Drawn By AvdGM	Checked By RW
Project No. 210206	Drawing No. Fig 2-1
Scale 1:10000	Date 21.08.2023

MKO
Planning and Environmental Consultants
Tuam Road, Galway
Ireland, H91 WW84
+353 (0) 91 735611
email: info@mkofireland.ie
Website: www.mkofireland.ie

3. METHODS

3.1 Desktop Study

A desktop review of published material was undertaken to inform all subsequent field studies and assessments. The aim of the desktop review was to identify the presence of species of interest within the Proposed Development site and surrounding region.

The following list describes the sources of data consulted:

- *Review of online web-mappers: National Parks and Wildlife Service (NPWS) mapping.*
- *Review of NPWS Article 17 Report.*
- *Review of the publicly available National Biodiversity Data Centre web-mapper.*
- *Review of specially requested records from the NPWS Rare and Protected Species Database for the hectads which overlap with the study area.*
- *Review of N6 Galway City Transport Project; Ecological information presented in the Route Selection Report: Chapter 4: <http://www.n6galwaycity.ie>.*
- *Review of N6 Galway City Ring Road Environmental Impact Assessment Report (2018)*

3.1.1 National Bat Database of Ireland

The National Bat Database of Ireland holds records of bat observations received and maintained by Bat Conservation Ireland. These records include results of national monitoring schemes, roost records as well as ad-hoc observations. The database was searched on 18/10/2022 for bat presence and roost records within 10km of the Proposed Development site.

In addition, information on species' range and distribution, available in the 2019 Article 17 Reports (NPWS, 2019), was reviewed in relation to the location of the development. The NPWS monitors the conservation status of European protected habitats and species and reports their findings to the European Commission every 6 years in the form of an Article 17 Report. The most recent report for the Republic of Ireland was submitted in 2019.

3.1.2 Designated Sites

The potential for the Proposed Development to impact on sites that are designated for bats was considered in the main Biodiversity Chapter.

Special Areas of Conservation (SACs) are designated under EU Habitats Directive. The potential for effects on European Sites is fully considered in the AA Screening Report that accompanies this report. The European Sites that are within the Zone of Likely Impact, with bats identified as Qualifying Interests, are listed in the Appropriate Assessment Screening Report (AASR) and are not repeated in this document.

Natural Heritage Areas (NHAs) are designated under the Wildlife (Amendment) Act 2000 and their management and protection is provided for by this legislation and planning policy. The potential for effects on these designated sites is fully considered in the Biodiversity Chapter.

Proposed Natural Heritage Areas (pNHAs) were designated on a non-statutory basis in 1995 but have not since been statutorily proposed or designated. However, the potential for effects on these designated sites is fully considered in the Biodiversity Chapter.

3.1.3 Galway City Transport Project (2015) and Galway City Ring Road EIAR (2018)

The “Route Selection Report: Chapter 4” of the N6 Galway City Transport Project Environmental Impact Statement, the N6 Galway City Ring Road Environmental Impact Assessment Report (2018) were consulted as part of the desk study for the purposes of the bat assessment. Details of consultation, specifically related to bats, are provided in Section 4.1 below.

3.2 Ecological Appraisal (Bats)

A walkover survey of the Study Area was carried out during daylight hours on the 27th July and 24th of August 2021. The landscape features on the site were visually assessed for potential use as bat roosting habitats and commuting/foraging habitats using a protocol set out in BCT *Bat Surveys for Professional Ecologists: Good Practice Guidelines* (3rd edn.) (Collins, 2016). Table 4.1 of the 2016 BCT Guidelines identifies a grading protocol for assessing structures, trees and commuting/foraging habitat for bats. The protocol is divided into four Suitability Categories: *High, Moderate, Low* and *Negligible*.

3.3 Bat Surveys

3.3.1 Roost Assessment

A search for roosts was undertaken within the boundary of the Proposed Development. The aim was to determine the presence of roosting bats and the need for further survey work or mitigation. The site was visited on multiple occasions in July and August 2021. All structures and trees were assessed for their potential to support roosting bats. Any potential roost sites were subject to a roost assessment. This comprised a detailed inspection of the exterior and interior (if accessible) to look for evidence of bat use, including live and dead specimens, droppings, feeding remains, urine splashes, fur oil staining and noises.

Trees within the site were also assessed from ground level, with the aid of binoculars. Any potential tree roosts were examined for the presence of rot holes, hazard beams, cracks and splits, partially detached bark, knot holes, gaps between overlapping branches and any other potential roost features (i.e., PRFs) identified by Andrews (2018).

3.3.2 Dusk and Dawn Activity Surveys

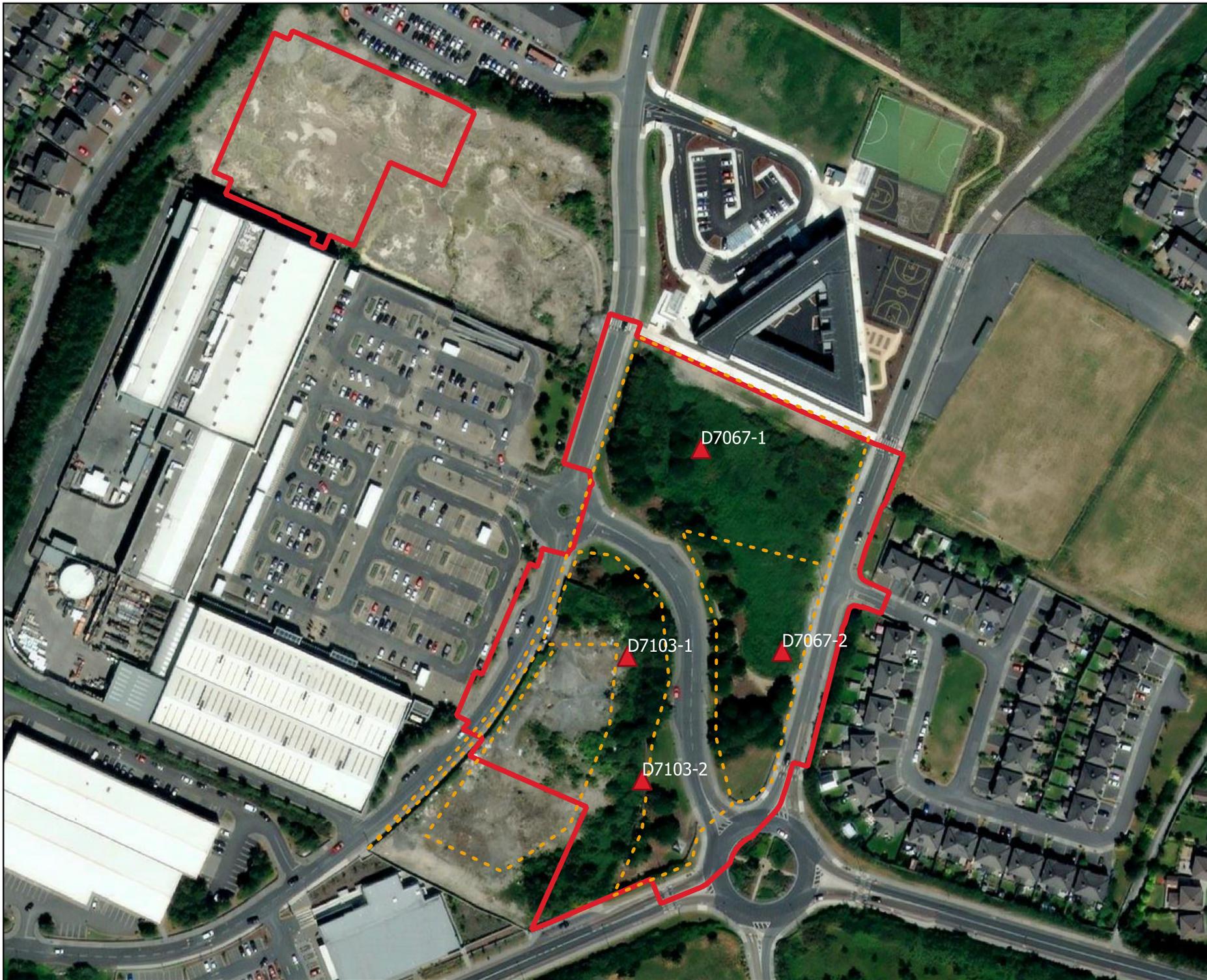
Three dusk and one dawn surveys were carried out in July/ August 2021 (Table 3-1). The aim of the surveys was to identify if there were bats present at the proposed site, what bat species were present and to gather any information on bat foraging and commuting behaviour. The activity surveys included walked transects across the extent of the proposed site during the dusk and dawn surveys. Figure 3-1 shows the route travelled during the manual surveys.

The dusk surveys commenced 30 minutes before sunset and were completed for 2 hours after sunset. The dawn surveys commenced two hours before sunrise and was completed at sunrise. Conditions were suitable for all bat surveys completed at the site (Table 3-1).

Table 3-1 Bat Activity Survey Effort 2021

Date	Surveyor	Type	Sunrise/Sunset	Weather
27 th July 2021	Keith Costello and Donal Folan	Dusk	21:40	17° C, Dry, Light breeze, cloud cover approx. 40%

Date	Surveyor	Type	Sunrise/Sunset	Weather
10 th August 2021	Keith Costello and Ellen Tuck	Dawn	06:07	12° C, Dry, Light breeze, cloud cover approx. 60%
24 th August 2021	Keith Costello and Kevin McElduff	Dusk	20:45	23° C, Dry, Light Breeze, cloud cover approx. 10%



Map Legend

-  Static Detector Locations
-  Manual Transect Route
-  Site Boundary



Microsoft product screen shots reprinted with permission from Microsoft Corporation © Ordnance Survey Ireland. All rights reserved. Licence number CYAL50267517

Drawing Title	
2021 Survey Effort	
Project Title	
Knocknacarra District Centre LRD	
Drawn By	Checked By
NC	AJ
Project No.	Drawing No.
210206	Fig 3-1
Scale	Date
1:2000	14/12/2022

MKO
 Planning and
 Environmental
 Consultants
 Tuam Road, Galway
 Ireland, H91 VW84
 +353 (0) 91 735611
 email: info@mkofireland.ie
 Website: www.mkofireland.ie

3.3.3 Static Detector Surveys

Full spectrum bat detectors, Song Meter Mini (Wildlife Acoustics, Maynard, MA, USA), were deployed during static surveys to record bat activity at four fixed locations over a 4-week period in 2021. The four locations of static detectors were selected to represent the range of habitats present within the site, including favourable bat habitats. Settings used were those recommended by the manufacturer for bats, with minor adjustments in gain settings and band pass filters to reduce background noise when recording. Detectors were set to record from 30 minutes before sunset until 30 minutes after sunrise. The Song Meter automatically adjusts sunset and sunrise times using the Solar Calculation Method when provided with GPS coordinates.

The survey was designed to utilise two static detectors to monitor bat activity. Two full spectrum bat detectors, Song Meter SM4 detectors were deployed on site on the 27th of July 2021. The detectors were moved to alternative locations within the site on the 10th of August 2021, to sample a range of habitats, before being collected on the 25th of August 2021. Static detector locations can be found in Figure 3-1.

Analysis of Static Detector Results

Echolocation signal characteristics (including signal shape, peak frequency of maximum energy, signal slope, pulse duration, start frequency, end frequency, pulse bandwidth, inter-pulse interval and power spectra) were compared to published signal characteristics for local bat species (Russ, 1999). Myotis species (potentially *M. daubentonii*, *M. mystacinus*, *M. nattereri*) were considered as a single group, due to the difficulty in distinguishing them based on echolocation parameters alone (Russ, 1999). The echolocation of *P. pygmaeus* and *P. pipistrellus* are distinguished by having distinct frequencies (peak frequency of maximum energy in search flight) of ~55 kHz and ~46 kHz respectively (Jones & van Parijs, 1993).

Plate 3-1 below shows a typical sonogram of echolocation pulses for Common pipistrelle recorded with a SM4BAT bioacoustic static bat recording device. The recorded file is illustrated using Wildlife Acoustics Kaleidoscope software.

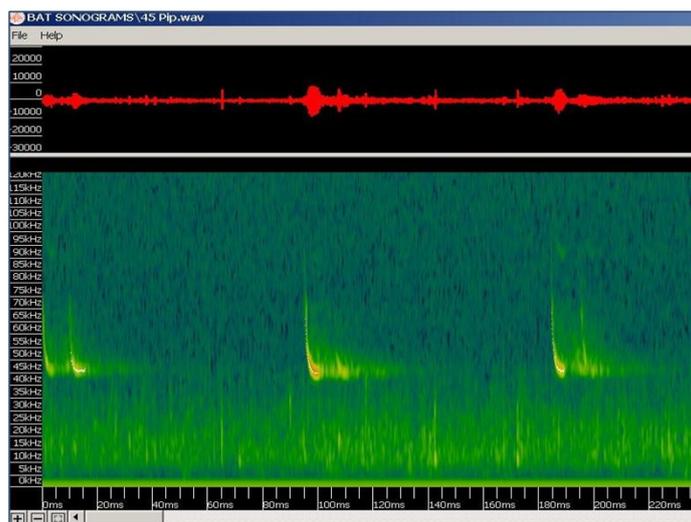


Plate 3-1 Sonogram of Echolocation Pulses of Common pipistrelle (Peak Frequency 45kHz)

Individual bats of the same species cannot be distinguished by their echolocation alone. Thus, ‘bat passes’ was used as a measure of activity (Collins, 2016). For the purposes of this survey, a bat pass was defined as a recording of an individual species/species group’s echolocation containing at least two echolocation pulses and of maximum 15 seconds length.

3.4 Survey Limitations

Survey design and effort was created in accordance with the most current best practice guidelines for surveying bats (Collins, 2016).

The information provided in this report accurately and comprehensively describes the baseline environment; provides an accurate prediction of the likely effects of the Proposed Development; prescribes mitigation as necessary; and describes the predicted residual impacts. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines.

July and August are within the optimal survey period for bat activity surveys, (Collins, 2016). Weather conditions were suitable for carrying out all surveys.

No significant limitations in the scope, scale or context of the assessment have been identified. Overall, a comprehensive assessment has been achieved.

4. RESULTS

4.1 Desktop Study

4.1.1 National Bat Database of Ireland

National Biodiversity Data Centre

A review of the National Bat Database of Ireland was made on the 18th of October 2022 yielded results of bats within a 10km radius of the development site. The search yielded seven bat species within 10km. Table 4-1 lists the bat species recorded within the hectad which pertains to the current study area (M22).

Table 4-1 NBDC Bat Records

Hectad	Species	Date	Database	Status
M22	Brown long-eared bat <i>Plecotus auritus</i>	21/05/2007	National Bat Database of Ireland	HD Annex IV, WA
M22	Daubenton's bat <i>Myotis daubentonii</i>	19/08/2014	National Bat Database of Ireland	HD Annex IV, WA
M22	Lesser horseshoe bat <i>Rhinolophus hipposideros</i>	30/01/2015	National Bat Database of Ireland	HD Annex II & IV, WA
M22	Leisler's bat <i>Nyctalus leisleri</i>	21/05/2016	National Bat Database of Ireland	HD Annex IV, WA
M22	Natterer's bat <i>Myotis nattereri</i>	15/08/2005	National Bat Database of Ireland	HD Annex IV, WA
M22	Common pipistrelle <i>Pipistrellus pipistrellus</i>	21/05/2016	National Bat Database of Ireland	HD Annex IV, WA
M22	Soprano pipistrelle <i>Pipistrellus pygmaeus</i>	21/05/2016	National Bat Database of Ireland	HD Annex IV, WA

4.1.2 Designated Sites

The following Designated Sites have been identified as having Lesser horseshoe bat as a Qualifying Interest within 15km of the Proposed Development.

Lough Corrib SAC (000297)

The SAC site boundary is located 2.5km from the Proposed Development. The Lesser horseshoe bat roost for which the SAC has been designated (roost id. 217 in NPWS database) is located approximately 33.5km to the north-west of the site of Proposed Development. This is significantly outside the foraging range (2.5km) of Lesser Horseshoe bat (NPWS, 2013). There is no potential for significant effect on the Lesser horseshoe bat population or the QI habitats either in the form of disturbance, loss or deterioration of habitat quality.

Ross Lake And Woods SAC (001312)

The SAC site boundary is located 12km from the Proposed Development. The Lesser horseshoe bat roost for which the SAC has been designated (roost id. 212 in NPWS database) is located approximately 15.4km to the north-west of the site of Proposed Development. This is significantly outside the foraging range (2.5km) of Lesser Horseshoe bat (NPWS, 2013). There is no potential for

significant effect on the Lesser horseshoe bat population or the QI habitats either in the form of disturbance, loss or deterioration of habitat quality for which the SAC has been designated.

East Burren Complex SAC (001926)

The SAC site boundary is located 13.86km from the Proposed Development. The Lesser horseshoe bat roosts for which the SAC has been designated, is located approximately 28.5km to the south of the site of Proposed Development. This is significantly outside the foraging range (2.5km) of Lesser horseshoe bat (NPWS, 2013). There is no potential for significant effect on the Lesser horseshoe bat population or the QI habitats either in the form of disturbance, loss or deterioration of habitat quality.

4.1.3

Galway City Transport Project (2015) and Galway City Ring Road EIAR (2018)

Galway City Transport Project (2015)

A review of publicly available information, on studies undertaken as part of the Galway City Transport Project (GCTP), was carried out. As part of this project, detailed bat surveys were undertaken in the area surrounding Galway City and this publicly available information was consulted.

Extensive bat survey work carried out as part of the GCTP included walked transect surveys in Ballymoneen/Rahoon and surrounding areas. Chapter 4 of the Route Selection Report identifies bats and bat roosts throughout Galway city (Table 4-2). Detector surveys recorded Soprano pipistrelle, Common pipistrelle, Leisler’s bat and Brown long-eared bat commuting/foraging in the area surrounding Ballymoneen/Rahoon.

Table 4-2 Roosts identified within 2.5km of Proposed Development (2015).

Species	Approx. Distance from Site
Common pipistrelle (<i>Pipistrellus pipistrellus</i>)	400m west
Common pipistrelle (<i>Pipistrellus pipistrellus</i>)	400m west
Soprano Pipistrelle (<i>Pipistrellus pygmaeus</i>)	1.2km north
Brown long-eared bat (<i>Plecotus auratus</i>)	1.2km north
Daubenton’s bat (<i>Myotis daubentonii</i>)	2.2km northwest
Daubenton’s bat (<i>Myotis daubentonii</i>)	2.2km northwest
Lesser horseshoe bat (<i>Rhinolophus hipposideros</i>)	2.2km southwest
Leisler’s bat (<i>Nyctalus leisleri</i>)	2.3km west
Leisler’s bat (<i>Nyctalus leisleri</i>)	2.3km west
Whiskered bat (<i>Myotis mystacinus</i>)	2.4km southeast
Lesser horseshoe bat (<i>Rhinolophus hipposideros</i>)	2.4km southwest
Daubenton’s bat (<i>Myotis daubentonii</i>)	2.5km east
Daubenton’s bat (<i>Myotis daubentonii</i>)	2.5km east

Galway City Ring Road EIAR (2018)

The N6 Environmental Impact Assessment Report for the Galway City Ring Road (GCRR) was consulted for roost records near the Proposed Development site (Table 4-3).

Table 4-3 Roosts identified within 2.5km of Proposed Development (2018).

Roost ID	Species	Approx. Distance from Site	Details
PBR141	Common pipistrelle <i>Pipistrellus pipistrellus</i>	400m northwest	Female roosting in two modern buildings in a housing estate at Ballymoneen
PBR147	Common pipistrelle <i>Pipistrellus pipistrellus</i>	400m northwest	Female roosting in two modern buildings in a housing estate at Ballymoneen
PBR165	Common pipistrelle <i>Pipistrellus pipistrellus</i>	400m northwest	N/A
PBR49	Soprano Pipistrelle (<i>Pipistrellus pygmaeus</i>), Brown Long-eared bat (<i>Plecotus auritus</i>)	1.2km north	Building. Roost for small numbers of Soprano pipistrelle and Brown long-eared bats (likely to be a transition/occasional roost)
PBR237	Soprano pipistrelle <i>Pipistrellus pygmaeus</i>	1.2km north	Unoccupied farm building or house
PBR267	Soprano Pipistrelle (<i>Pipistrellus pygmaeus</i>), Brown Long-eared bat (<i>Plecotus auritus</i>)	1.4km northwest	Building. Roost for small numbers of Soprano pipistrelle and Brown long-eared bats (likely to be a transition/occasional roost)
PBR173	Brown Long-eared bat (<i>Plecotus auritus</i>)	1.8km northwest	Building. Possible maternity roost for Brown long-eared bats, small roost
PBR143	Daubenton's bat (<i>Myotis daubentonii</i>)	2.1km northeast	Building. Galway City Centre
PBR144	Daubenton's bat (<i>Myotis daubentonii</i>)	2.1km northeast	Building. Galway City Centre
PBR116	Lesser Horseshoe Bat (<i>Rhinolophus hipposideros</i>)	2.2km southeast	N/A
PBR146	Leisler's bat (<i>Nyctalus leisleri</i>)	2.3km west	Building. Day roost for Leisler's bats.
PBR139	Leisler's bat (<i>Nyctalus leisleri</i>)	2.3km west	Building. Day roost for Leisler's bats.
PBR256	Brown Long-eared bat (<i>Plecotus auritus</i>)	2.3km northwest	Building. Brown long-eared maternity roost.
PBR177	Soprano Pipistrelle (<i>Pipistrellus pygmaeus</i>)	2.3km northwest	Building. Roost for small numbers of Soprano pipistrelle bats (likely to be a transition/occasional roost)
PBR255	Soprano Pipistrelle (<i>Pipistrellus pygmaeus</i>)	2.3km northwest	Building. Roost for small numbers of Soprano pipistrelle bats (likely to be a transition/occasional roost)
PBR124	Lesser horseshoe bat (<i>Rhinolophus hipposideros</i>)	2.4km southeast	Night roost in vicinity of Bearna woods
PBR140	Whiskered bat (<i>Myotis mystacinus</i>)	2.4km southeast	Roosting in modern dwelling house in residential estate by the Sports Centre, near Bearna Woods
PBR151	Whiskered bat (<i>Myotis mystacinus</i>)	2.4km southeast	Roosting in modern dwelling house in residential estate by the Sports Centre, near Bearna Woods
PBR210	Lesser Horseshoe Bat (<i>Rhinolophus hipposideros</i>)	2.5km northwest	Building. Night roost for Lesser Horseshoe bat (<i>Rhinolophus hipposideros</i>)
PBR130	Lesser Horseshoe Bat (<i>Rhinolophus hipposideros</i>)	2.5km northwest	N/A
PBR73	Natterer's Bat (<i>Myotis nattereri</i>)	2.5km north	Church. Historical record of Natterer's roost
PBR150	Daubenton's bat (<i>Myotis daubentonii</i>)	2.5km east	Bridge. Galway City Centre
PBR152	Daubenton's bat (<i>Myotis daubentonii</i>)	2.5km east	Bridge. Galway City Centre

Roost ID	Species	Approx. Distance from Site	Details
PBR178	Lesser horseshoe bat (<i>Rhinolophus hipposideros</i>) Brown long-eared bat (<i>Plecotus auritus</i>)	2.5km northwest	Building. Lesser horseshoe bat roost. Juvenile bats present late in the maternity season but not proven to be a maternity roost.
PBR222	Soprano pipistrelle <i>Pipistrellus pygmaeus</i>	2.4km southwest	Occupied dwelling in Bearna woods

4.1.4 Conclusion of Desktop Study

The desktop study has provided information about the existing bat activity in grid square M22, within which the Proposed Development is located. The GCTP and GCRR have provided information about the existing bat activity and roost locations within Galway city.

Bat records within 2.5km and 10km of the Proposed Development revealed that the wider area has been studied for bats and that a number of bat roost for a variety of species have been recorded. This suggests that the area offers potential for foraging and commuting bat species.

4.2 Bat Habitat Appraisal

A walkover survey, assessing bat habitat suitability, was conducted on the 27th of July 2021. Habitats recorded at the site are listed in Table 4-4. Further details on habitats present within the site can be found in the main Biodiversity Chapter.

Table 4-4 Habitats recorded within and adjacent to the Proposed Development.

Habitat	Fossitt (2000) Code
Spoil and Bare Ground	ED2
Recolonising Bare Ground	ED3
Buildings and Artificial Surfaces	BL3
Scattered Trees and Parkland	WD5
Amenity Grassland	GA2
Scrub	WS1
Ornamental/ non-native shrub	WS3
Hedgerows	WL1

The Proposed Development area is bisected by a public access road. This road and associated footpaths are classified as **Buildings and Artificial Surfaces (BL3)**. Areas of concrete block and stone wall façade along the boundaries of the site are also classified as *Buildings and Artificial Surfaces*. The Proposed Development area, south of the road, is dominated by **Spoil and bare ground (ED2)** and **Recolonising Bare Ground (ED3)**, with areas of **Scrub (WS1)** and **Scattered trees and Parkland (WD5)** acting as a natural barrier to the road to the North and East.

The northern portion of the Proposed Development site is dominated by **Scrub (WS1)** habitat characterised by bindweed (*Calystegia sepium*), willowherb (*Epibolium spp.*), immature willows (*Salix spp.*), gorse (*Ulex europeaus*), bramble (*Rubus fruticosus agg.*), ragwort (*Senecio jacobaea*), dandelion (*Taraxacum spp.*), and butterfly bush (*Buddleja davidii*) among other common and widespread species (Plate 4-1).

Habitats bordering the public access road and within the north-western boundary are classified as **Scattered trees and parkland (WD5)** characterised by maple (*Acer platanoides*), sycamore (*Acer pseudoplatanus*), beech (*Fagus sylvatica*), birch (*Betula spp.*), ash (*Fraxinus excelsior*), and willow as well as areas of **Amenity grassland (GA2)** (Plates 4-2 and 4-3).

The southern portion of the Proposed Development site is dominated by artificial habitats classified as a mosaic of **Spoil and bare ground (ED2)** and **Recolonising bare ground (ED3)** (Plate 4-4). Large areas of the southern portion of the Proposed Development site area classified as a mosaic of **Scrub (WS1)** and **Ornamental/ non-native shrub (WS3)** dominated by himalayan knotweed (*Persicaria wallichii*) and butterfly bush.

A short immature **Hedgerow (WL1)** is present within the southeastern boundary of the Proposed Development site. A short, planted line of **Ornamental/ non-native shrub (WS3)** is present along the western boundary of the Proposed Development site bordering the existing car park west of the Proposed Development.

With regard to foraging and commuting bats, areas of spoil and bare ground, recolonising bare ground, buildings and artificial surfaces, ornamental shrubs and amenity grassland and were considered *Low* suitability, i.e., habitat that could be used by small numbers of commuting or foraging bats (Collins, 2016). Hedgerows, scrub and scattered trees forming boundary habitats provide some connectivity to the surrounding landscape. As such, they were assessed as having *Moderate* suitability i.e., Continuous habitat connected to the wider landscape that could be used by bats for commuting such as lines of trees and scrub or linked back gardens (Collins, 2016).



Plate 4-1 Area of scrub on the north section of the development.



Plate 4-2 Scattered Trees and Parkland (WD5) adjacent to public access road Buildings and Artificial Surfaces (BL3).



Plate 4-3 View of Amenity grassland (GA2) with Scattered Trees and Parkland (WD5) in background and Buildings and Artificial Surfaces (BL3) in right middle.



Plate 4-4 View of Spoil and bare ground (ED2) in the south section of the development area.

4.3 Bat Surveys

4.3.1 Roost Assessment

A daytime walkover survey and inspection of the site was conducted on the 27th July 2021. Following the search for roosts, no structures were identified on site. The site was also checked for potential tree roosts. Trees within the site consisted of a mixture of immature and semi mature, sycamore, beech, birch, ash and willow. No trees within the Proposed Development site were identified as having any potential roost features (PRF's). As such, the Proposed Development site was considered to have *Negligible* suitability for roosting bats.

4.3.2 Dusk and Dawn Activity Surveys

Numerous foraging and commuting bats were recorded during the dusk and dawn bat activity surveys. In total, 57 bat passes were recorded. Activity was dominated by Soprano pipistrelle (*Pipistrellus pygmaeus*) n=28. This was followed by Common pipistrelle (*Pipistrellus pipistrellus*) n=22. These species are common and widespread across Ireland. In addition, very small numbers of Leisler's bat (*Nyctalus leisleri*) n=6 and *Myotis spp.* n=1 were also recorded. Activity levels were concentrated along the scattered trees that border the road which bisects the site (Figure 4-1 – 4-3). Overall activity within the site during the dusk and dawn activity surveys was low. Plate 4-5 shows total bat species composition and Table 4-5 presents the results per survey. Plate 4-6 shows total bat passes per night.

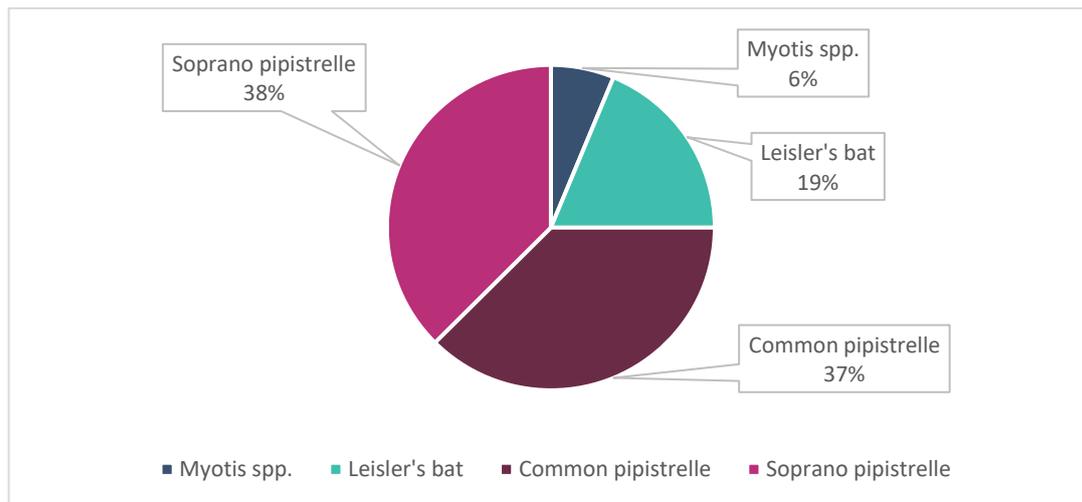


Plate 4-5 Dusk and Dawn Activity Survey Total Bat Species Composition

Table 4-5 Manual Transect Bat Pass Results Per Survey

Species	Dusk 27 th July	Dawn 10 th August	Dusk 24 th August	Total
<i>Myotis spp.</i>	1	-	-	1
Leisler's bat	3	2	1	6
Common pipistrelle	6	1	15	22
Soprano pipistrelle	6	2	20	28
Grand Total	16	5	36	57

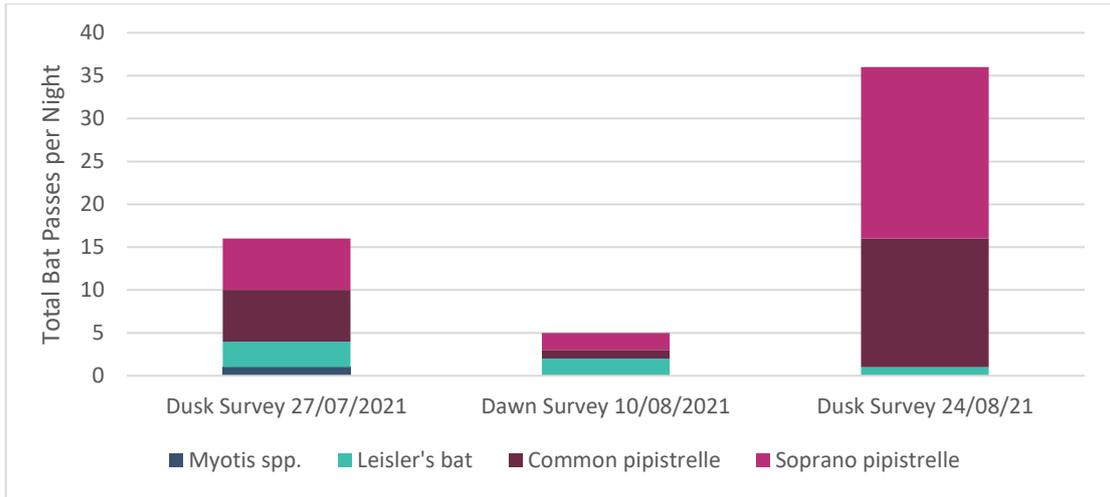
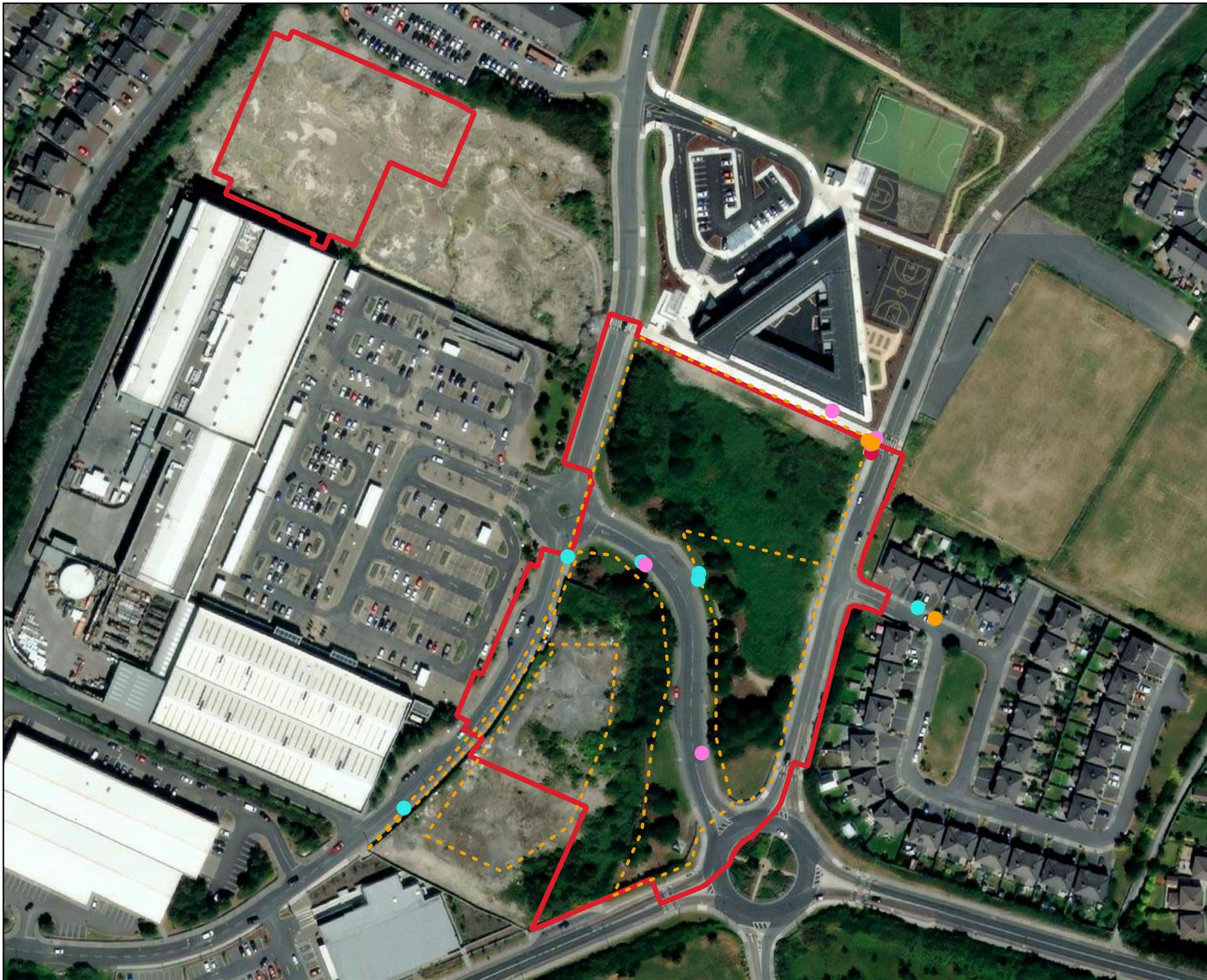


Plate 4-6 Total Bat Passes Per Night



Map Legend

- Site Boundary
 - - - Manual Transect Route
- Dusk Survey Results
- Leisler's bat
 - Common pipistrelle
 - Soprano pipistrelle



Microsoft product screen shots reprinted with permission from Microsoft Corporation © Ordnance Survey Ireland. All rights reserved. Licence number CYAL50267517

Dusk Survey Results
27/07/2021

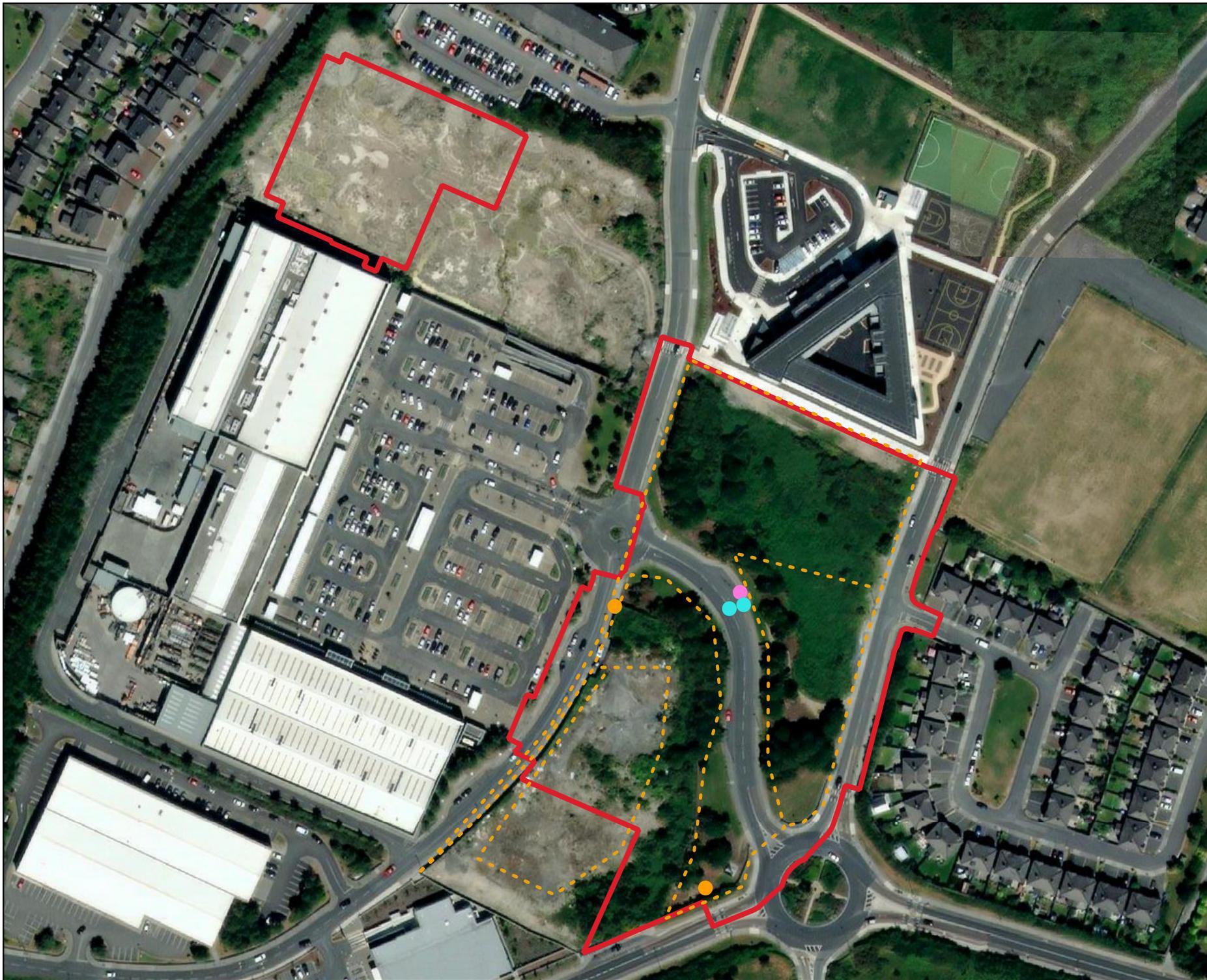
Project Title
Knocknacarra District Centre LRD

Drawn By NC	Checked By AJ
----------------	------------------

Project No. 210206	Drawing No. Fig 4-1
-----------------------	------------------------

Scale 1:2000	Date 14/12/2022
-----------------	--------------------

MKO
Planning and Environmental Consultants
Tuam Road, Galway
Ireland, H91 VW84
+353 (0) 91 735611
email: info@mkofireland.ie
Webst: ww.mkofireland.ie



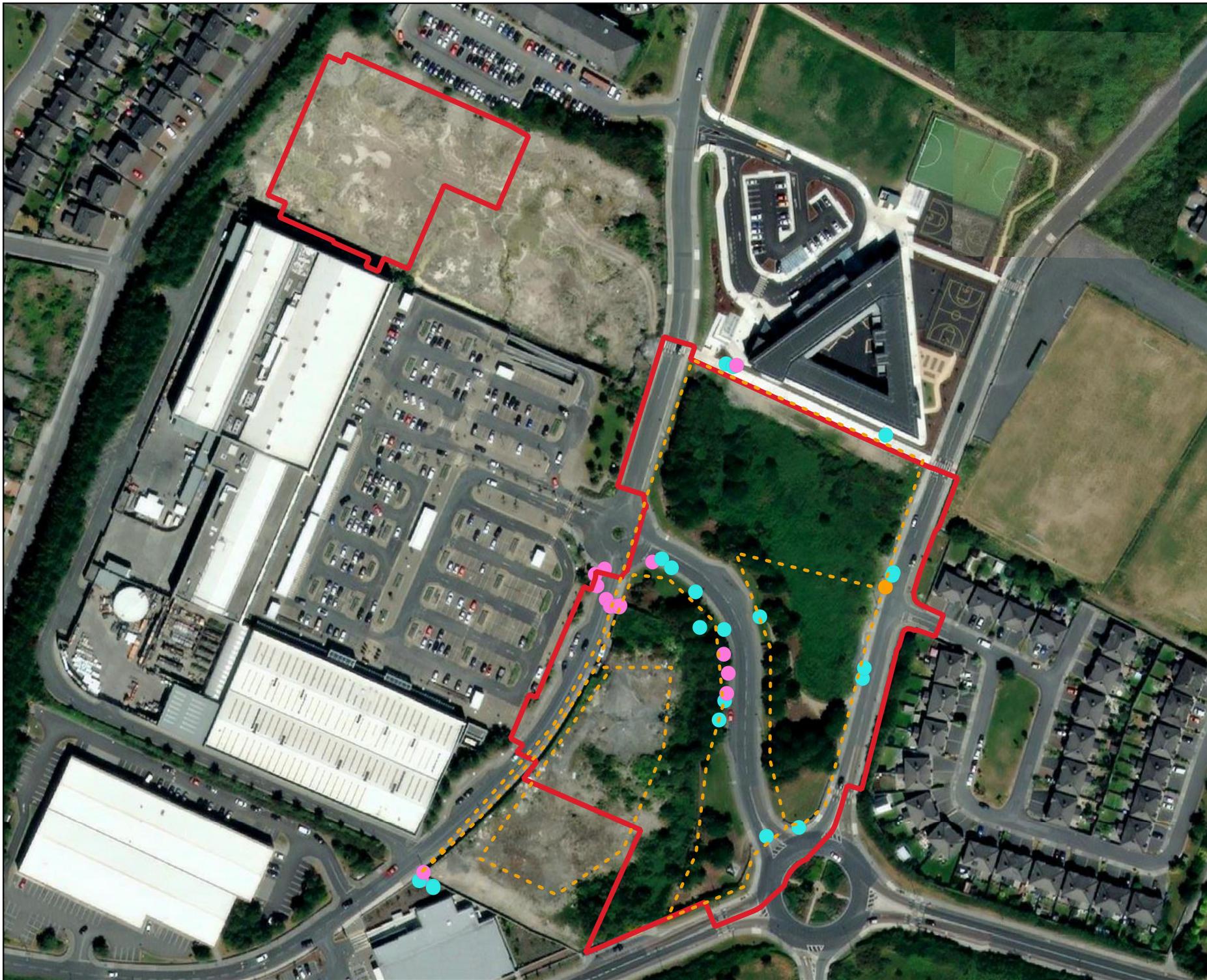
Map Legend

- Site Boundary
- - - Manual Transect Route
- Dawn Survey Results**
- Leisler's bat
- Common pipistrelle
- Soprano pipistrelle



Microsoft product screen shots reprinted with permission from Microsoft Corporation © Ordnance Survey Ireland. All rights reserved. Licence number CYAL50267517

Drawing Title	
Dawn Survey Results 10/08/2021	
Project Title	
Knocknacarra District Centre LRD	
Drawn By	Checked By
NC	AJ
Project No.	Drawing No.
210206	Fig 4-2
Scale	Date
1:2000	14/12/2022
MKO Planning and Environmental Consultants Tuam Road, Galway Ireland, H91 VW84 +353 (0) 91 735611 email: info@mkofireland.ie Website: www.mkofireland.ie	



Map Legend

- Site Boundary
 - - - Manual Transect Route
- Dusk Survey Results
- Leisler's bat
 - Common pipistrelle
 - Soprano pipistrelle

Microsoft product screen shots reprinted with permission from Microsoft Corporation © Ordnance Survey Ireland. All rights reserved. Licence number CYAL50267517

Drawing Title
Dusk Survey Results
 24/08/2021

Project Title
 Knocknacarra District Centre LRD

Drawn By NC	Checked By AJ
----------------	------------------

Project No. 210206	Drawing No. Fig 4-3
-----------------------	------------------------

Scale 1:2000	Date 14/12/2022
-----------------	--------------------

MKO
 Planning and Environmental Consultants
 Tuam Road, Galway
 Ireland, H91 VW84
 +353 (0) 91 735611
 email: info@mkofireland.ie
 Website: www.mkofireland.ie

4.3.3 Static Detector Survey Results

Two static detectors were deployed on the site at four different locations (Figure 3-1), based on likely areas of bat activity, for a total of 29 nights. These detectors allowed a specified look into species composition, commuting and foraging activities within the site.

All recordings were later analysed using bat call analysis software Kaleidoscope Pro v.5.4.2 (Wildlife Acoustics, MA, USA). Bat species were identified using established call parameters, to create site-specific custom classifiers. All identified calls were also manually verified. In total 8,171 bat passes were recorded.

Analysis of the detector recordings positively identified five bats to species level. Bat species included: Soprano pipistrelle (*Pipistrellus pygmaeus*) (n=5,960) and Common pipistrelle (*Pipistrellus pipistrellus*) (n=1,940). Leisler’s bat (*Nyctalus leisleri*) (n=265) was encountered less frequently. Nathusius’ pipistrelle (*Pipistrellus nathusii*) (n=3) and brown long-eared bat (*Plecotus auritus*) (n=3) was rarely encountered, with less than 1% of total bats recorded (Plate 4-7).

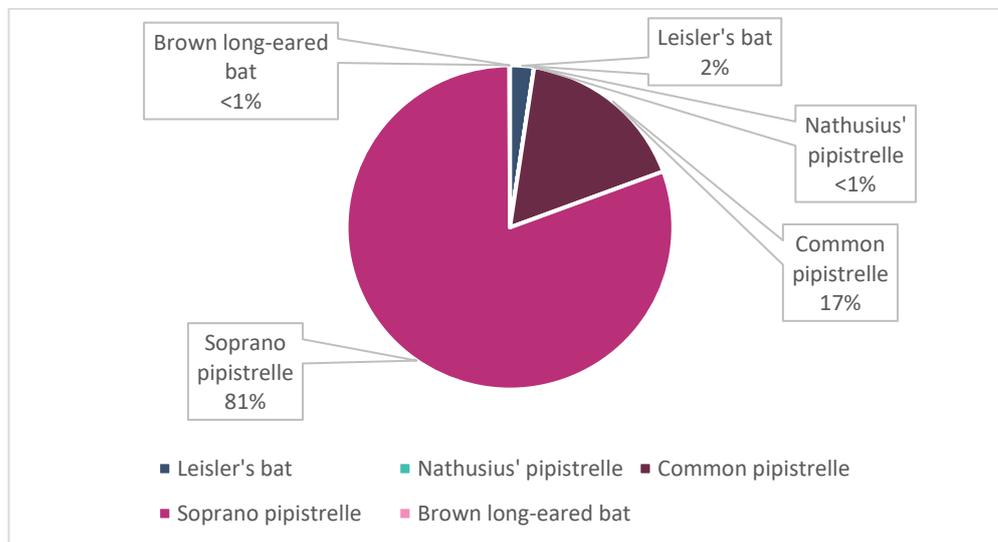


Plate 4-7 Species Composition – Static Detectors

Plate 4-8 shows total bat passes per detector. Detector 7067-1 was located in the northwest corner of the site adjacent to a treeline and a lone tree. Activity here appears to be higher than other detector locations potentially due to the presence of suitable linear habitat features which could provide potential commuting and foraging routes. Detector 7103-1 was located beside the area of spoil and bare ground and scattered trees. Detector 7067-2 was located in the centre of the site, between scattered trees and the public road. Detector 7103-2 was located to the south of the site, near scrub and an area of amenity grassland adjacent to the road.

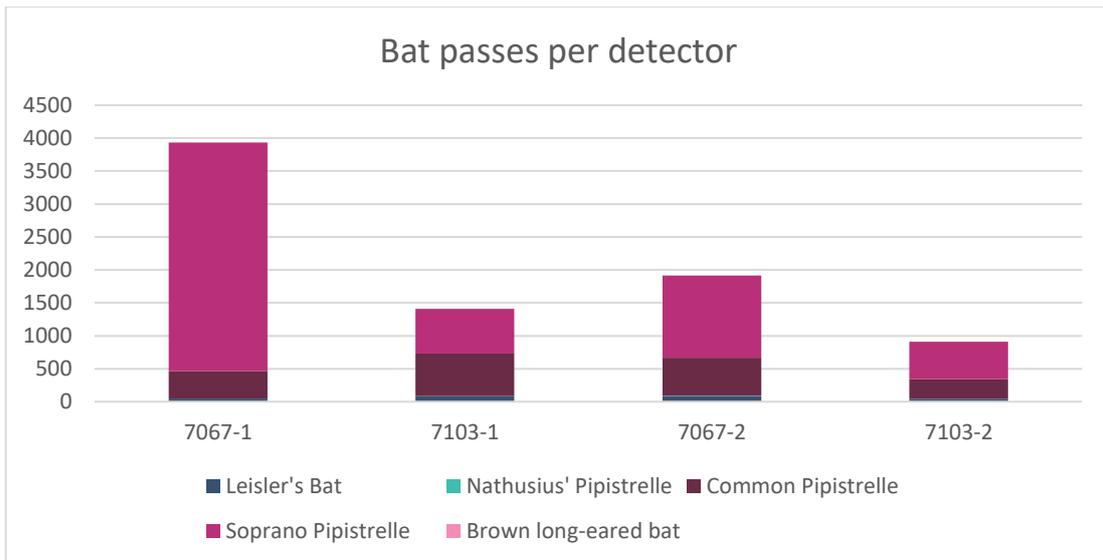


Plate 4-8 Total Bat Passes Per Detector

Analysis of the detector recordings also highlighted the total bat passes per night. Species composition per night is shown in Plate 4-9. Nights from the 27th of July to the 10th of August are associated with the first deployment locations D7067-1 and D7103-1. Nights from the 10th of August to the 28th of August include bat passes from the second deployment locations D7067-2 and D7103-2. The graph demonstrates that soprano and common pipistrelle species were most commonly recorded during the survey periods. These species are common and widespread across Ireland. Activity varied across each deployment and each night.

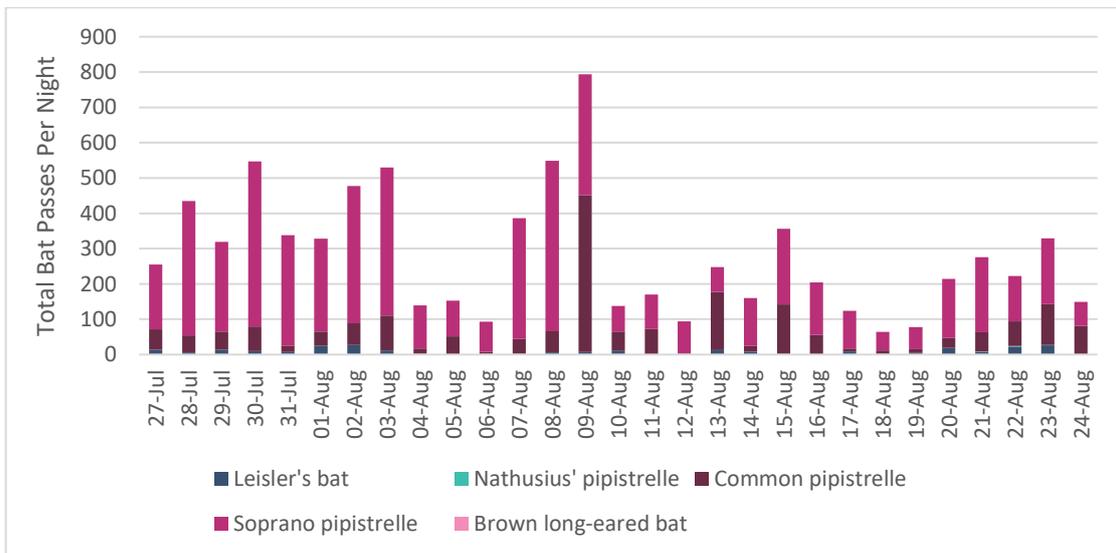


Plate 4-9 Total Bat Passes per Night

4.4 Importance of Bat Population Recorded at the Site

Ecological evaluation within this section follows a methodology that is set out in Chapter three of the ‘*Guidelines for Assessment of Ecological Impacts of National Roads Schemes*’ (NRA, 2009).

All bat species in Ireland are protected under the Bonn Convention (1992), Bern Convention (1982) and the EU Habitats Directive (92/43/EEC). Additionally, in Ireland bat species are afforded further protection under the Birds and Natural Habitats Regulations (2011) and the Wildlife Acts 1976-2022.

Bats as an Ecological Receptor have been assigned *Local Importance (Higher value)* on the basis that the habitats within the Proposed Development site are utilized by a regularly occurring bat population of *Local Importance*.

The results of the bat surveys, carried out in 2021 indicate that the Proposed Development site does not provide significant suitable habitat for a roosting bat population of ecological significance. No roosting site of *National Importance* (i.e. site greater than 100 individuals) was recorded within the site.

5. ASSESSMENT OF LIKELY EFFECTS

5.1 Loss of Roosting Habitat

No evidence of roosting bats and no potential roost features were identified within the Proposed Development site during the daytime inspections and dusk and dawn activity surveys. Overall, the site is not considered to provide significant suitable roosting habitat for bat species and habitats were assessed as having ‘*Negligible*’ suitability for roosting bats. Given that no potential for impact on roosting bats exists there is no requirement for mitigation. No potential for significant impact on bat roosting habitat exists.

5.2 Loss of Foraging and Commuting Habitat

Table 5-1 Assessment of Potential Impacts on Commuting/Foraging Bats

<p>Description of Effect</p>	<p>The Proposed Development will result in the loss of some linear habitat features i.e., all immature hedgerow (16 metres), all scattered trees and parkland (0.37 hectares) and all scrub (0.79 hectares) habitat within the site.</p> <p>Scattered trees and immature hedgerow within the Proposed Development boundary were assessed as <i>Moderate</i> suitability for foraging and commuting bats. These habitats provide connectivity to the wider landscape. The loss of these landscape features during construction could result in the fragmentation of foraging and commuting corridors for bat species.</p>
<p>Characterisation of unmitigated effect</p>	<p>The loss of linear habitat features would constitute a permanent slight effect on commuting and foraging bats. While the trees individually are of limited biodiversity value, collectively they contribute to ecological and habitat connectivity throughout the site and with the wider area. The magnitude of this impact is Slight at the local scale given the small number affected.</p>
<p>Assessment of Significance prior to mitigation</p>	<p>This is a permanent slight effect on a receptor of <i>Local Importance (Higher Value)</i>. The loss of a small number of trees within the site is considered significant at a local scale but not significant at a county, national or international scale.</p>
<p>Mitigation</p>	<p>A landscape plan has been prepared for the development which outlines plans for additional tree planting. The landscape plan also includes areas of open amenity grassland and mixed native woodland planting. The proposed landscape plan includes for the planting of a linear strip of native hedgerow, planting of 44 106 predominantly native trees, rain gardens, open green spaces and green roofs, to ameliorate immature hedgerow, scrub and tree loss and ensure there is no net loss in suitable ecological habitat features.</p>
<p>Residual Effect following Mitigation</p>	<p>With the implementation of the prescribed mitigation measures, no significant residual effects are predicted.</p>

5.3 Disturbance

Table 5-2 Assessment of Potential Impacts from Disturbance on Bats

<p>Description of Effect</p>	<p>Construction and operation of the Proposed Development will result in increased human activity, noise and lighting within the proposed site. Therefore, the potential for disturbance to bats requires consideration.</p>
-------------------------------------	--

	<p>However, the Proposed Development is in close proximity to existing residential and commercial developments to the south and east as well as busy local roads. It is likely that bat species in the area are accustomed to some levels of disturbance.</p>
<p>Characterisation of unmitigated effect</p>	<p>In the absence of appropriate design, the development has the potential to disturb bats by illumination of commuting and foraging areas. This is assessed as a temporary slight effect.</p>
<p>Assessment of Significance prior to mitigation</p>	<p>This is assessed as a temporary slight effect on a receptor of Local Importance (Higher Value).</p>
<p>Mitigation</p>	<p>Where lighting is unavoidable during construction, low-intensity lighting and motion sensors will be used to limit illumination. Exterior lighting, during construction, shall be designed to minimize light spillage, thus reducing the effect on areas outside the Proposed Development, and consequently on bats i.e., Lighting will be directed away from mature trees/treelines around the periphery of the site boundary to minimize disturbance to bats. Directional accessories will be used to direct light away from these features, e.g., through the use of light shields (Stone, 2013). The luminaires will be of the type that prevent upward spillage of light and minimize horizontal spillage away from the intended lands.</p> <p>The lighting plan for the operational phase of the Proposed Development, has been designed with consideration of the following: Bat Conservation Trust (Guidance Note 08/18 Bats and Artificial Lighting in the UK (BCT, 2018), <i>Bat Conservation Ireland (Bats and Lighting: Guidance Notes for Planners, Engineers, Architects and Developers, BCI, 2010)</i> to minimise light spillage, thus reducing any potential disturbance to bats.</p> <p>The design will incorporate the following:</p> <ul style="list-style-type: none"> ➤ The site entrance is designed in accordance with the requirements of IS 13201-2:2015 for a lighting class level of P3. The residential development is designed in accordance with lighting class level of P4. ➤ The main proposed lighting scheme throughout the residential roads and walkways within the development consists of LED streetlights mounted on 4m to 8m poles. (Refer to drawing G023-PMEP-01-00-DR-E-01 for Site Lighting layout and G025-PMEP-01-00-DR-E-02 for the Site Lighting Iso-Lux Contour Lux Levels layout). The height of public lighting poles are in accordance with Galway City Council specification requirements. ➤ All pole mounted streetlights within the Residential development have been designed with zero-degree tilt and will have zero light uplift to ensure limited unwanted light spill. ➤ Each street light fitting will be controlled via an individual Photoelectric Control Unit (PECU). The operation of the lighting will be on a dusk-dawn profile, 35 lux on/18 lux off. In addition, all lighting will be dimmed by 30% post curfew, this will limit the amount of upward sky glow at night. For this development. post curfew is considered to be 11pm. ➤ Utilisation of 3000K colour correlated temperature LED luminaires in the residential road and circulation routes. Site entrance will utilise 4000K LED luminaires.
<p>Residual Effect following Mitigation</p>	<p>With the implementation of the prescribed mitigation measures, no significant residual effects are predicted.</p>

6.

CONCLUSION

Five bat species were recorded across the Proposed Development site. No evidence of roosting bats was identified on the site of the Proposed Development. Foraging and commuting was mainly associated with scattered trees and areas of scrub at the centre of the site along the main road.

This report provides a full and comprehensive assessment of the potential for impact on bat populations within the site boundary. The surveys and assessment provided in this report are in accordance with the relevant industry guidance. Following consideration of the residual effects (post mitigation) it is noted that the Proposed Development will not result in any significant effects on bats.

Provided that the Proposed Development is constructed and operated in accordance with the design, best practice and mitigation that is described within this report; no significant impacts on local bat populations is anticipated at any geographic scale.

7.

BIBLIOGRAPHY

- Andrews, H. (2018) *Bat Roosts in Trees*. AEcol, Bridgewater.
- Aughney, T., Kelleher, C. & Mullen, D. (2008) *Bat Survey Guidelines: Traditional Farm Buildings Scheme*. The Heritage Council, Áras na hOidhreachta, Church Lane, Kilkenny.
- Aughney, T., Langton, S. & Roche, N. (2011) *Brown long-eared bat roost monitoring scheme for the Republic of Ireland: synthesis report 2007 - 2010. Irish Wildlife Manual s, No. 56*. National Parks and Wildlife Service, Department of Arts, Heritage and the Gaeltacht, Dublin, Ireland.
- Bontadina, F., Schofield, H. and Naef-Daenzer, B. (2002) *Radio-tracking reveals that lesser horseshoe bats (Rhinolophus hipposideros) forage in woodland*. *Journal of Zoology* 258: 281–290.
- ILP (2018) *Guidance Note 08/18: Bats and Artificial Lighting in the UK. Bats and the Built Environment Series*. Institute of Lighting Professionals, Warwickshire, UK.
- Boye, P., & Dietz, M. (2005). *Development of good practice guidelines for woodland management for bats*. English Nature.
- CIEEM (2013) *Competencies for Species Surveys: Bats*. Chartered Institute of Ecology and Environmental Management, Winchester.
- Collins, J. (ed) (2016) *Bat Surveys for Professional Ecologists – Good Practice Guidelines* (3rd edn). The Bat Conservation Trust, England.
- Fossitt, J. A. (2000) *A Guide to Habitats in Ireland*. The Heritage Council Dublin Ireland.
- Kelleher, C. & Marnell, F. (2006) *Bat Mitigation Guidelines for Ireland. Irish Wildlife Manuals, No. 25*. National Parks and Wildlife Service, Department of Environment, Heritage and Local Government, Dublin, Ireland.
- Marnell, F., Kelleher, C. & Mullen, E. (2022) *Bat mitigation guidelines for Ireland v2*. Irish Wildlife Manuals, No. 134. National Parks and Wildlife Service, Department of Housing, Local Government and Heritage, Ireland
- Mitchell-Jones, A.J. & McLeish, A.P. (eds) (2004) *'Bat Workers' Manual'* (3rd edn). JNCC, Peterborough.
- Mitchell-Jones, A.J. (2004) *Bat Mitigation Guidelines*. English Nature, Peterborough.
- N6 Galway City Ring Road, Environmental Impact Assessment Report (2018): [N6 Galway City Ring Road - Planning Documents](#)
- N6 Galway City Transport Project; Ecological information presented in the Route Selection Report: Chapter 4: <http://www.n6galwaycity.ie>
- National Roads Authority (2006) *Best Practice Guidelines for the Conservation of Bats in the Planning of National Road Schemes*. National Roads Authority, Dublin Ireland.
- National Roads Authority (2006b) *Guidelines for the Treatment of Bats during the Construction of National Road Schemes*. National Roads Authority, Dublin, Ireland.
- Russ, J.M. (2012) *British Bat Calls: A Guide to Species Identification*. Pelagic Publishing, Exeter.
- Stone, E. L., Jones, G., & Harris, S. (2009). Street lighting disturbs commuting bats. *Current biology*, 19 (13), 1123-1127.
- Stone, E.L. (2013) *Bats and lighting: Overview of current evidence and mitigation*. The Bat Conservation Trust, England.