LEWIS HOMES

SANDY LANE, YSTRADOWEN

STAGE 2 ECOLOGY REPORT

April 2024

4 Stangate House,
Stanwell Road,
Penarth,
Vale of Glamorgan,
United Kingdom.
CF64 2AA

Telephone:- 033 00 13 00 12
e-mail:- enquiry@soltysbrewster.co.uk
Web Site:- www.soltysbrewster.com

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STAGE 2 ECOLOGY REPORT

DOCUMENT REF: E22108601/DOC 02 – April 2024

Issue	Revision	Stage	Date	Prepared by	Approved by	Signed
1	-	Draft for review	07 December 2022	Daniel Jones (Senior Ecologist)	Dr M Watts (Director)	[redacted]
2		For submission	05 July 2023	Daniel Jones (Senior Ecologist)		
3	Updated Proposed Site Layout	For submission	18 March 2024	Daniel Jones (Associate Ecologist)		
4	Updated Site Layout to Appx I	For submission	11 April 2024	Daniel Jones (Associate Ecologist)		

CONTENTS

1.0 INTRODUCTION

1.1 Soltys Brewster Ecology (SBE) were commissioned by Lewis Homes to undertake additional ecological survey work (Stage 2 surveys) at land located to the north of Sandy Lane in Ystradowen, Vale of Glamorgan. The site, approx. 1.5 ha in size, is proposed for the development of 46no. residential units. A plan showing the site location and proposed layout is included in Appendix I.

1.2 A Preliminary Ecological Appraisal was undertaken at the site by SBE in March 2022 (SBE, 2024). The survey identified a limited range of habitats present at the application site including poor semi-improved grassland, hedgerow boundaries and scattered trees. The habitats at the site were considered to have potential to support foraging and commuting bats, nesting birds, Hazel Dormouse and Great Crested Newt within their terrestrial phase.

1.3 Based on the proposed layout and expected development impacts (i.e., loss of poor SI grassland & translocation of southern hedgerow), targeted survey work to establish the level of use of the application site by foraging and commuting bats and the likely presence/absence of Hazel Dormouse and Great Crested Newt was recommended to inform any mitigation or enhancement measures.

1.4 The current report presents the findings of bat activity and automated monitoring surveys, Great Crested Newt eDNA sampling and Hazel Dormouse presence/absence surveys undertaken at the application site and surrounding area between April and November 2022. The report describes appropriate avoidance, mitigation and enhancement measures in regard to protected species associated with the proposals at the application site. This report should be read in conjunction with the PEA document – both documents would form part of the planning submission to the Vale of Glamorgan.

2.0 METHODOLOGY

Bats

2.1 The habitats at the application site (e.g., hedgerow and tree boundaries) were considered likely to support locally foraging and commuting bats species. The proposed layout plan indicates that the hedgerow located along Sandy Lane will be removed and translocated to another location on-site to accommodate the development design. The aim of additional bat surveys was to identify which bat species are using the site, establish the level of use and assess the likely impacts of the development design. As noted within the PEA survey (SBE 2022), no trees with bat roost potential would be affected by the proposed layout – a mature Oak within the northern boundary hedgerow will be retained.

Activity transect

2.2 A total of 4no. bat activity transects were undertaken at the application site between April – August 2022 (see Table 1 for bat survey schedule), although the survey in June was affected by rain. The surveys were undertaken by a team of two suitability experienced surveyors and followed current best practice guidelines (BCT, 2016) e.g., no rain or strong winds, temperatures above 10 °C. The transect route followed the hedgerow boundaries whilst also incorporating a listening stop within the centre of the field (transect plan included in Appendix II). During the surveys, the surveyors noted the time, species and behaviour of each bat recorded. Bat calls were recorded using either an Echo Meter Touch 2 or Peersonic unit and were later analysed in Anabat Insight Pro software.

Table 1: Bat Survey Schedule

Date	Sunset	Start	End	Notes
Activity transect				
27th April 2022	20:30	20:30	22:30	11°C at start, overcast 100% cloud cover, no rain, light wind
30th June 2022	21:35	21:35	22:30	13°C at start, overcast 100% cloud cover, unforecast heavy rain at 22:30. Survey stopped early
4th July 2022	21:30	21:30	23:30	15°C at start, 3-40% cloud cover, no rain, light wind
3rd August 2022	20:59	20:59	22:59	21°C at start, 25% cloud cover, no rain or wind

Automated monitoring

2.3 In addition to the above, three automated monitoring sessions were undertaken at the application site between April – August 2022. For each monitoring session, 2no. static bat detectors (Anabat Express or Swift models) were deployed and left recording *in situ* for 5-7 nights. Monitoring sessions were undertaken from 27th April – 2nd May, 30th June – 5th July and 3rd – 8th August 2022. Static detectors were placed within areas of the site likely

to be impacted by the development design (e.g., Sandy Lane hedgerow to be translocated) and within retained boundary vegetation (northern boundary hedgerow). The locations are shown on the plans included in Appendix II. As above, all bat calls were later analysed in Anabat Insight Pro software. Larger data sets were initially checked using the Bat Classify UK plug-in (confidence limited set at 70%), however, all highlighted calls were manually verified to confirm species.

Survey limitations

2.4 During the activity transect undertaken on 30th June 2022, unforecast heavy rain at 22:30 resulted in the survey being stopped early. An additional survey visit was programmed in on 4th July 2022. As such, it is not considered this had any overall negative impact on the findings and conclusions of the survey work.

Great Crested Newt

eDNA sampling

2.5 The Preliminary Ecological Appraisal identified the location of 3no. ponds located within 250m of the application site. This included two attenuation basins located at Badgers Brook Rise (approx. 100m south of the site) and a single pond located alongside the A4222 carriageway (approx. 175m north). The latter of which was found to be dry and overgrown with scrub during subsequent site visits. The two attenuation basins were subject to a Habitat Suitability Index (HSI) assessment for Great Crested Newt based on ARG (2010) and Oldham *et al.,* (2000) guidelines. The lager pond was assessed to be of Average suitability (HSI score = 0.61) with the smaller pond as Below Average (0.58). The larger pond was the focus of the eDNA sampling.

2.6 In order to establish the presence/absence of Great Crested Newts within the larger pond at Badgers Brook Rise (Grid Ref: ST 01648 77746), water samples were collected on 19th May 2022 by a licensed surveyor[1]. Samples were collected using eDNA kits purchased from FERA Science Ltd and followed the recommended protocol and methodologies approved by Natural England (Biggs *et al.,* 2014). An *ad-hoc* check of aquatic vegetation was undertaken during the sample collection for any characteristically folded leaves although no other sampling techniques were used.

Hazel Dormouse

2.7 As described in the PEA report no desk study records of Hazel Dormouse were identified within 1km of the site. However, the hedgerow habitats at the site were considered suitable to support Dormouse, containing a mixture of food resources and existing connectivity to woodland habitats in the wider landscape. A nest tube survey was undertaken based on best practice guidelines (e.g., Chanin & Woods, 2003 and Bright *et al.,* 2006),

[1] NRW Reference: S089080/1

over the 2022 season with nest tubes deployed on 7th April and subjected to monthly checks up to 16 November – nest tubes were collected on completion of the survey.

2.8 A total of 47no.[2] nest tubes were deployed within the hedgerow boundaries at the application site (see plan in Appendix III). Checks of nest tubes were completed by a licensed dormouse surveyor[3] and notes made on the presence or absence of Dormice (i.e. observation of the animal itself or characteristic nesting materials) or occupation by species other than dormice (e.g. nesting birds and other small mammals).

[2] The relatively small size of the site and availability of suitable hedgerow vegetation was such that the recommended 50no. nest tubes within the guidance could not be accommodated whilst still maintaining a reasonable spacing (10 – 20m) between net tubes. The use of 47 nest tubes was still considered appropriate to provide a thorough and robust survey.

[3] NRW Reference: S089089/1

3.0 RESULTS

Bats

Activity transect

3.1 Plans to illustrate the bat activity transect results are included in Appendix II. During the first transect survey (April) low levels of activity by Common Pipistrelle *Pipistrellus pipistrellus* were observed, with the majority of activity associated with the northern hedgerow boundary and north-east corner of the site. At least two pipistrelle bats were seen foraging along the northern hedgerow 20 minutes following sunset. Regular passes by individual common pipistrelle were recorded along this section throughout the survey. A single pipistrelle bat was also observed foraging near the centre of the field.

3.2 During the second survey visit (June) limited levels of bat activity were recorded, due to unforecast heavy rain which stopped the survey early. A single Soprano Pipistrelle *Pipistrellus pygmaeus* was observed foraging up and down the northern hedgerow, with two Common Pipistrelle bats seen flying south along the western boundary. Prior to stopping the survey two Brown Long-Eared bats *Plecotus auritus* were also observed flying from the field centre towards the northern hedgerow boundary 45 minutes following sunset.

3.3 The July survey (third transect visit) recorded regular foraging and commuting activity by several Common and Soprano Pipistrelle and Myotis[4] bats, again associated with the northern hedgerow boundary. Single passes by Noctule *Nyctalus noctula* and Serotine *Eptesicus serotinus* were also recorded at listening stops along the southern hedgerow.

3.4 Similar levels of bat activity were recorded during the fourth survey visit in August. Surveyors noted regular passes by foraging Common and Soprano Pipistrelle along the northern hedgerow boundary (2-3 bats), close to the mature Oak tree located near the static detector position. A single Noctule was also observed foraging over the open grassland habitats within the centre of the field.

3.5 Overall, the activity transect surveys highlighted that the majority of bat activity at the application site is associated with the hedgerow habitats located along the northern boundary. Across all four survey visits, most bat recordings were attributed to Soprano Pipistrelle (55 passes[5]) and Common Pipistrelle (41 passes) with lower numbers of Myotis sp. (20 passes), Noctule (4 passes), Brown Long-Eared bat (2 passes) and Serotine (1 pass) recorded.

[4] Both the monitoring and activity surveys recorded a number of passes identified as Myotis species. Due to the similarities of call characteristics between different Myotis species and the cluttered nature of some calls no positive identification to species level could be made. However, some calls were considered to be characteristic of Daubenton's bat and Whiskered/Brandt's bat.

[5] For the context of this report a bat pass is defined the identification of any part of a bat call within a 5-10 second sound file and does not necessarily correlate to the number of bats present.

Automated monitoring

3.6 The findings of the automated monitoring sessions are summarised in Table 2 and Figure 1. The surveys established the use of the application site by at least 6no. different bats species including Common and Soprano Pipistrelle, Noctule, Serotine, Myotis sp. and Brown Long-Eared bat, similar to the activity surveys. Significantly higher levels of bat activity were recorded along the northern hedgerow compared to the southern hedgerow (located along Sandy Lane).

3.7 The highest levels of bat activity were observed during the August 2022 session when a peak count (week total) of 4009 bat passes were recorded at the northern hedgerow detector. Lower levels of bat activity were recorded during the April – May session. The highest per night data was recorded 3rd August at the northern hedgerow where a total of 965 Soprano Pipistrelle passes were recorded on one night, equating to approx. 1.8 passes per minute.

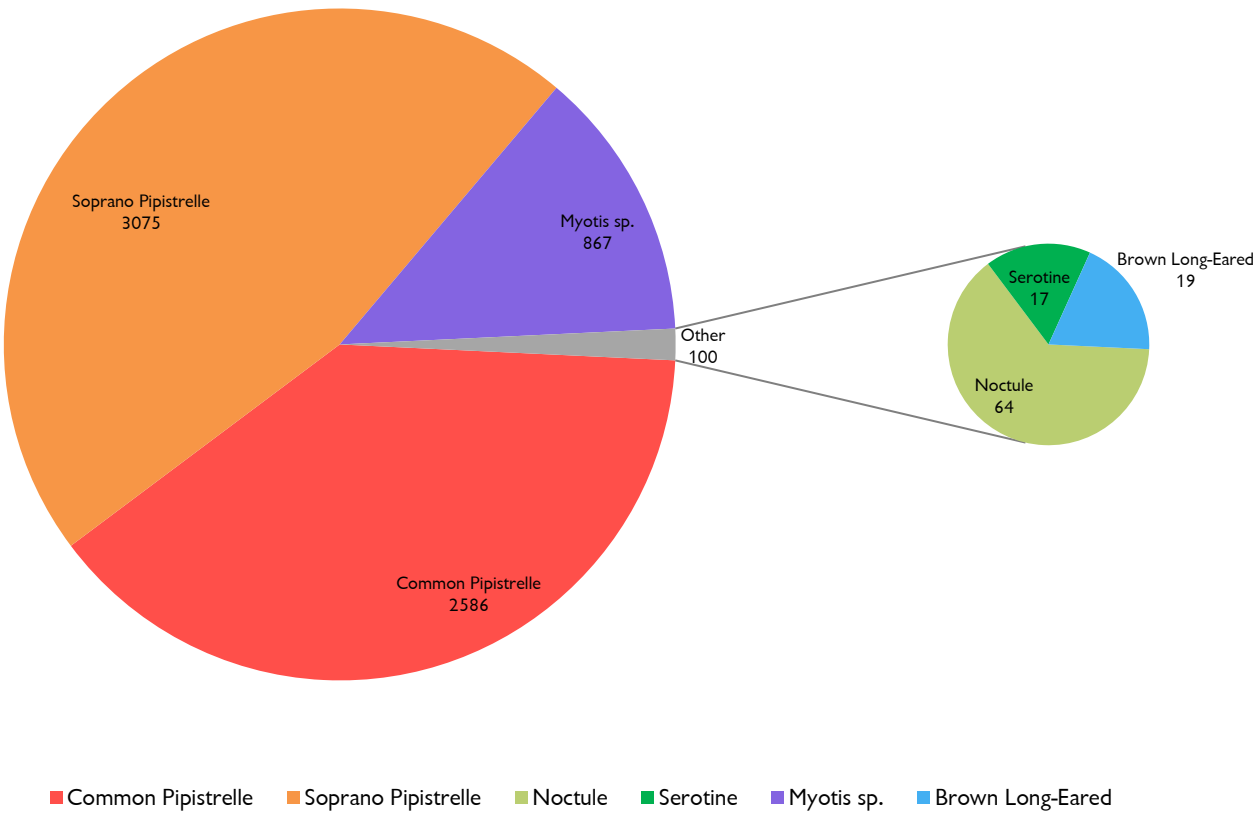
3.8 Overall, across all detectors and monitoring periods, Soprano Pipistrelle accounted for 46% of all bat passes, Common Pipistrelle 39%, Myotis sp. 13% and Noctule 1% with <1% of passes attributed to Serotine and Brown Long-Eared bat.

3.9 Levels of activity by Common and Soprano Pipistrelle were found to be significantly higher along the northern hedgerow compared to the southern hedgerow. Noctule, Serotine and Brown Long-Eared activity was found to be more evenly distributed across both hedgerow boundaries.

Table 2: Automated monitoring survey results.

Detector	Species						Total
	Common Pipistrelle	Soprano Pipistrelle	Noctule	Serotine	Myotis sp.	Brown Long-Eared	
April – May 2022							
Northern	381	30	1	1	21	1	**435**
Southern	97	13	0	1	10	1	**122**
June – July 2022							
Northern	599	728	16	4	507	2	**1856**
Southern	33	20	13	3	9	5	**83**
August 2022							
Northern	1436	2237	13	2	319	2	**4009**
Southern	40	47	21	6	1	8	**123**

Figure 1: Accumulation of bat passes recorded at both hedgerow locations across all automated monitoring sessions.



Great Crested Newt

eDNA sampling

3.10 Analysis of the samples collected at the larger attenuation pond returned a negative result for presence of Great Crested Newt (Appendix IV). The nearest known GCN population is located approx. 350m west of the application site (information informed by previous survey work undertaken in Ystradowen by SBE in 2017). Adult newts generally use terrestrial habitats within 250m of breeding ponds, but are known to disperse up to 1km away to colonise new ponds (Langton *et al.,* 2001). The application site is also separated from the known GCN record by existing residential development and the A4222 carriageway, which are likely to act as overland dispersal barriers for any regular movement by the species in the local area. As such, the presence of GCN within the terrestrial habitats at the application site is considered unlikely.

Hazel Dormouse

3.11 No evidence of Dormice was identified from the nest tube checks completed between May and November 2022 (see Table 3). Using the scoring system devised by Chanin & Woods (2003) for the probability of finding Dormice in nest tubes, the survey effort at Sandy Lane would score 22.56[6]. A robust survey is considered to be represented by a score of 20 and the current survey indicates likely absence of Dormice within the surveyed habitats.

3.12 Surveys between May and July identified very limited use of the nest tubes by any species (Table 3) although regular use by Woodmice was noted over the late summer/autumn period (Aug – Nov). Nest tubes which were occupied at the time of the November check were left in place – all other tubes were collected/removed from site.

Table 3 Summary of nest tube checks: May – November 2022

Date	Conditions	Findings
20 May	Check from 11.45h: Fine, 16°c, 20-30% cloud, rain overnight, wind force Beaufort 2-3	All tubes checked and empty apart from bird droppings in No. 39
14 June	Check from 13.30h: 19°c, 20-30% cloud, no rain, wind force 1 – 2.	All tubes checked & empty apart from loose moss (suggesting birds or Woodmouse) in No. 24
06 July	Check from 09.00h: 19°c, 70% cloud, no rain, wind force 1 – 2.	All tubes checked and empty.
22 August	Check from 12.00h: 19°c, 90% cloud, no rain during	Nest tubes checked and empty apart from: No.2, 3, 8, 17, 21 – Loose green/brown leaves indicative of Woodmouse

[6] Deployment of 47 tubes in April 2022 with checks up to November gives a score of 24, which is multiplied by 0.94 as 47 nest tubes were deployed during the survey (see section 2.8).

Date	Conditions	Findings
	check but drizzle prior to start, wind force 1 – 2.	No. 27 – Loose grass stems – indicates Woodmouse
20 Sept.	Check from 12.00h: 16°c, 30-40% cloud, no rain, wind force 1.	Nest tubes checked and empty apart from: No. 2, 3, 8, 21, 27, 29, 37, 38 – Loose green/brown leaves indicates Woodmouse. No.10 – Woodmouse in loose nest of green/brown leaves No. 17 – Woodmouse in loose nest of grass No. 39 – 2no. Woodmice in loose Willow leaves No. 43 – Woodmouse in loose Blackthorn leaves
10 Oct.	Check from 13.00h: 15°c, 10-20% cloud, no rain, wind force 1.	Nest tubes checked and empty apart from: No. 2, 8, 10, 17, 21, 27-30, 34, 38 – Loose green/brown leaves or grass indicative of Woodmice No. 37 – Woodmouse in loose green leaves No.41 & 42 – Woodmouse in loose Blackthorn leaves
16 Nov.	Check from 13.00h: 11°c, overcast 100% cloud, no rain, wind force 1.	Nest tubes checked and empty apart from: No. 3, 5, 8, 17, 19, 23, 24, 27, 29, 31, 33 – Loose nest of green/brown leaves or grass. Indicated Woodmouse No. 22 – Small cache of Hawthorn berries. Suggests Woodmouse No. 28 – 4no. Woodmice in nest of loose grass. No. 30 – 2no. Woodmice in loose leaves/grass No. 38 – Woodmouse in loose nest No. 41 – 4no. Woodmice in loose nest Nest tubes collected unless occupied.

3.13 The surveys completed at the site indicate likely absence of Dormice from the surveyed habitats and no specific mitigation or licensing requirements would apply for proposed hedgerow translocation or management works.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Bats

4.1 The bat survey work established the use of the habitats present at the application site by at least 6no. different bats species including Common and Soprano Pipistrelle, Noctule, Serotine, Myotis sp. and Brown Long-Eared bat. A number of which are considered to be light sensitive species (e.g., Brown Long-Eared bat and Myotis species). In addition, whilst all other bat species recorded at the site would be considered common, Serotine is classified as a Vulnerable species within the IUCN Red List for British Mammals (Matthews *et al.,* 2018). The species was recorded on 17 occasions during the monitoring sessions indicating the use of the site by a small number of bats on an irregular basis.

4.2 The surveys identified that the northern hedgerow boundary supports significantly higher levels of bat activity compared to the hedge located along Sandy Lane. The latter hedge is shorter and regularly managed/cut as opposed to the northern hedgerow which is well established and contains mature trees. The northern hedgerow is likely to act as important flight corridor and foraging resource for bats in the local area. The survey data and activity transect observations indicate that this hedgerow is used on a regular basis by Common and Soprano Pipistrelle and Myotis bats, and on an occasional basis by individual Noctule, Serotine and Brown Long-Eared bats. Based on guidance from Wray *et al.,* (2010) the habitats at the site would be considered of County importance for foraging and commuting bats.

4.3 Low levels of bat activity were associated with the hedgerow located along Sandy Lane. It is not considered that the removal and translocation of the hedge (to be planted around the areas of POS) would result in a long-term negative impact to commuting bats, but may result in a temporary loss of a small foraging resource. The proposed site layout indicates that the northern hedgerow is to be retained. This linear habitat feature should be maintained as a dark corridor for foraging and commuting bats to avoid any impacts to habitat connectivity. The design of site lighting should aim to reduce artificial light spill onto this corridor as far as practicable i.e., illuminated at <0.5 lux. Design measures to minimise artificial light spill include appropriate positioning of lighting columns, the use of cowls or hoods, dimming of site lighting during sensitive times for bats (e.g., nights during summer months), the placement of internal lighting away from windows and the design of outdoor security lighting to include down-lighters. In addition, positioning of interior lighting and the type of window glass on the western elevation of plot 21 could be designed to further reduce any light spill onto the hedgerow corridor.

4.4 Other mitigation and enhancement measures would include a long-term management for existing and translocated hedgerows habitats. The management aims would be to maintain the current conditions of the northern hedgerow and suitability for foraging/commuting bats. For the translocated hedgerow, this hedge could be allowed to develop a taller and thicker shrub layer with a less intensive management regime (than

currently) to provide both biodiversity and landscape value (e.g., trimmed on a bi-annual basis to allow fruit/seed production). Other landscape elements (e.g., public open space and tree/shrub planting) would also provide new foraging resources of bats post-development.

Great Crested Newt

4.5 Based on the negative eDNA sample from the nearby pond, the habitats at the application site were considered unlikely to support Great Crested Newt in their terrestrial phase. On a precautionary basis it is recommended that the removal and translocation of the hedgerow located along Sandy Lane is undertaken via a supervised destructive search. This would include:

- Prior to the start of works, project ecologist to provide a toolbox talk to contractors detailing the working method and legal and conservation status of Great Crested Newt;
- Woody hedgerow vegetation to be trimmed to a height of 150-300mm outside of the nesting bird season (i.e., clearance possible between September – February);
- Removal/translocation of hedgerow roots and stumps be undertaken in autumn (September/October) or spring (when night temperatures regularly exceed 5 to avoid impacts to hibernating amphibians) under direct ecological supervision;
- Works to be undertaken via the use of a small excavator equipped with a toothed bucket. Root balls and stumps will be carefully pulled back and inspected by hand by the ecologist prior to translocation. Any wildlife found (e.g., reptiles or other common amphibians) will be transferred to retained habitats to the north of the site outside of the works footprint;
- No grubbing of root systems over winter period (November – February) to avoid impacts to hibernating amphibians;
- In the unlikely event a Great Crested Newt was found, all works would stop immediately and the project ecologist or Natural Resources Wales contact for advice on how to proceed.

4.6 Enhancement measures to improve the suitability of the site to support GCN and other amphibians and reptiles post development include the design of the attenuation basin to feature a damp base or hold water for most parts of the year. This could provide breeding habitats for amphibians in the spring. The attenuation basin banks could also be seeded with a native wetland grass mix or allowed to colonise naturally and managed via a single annual cut in later July/early August. In addition, the design could also feature the creation of hibernacula or log/brash piles around the basin to provide new shelter and hibernation opportunities for amphibians and reptiles. Guidance on the design of hibernacula is provided in Appendix VI.

Hazel Dormouse

4.7 No evidence of Dormice was recorded over the course of the 2022 surveys. The precautionary approach to translocation of the southern hedgerow would also be considered appropriate to address the low risk of

encountering this species (and other small mammals) during hedgerow cutting/movement. As noted for GCN, in the unlikely event that a Dormouse was found during works, all activity would stop immediately and NRW contacted for advice on how to proceed.

Avoidance, Mitigation & Enhancement

4.8 In addition to the precautionary approach to hedgerow translocation, the measures described within the PEA are considered appropriate to the proposed development layout at Sandy Lane.

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APPENDIX I SITE LOCATION & PROPOSED LAYOUT

Accommodation Schedule

House Name	Code	Beds	Structural Area (ft²)	No. of Units	Total Area
Open Market Units					
Hyatt	HY	3	978	8	7824
Burnaby	BU	3	1021	5	5105
Shelby	SH	4	1213	8	9704
Roxbury	ROX	4	1417	3	4251
Thornbury	TH	4	1479	3	4437
Sub Total				***27***	***31321***
Affordable Units			*Finished Area (ft²)*		
1 Bed Flats	2.1.1	1	557	8	4456
2 Bed House	4.2.1	2	850	9	7650
3 Bed House	5.3.1	3	1003	2	2006
Sub Total				***19***	***14112***
Total				**46**	**45433**

Site Key

- Application Boundary
- Social Rented Unit
- LCHO Unit
- 1.8m Close Board Fence
- 1.8m Screen Wall
- 1.2m Wall *(To Screen Bin Stores on Front Elevations)*
- 1.2m Ball Top Railings
- Translocated Hedgerow
  Refer to Landscape Architects design for further information
- Proposed Tree Planting
  Refer to Landscape Architects design for further information
- Existing Tree and RPZ
- Refuse Storage Area
- Refuse Collection Point
- Bicycle Storage Shed
- Indicative Rain Gardens
  Refer to engineers design for further information
- Proposed Retaining Walls and Steps
  Refer to engineers design for further information
- Indicative Location of Photovoltaic Panels
  Refer to supplier technical specification for accurate information
- Indicative Location of Air Source Heat Pump
  Refer to supplier technical specification for accurate information

REV.	DESCRIPTION	DATE
K:	Landscaping updated.	20.03.24
J:	Latest engineering info (steps, banking and retaining structures) imported with some private footpaths adjusted to suit. Foul pumping compound now omitted.	07.03.24
H:	Highway design updated following comments received in meeting with LA in January. Junction radii increased and shared surface road extended. Parking allocation amended. Public open space and play area improved. Substation omitted. Front boundary to plot 22 updated. Indicative solar panel and air source heat pump locations added to site plan.	13.02.24
G:	Plots 38, 42 and 44 handed. Affordable mix revised to address comments from LA housing strategy dept, resulting in alterations to plots 10-14 & 19-21. Bin storage areas to plots 13 and 20 relocated to the front of property due to site levels not allowing for acceptable rear access to mid terrace units. Bin store provided to flats (6-9) and bike shelters provided to all flats (6-9 & 15-18).	27.11.23
F:	Shared private drive serving plots 22-26 widened to the front of plots 25-26 to accommodate turning area for fire tender/delivery vehicles. Bin collection point added to the front of plot 22. Parking allocation reduced for the 3 bed affordable units (plots 10-12 & 19-21). Substation moved back 400mm.	29.08.23
E:	Application boundary updated	06.07.23
D:	Engineering information imported in to layout.	07.06.23
C:	Minor adjustments to house types. Private footpaths added with refuse storage added within rear gardens. Bicycle Storage sheds added to plots that have not been allocated a garage space. Refuse collection points added. Colour added and site key updated.	05.06.23
B:	New open market units added to site layout to comply with new 'Part L' regulations, resulting in revised floor areas. To accommodate larger units, plot 28 substituted to a Shelby house type (previously a Roxbury), plot 43 substituted to a Roxbury (previously a Thornbury). Plots 38 and 39 switched. All units and boundaries adjusted as a result of revised footprints.	20.04.23
A:	New WDQR affordable units added to layout (plots 3-21). Plots 15-18 reoriented to face north. Latest attenuation basin design imported from engineers site pack. Translocated hedgerow relocated to top edge of basin's southern boundary.	03.03.23

CLIENT
The key to quality
Lewis Homes

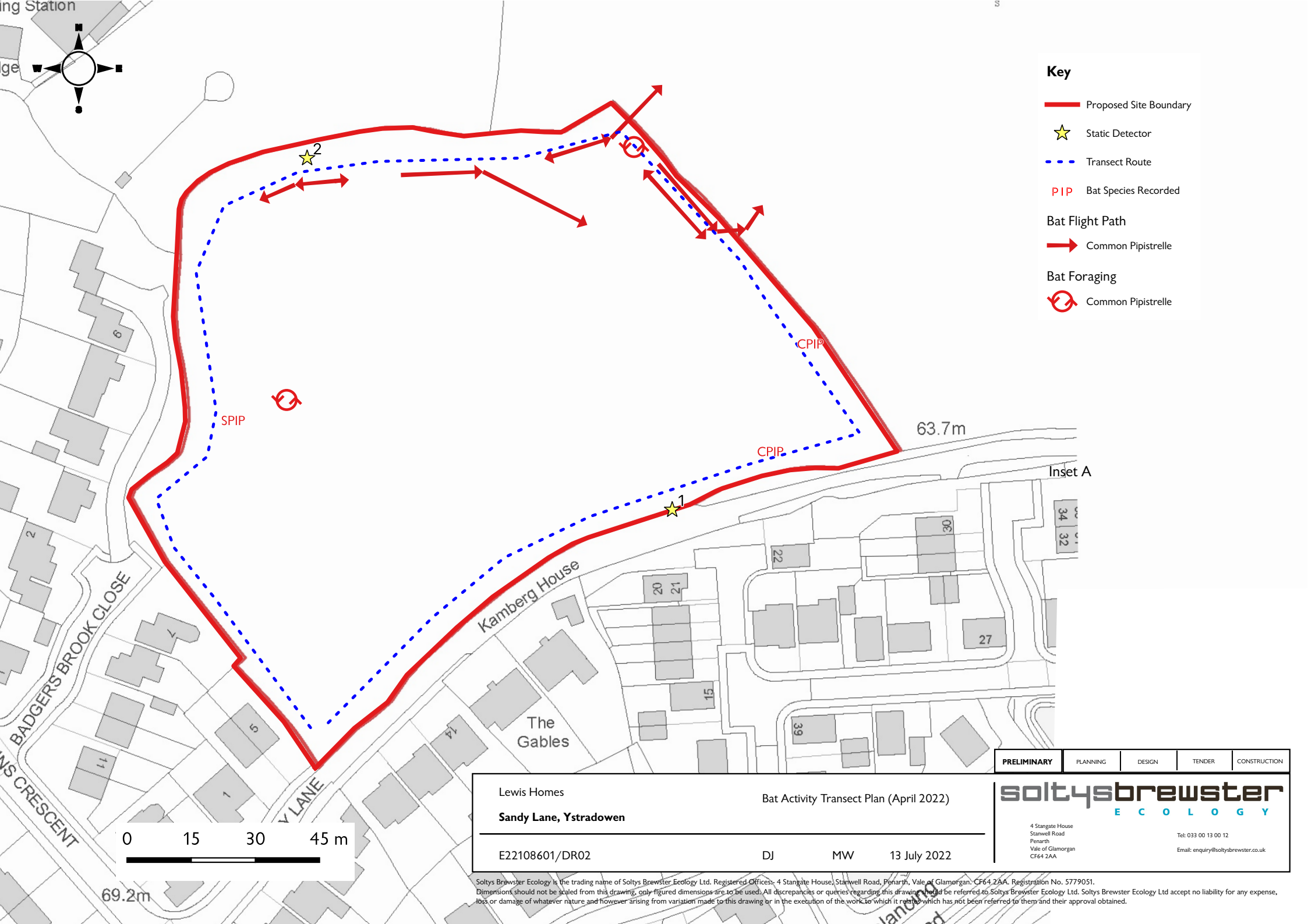
JOB TITLE
Sandy Lane, Ystradowen

DRAWING TITLE
Proposed Site Layout

SCALE @ A2	DATE	DRAWN BY
1:500	June '23	RW
JOB NO.	DRAWING NO.	REVISION
1941	TP-01	K

hammond Architectural Ltd
10 Gold Tops
Newport
NP20 4PH
t. 01633 844970
e. info@hammond-ltd.co.uk
www.hammond-ltd.co.uk

APPENDIX II BAT SURVEY TRANSECTS AND AUTOMATED MONITORING



PRELIMINARY	PLANNING	DESIGN	TENDER	CONSTRUCTION

Lewis Homes

Sandy Lane, Ystradowen

Bat Activity Transect Plan (April 2022)

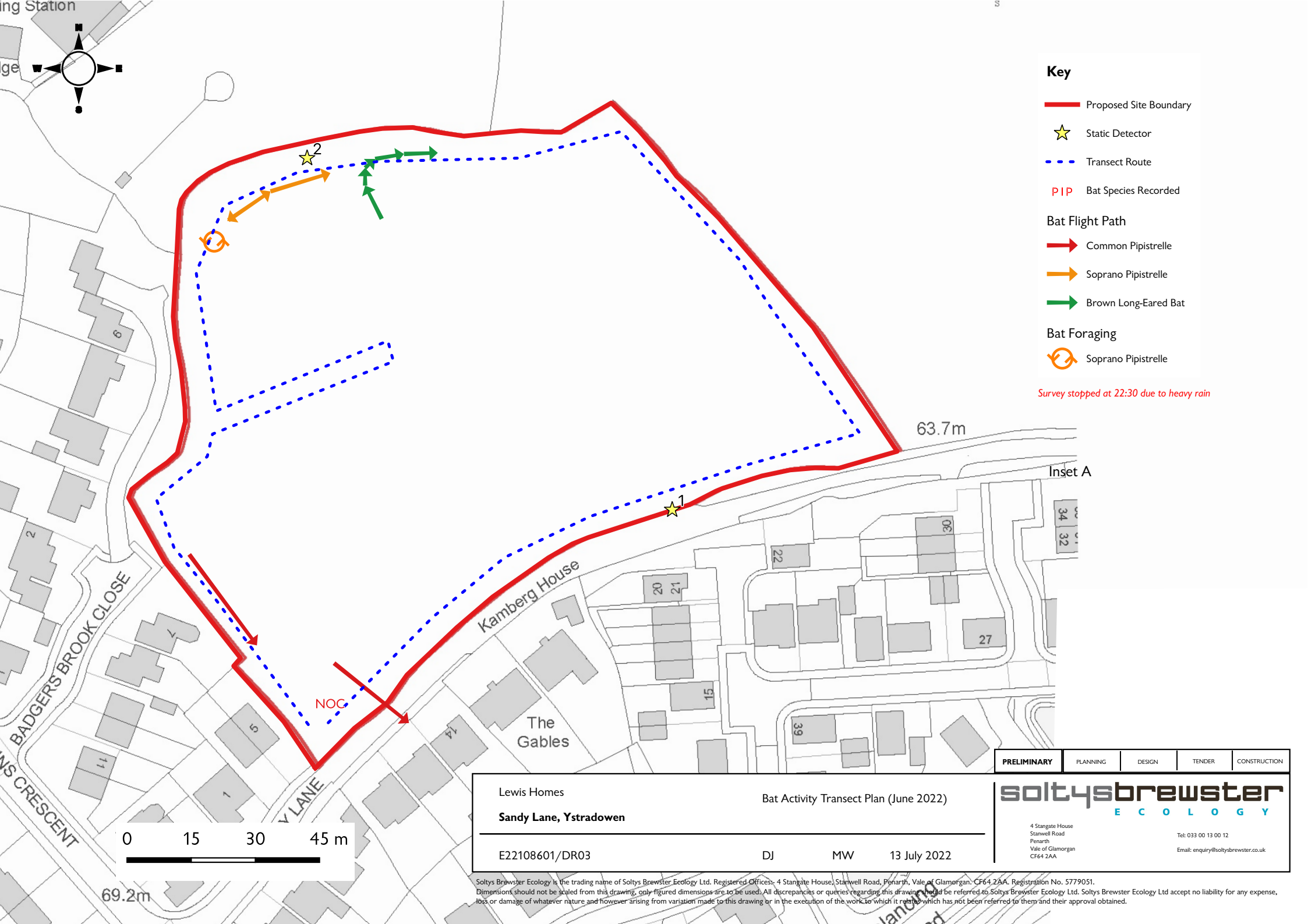
E22108601/DR02	DJ	MW	13 July 2022

soltysbrewster ECOLOGY

4 Stangate House
Stanwell Road
Penarth
Vale of Glamorgan
CF64 2AA

Tel: 033 00 13 00 12

Email: enquiry@soltysbrewster.co.uk



PRELIMINARY	PLANNING	DESIGN	TENDER	CONSTRUCTION

Lewis Homes

Sandy Lane, Ystradowen

Bat Activity Transect Plan (June 2022)

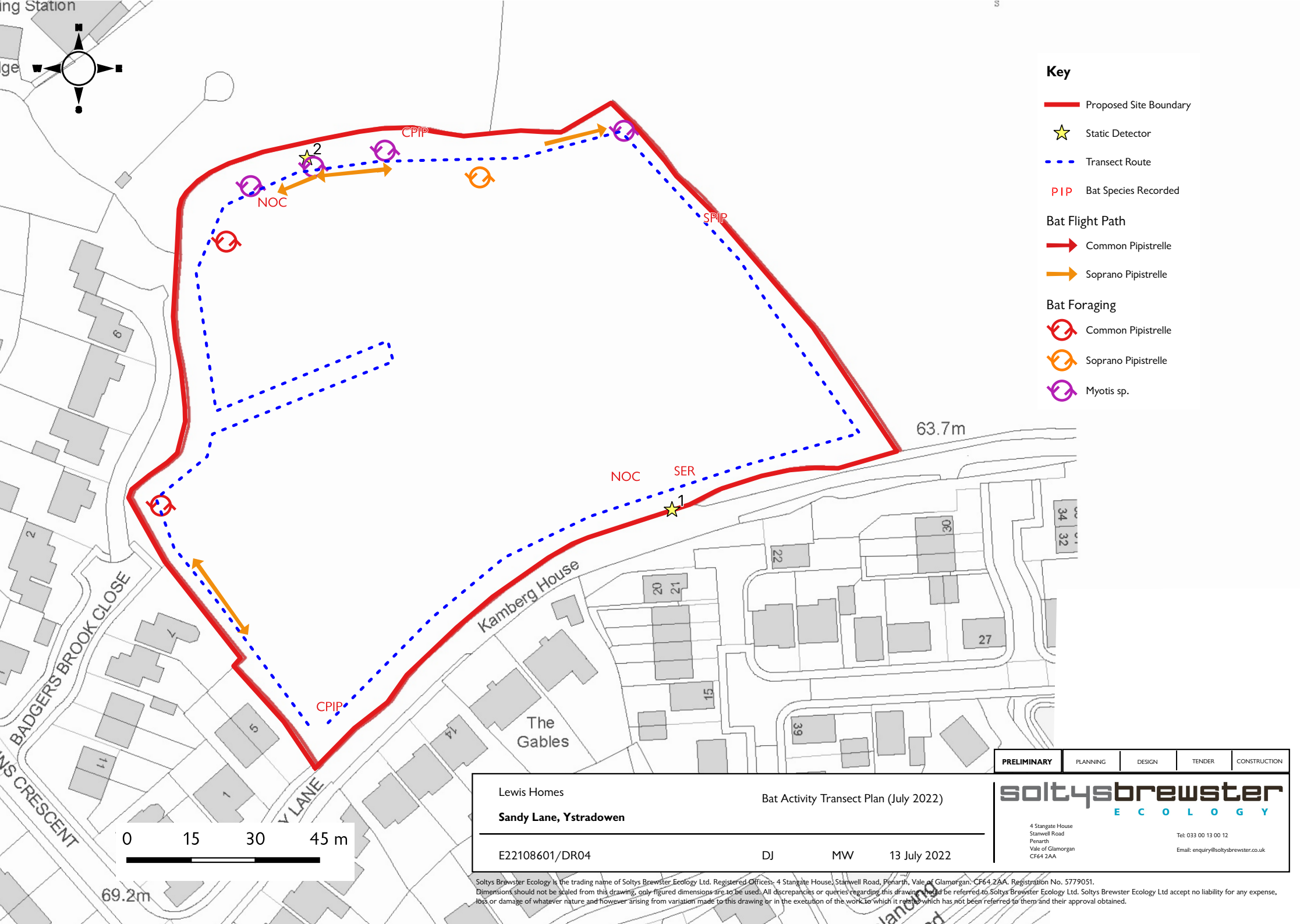
E22108601/DR03 DJ MW 13 July 2022

soltysbrewster ECOLOGY

4 Stangate House
Stanwell Road
Penarth
Vale of Glamorgan
CF64 2AA

Tel: 033 00 13 00 12

Email: enquiry@soltysbrewster.co.uk



PRELIMINARY	PLANNING	DESIGN	TENDER	CONSTRUCTION

Lewis Homes

Sandy Lane, Ystradowen

Bat Activity Transect Plan (July 2022)

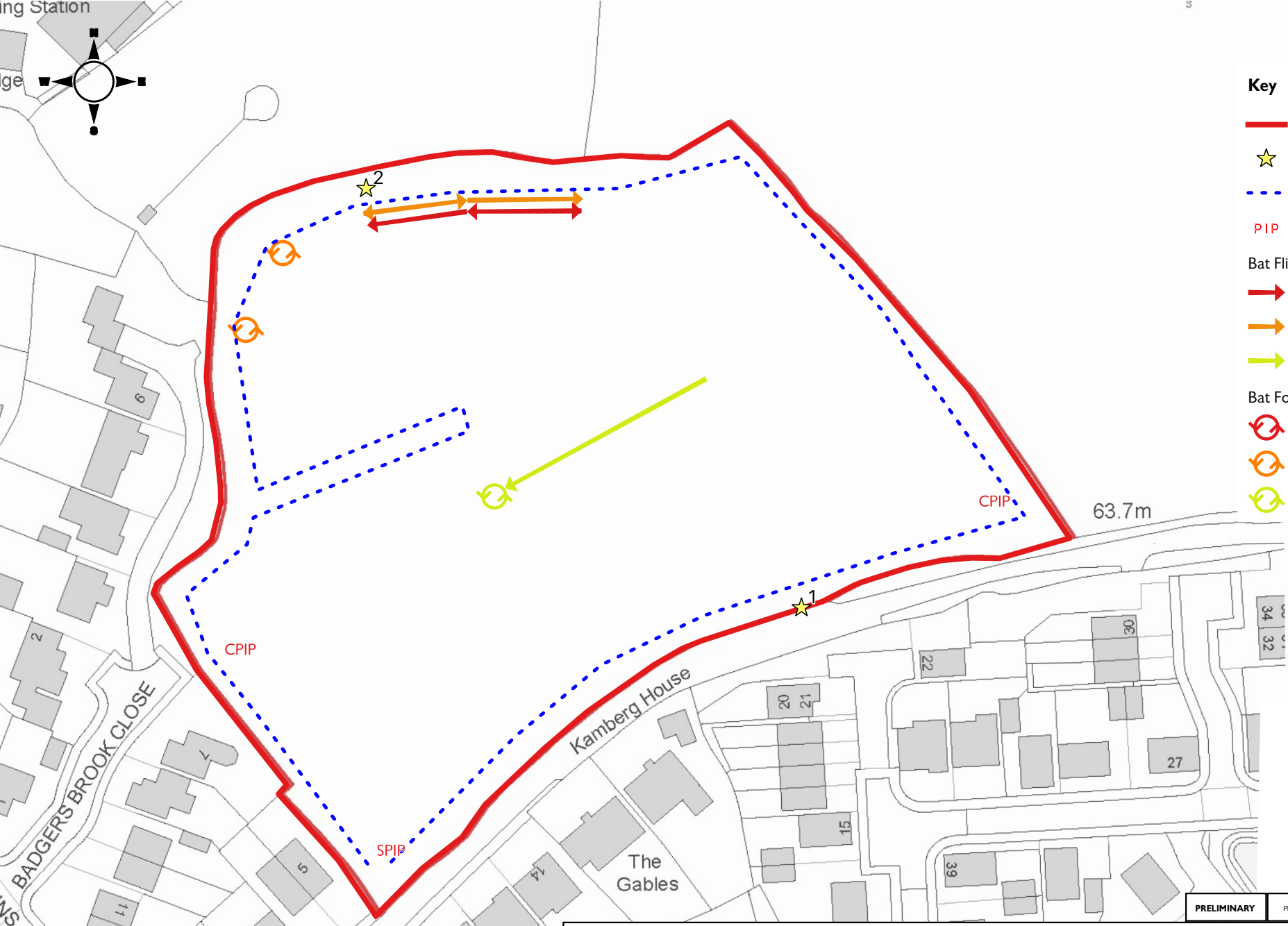
E22108601/DR04 DJ MW 13 July 2022

soltysbrewster ECOLOGY

4 Stangate House
Stanwell Road
Penarth
Vale of Glamorgan
CF64 2AA

Tel: 033 00 13 00 12

Email: enquiry@soltysbrewster.co.uk



PRELIMINARY	PLANNING	DESIGN	TENDER	CONSTRUCTION

Lewis Homes

Sandy Lane, Ystradowen

Bat Activity Transect Plan (August 2022)

E22108601/DR05	DJ	MW	24 August 2022

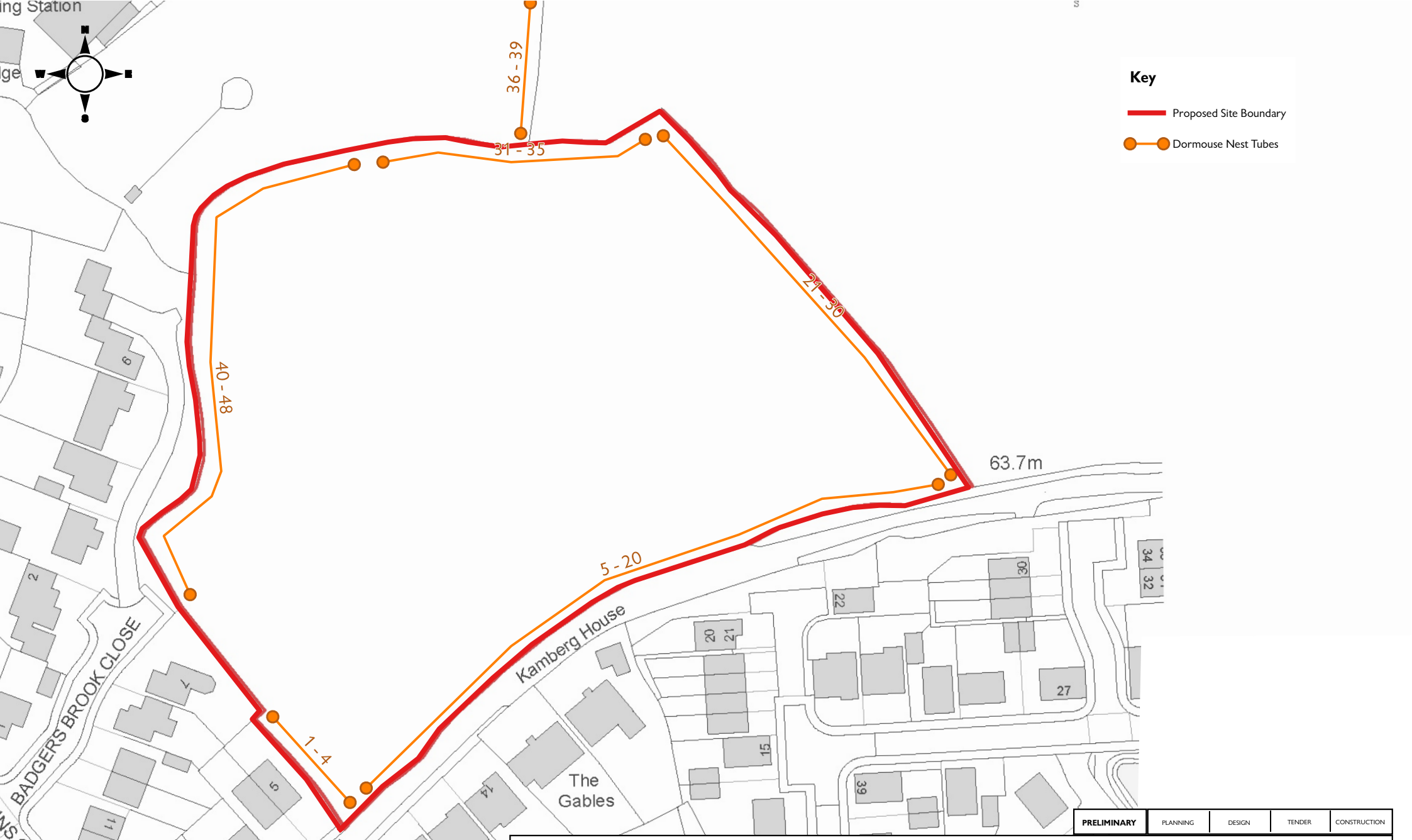
soltysbrewster ECOLOGY

4 Stangate House
Stanwell Road
Penarth
Vale of Glamorgan
CF64 2AA

Tel: 033 00 13 00 12

Email: enquiry@soltysbrewster.co.uk

APPENDIX III DORMOUSE NEST TUBE PLAN



PRELIMINARY	PLANNING	DESIGN	TENDER	CONSTRUCTION

Lewis Homes

Sandy Lane, Ystradowen

Dormouse Nest Tube Locations

E22108601/DR06	DJ	MW	07 December 2022

soltysbrewster ECOLOGY

4 Stangate House
Stanwell Road
Penarth
Vale of Glamorgan
CF64 2AA

Tel: 033 00 13 00 12

Email: enquiry@soltysbrewster.co.uk

APPENDIX IV EDNA SAMPLING RESULTS (GREAT CRESTED NEWT)

DNA Analysis Report - Commercial in Confidence

Customer:	Soltys Brewster Ecology Ltd
Address:	4 Stangate House Stanwell Road Penarth Vale of Glamorgan CF64 2AA
Contact:	Matthew Watts
Email:	matthew.watts@soltysbrewster.co.uk
Tel:	07852944042
Report date:	10-Jun-2022
Order Number:	GCN22-1482
Samples:	Pond Water
Analysis requested:	Detection of Great Crested Newt eDNA from pond water.

Thank you for submitting your samples for analysis with the Fera eDNA testing service. The details of the analysis are as follows:

Method:
The method detects pond occupancy from great crested newts (GCN) using traces of DNA shed into the pond environment (eDNA). The detection of GCN eDNA is carried out using real time PCR to amplify part of the cytochrome 1 gene found in mitochondrial DNA. The method followed is detailed in Biggs J., et al, (2014). Analytical and methodological development for improved surveillance of the Great Crested Newt. Appendix 5. Technical advice note for field and laboratory sampling of great crested newt (Triturus cristatus) environmental DNA. Freshwater Habitats Trust, Oxford.

The limits of this method are as follows: 1) the results are based on analyses of the samples supplied by the client and as received by the laboratory, 2) any variation between the characteristics of this sample and a batch will depend on the sampling procedure used. 3) the method is qualitative and therefore the levels given in the score are for information only, they do not constitute the quantification of GCN DNA against a calibration curve, 4) a 'not detected' result does not exclude presence at levels below the limit of detection.

The results are defined as follows:

Positive:	DNA from the species was detected.
eDNA Score:	Number of positive replicates from a series of twelve.
Negative:	DNA from the species was not detected; in the case of negative samples the DNA extract is further tested for PCR inhibitors and degradation of the sample.
Inconclusive:	Controls indicate degradation or inhibition of the sample, therefore the lack of detection of GCN DNA is not conclusive evidence for determining the absence of the species in the sample provided.

DNA Analysis Report - Commercial in Confidence

CustomerReference	Fera Reference	GCN Detection	eDNA Score	Inhibition	Degradation
Fairwater Park Pond	S22-012655	Positive	7	n/a	n/a
Ystradowen Pond	S22-012656	Negative	0	No	No

The results indicate that eDNA for great crested newts was detected in one of the samples and in the remaining sample eDNA was not detected (as detailed in the table above). Analysis was conducted in the presence of the following controls: 1) extraction blank, 2) appropriate positive and negative PCR controls for each of the TaqMan assays (GCN, Inhibition, and Degradation). All controls performed as expected.

This test procedure was developed using research funded by the Department of Environment, Food and Rural Affairs.

Issuing officer: Steven Bryce
Tel: 01904 462 070
Email: e-dna@fera.co.uk

APPENDIX V BATS AND ARTIFICAL LIGHTING AT NIGHT GUIDANCE NOTE

The following is an extract from the Bat Conservation Trust and Institution of Lighting Professionals (2023) guidance note on Bats and Artificial lighting at night. Section 4 contains advice on how to mitigate for the impacts of artificial lighting on bats. Full citation:

Bat Conservation Trust & Institution of Lighting Professionals (2023) *Bats and artificial lighting at night*. *Guidance Note 08/23*. Bat Conservation Trust, London.

4. Bats, lighting and the mitigation hierarchy

Introduction

4.1 This chapter provides a process for considering the impact on bats as part of a proposed lighting scheme or new development incorporating night-time lighting. It contains a toolkit of techniques which can be used on any site, whether a small domestic project or larger mixed-use, commercial or infrastructure development. It also provides best practice advice for the design of a lighting scheme, for both lighting professionals and other users who may be less familiar with the terminology and theory.

4.2 Under the Agent of Change principle within national planning policy, those seeking to introduce a new plan or project are also responsible for the management of its impact. Therefore, it is crucial that the impacts of obtrusive lighting are mitigated or avoided altogether. While this chapter focuses on how potential lighting impacts on bats can be identified, avoided and mitigated, opportunities for ecological betterment beyond maintaining the status quo should be pursued wherever possible. Doing so would not only fulfil our responsibilities under this principle but contribute to Biodiversity Net Gain in line with legislation. [xlix] Further information on Biodiversity Net Gain can be found here: https://cieem.net/i-am/current-projects/biodiversity-net-gain/

4.3 Effective avoidance and mitigation of lighting impacts on bats relies on close collaboration from the outset between multiple disciplines. Depending on the specific challenges this will almost certainly involve ecologists working alongside architects and/or engineers; however, lighting professionals and landscape architects should be approached when recommended by your ecologist. This should be done at as early a stage as possible, in order to ensure the proposed lighting strategy is acceptable to all disciplines, mitigation is effective and is not in breach of legislation. In this way, delays to approval/adoption and unforeseen costs or liability can be avoided.

4.4 The stepwise process and key follow-up actions are outlined in the flowchart overleaf see figure 3 and followed throughout the Chapter. The questions in the flowchart should be asked in good time to allow any necessary bat survey information to be gathered in advance of lighting design, or fixing a scheme design.

4.5 It should be noted that the measures discussed in this document relate only to the specific impacts of lighting upon retained or newly created bat habitat features, on or adjacent to the site. If loss or damage to roosting, foraging or commuting habitat is likely to be caused by other aspects of the development, separate ecological advice will likely be necessary in order to avoid, mitigate or compensate for this legally and/or in line with ecological planning policies.

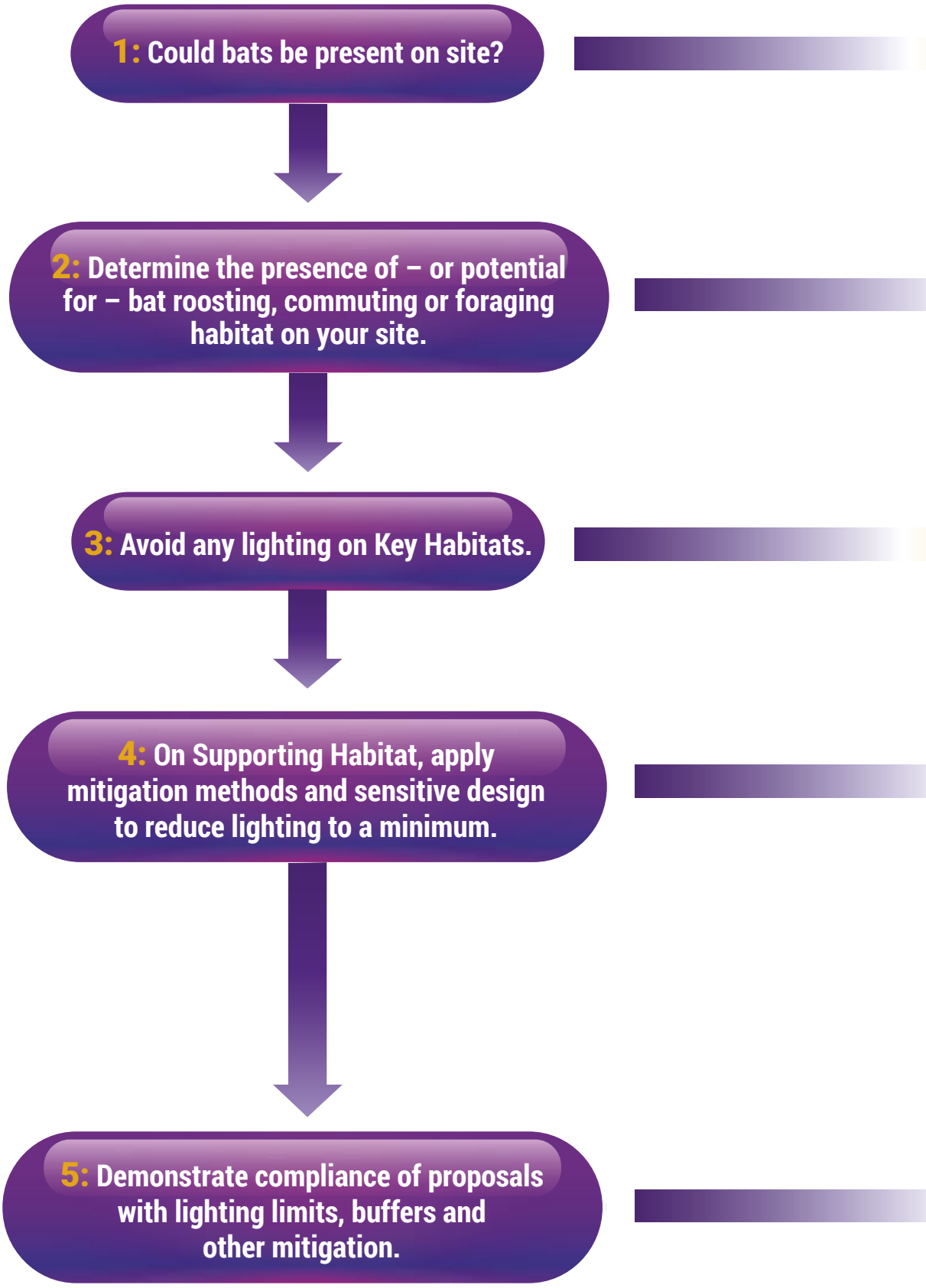

1: Could bats be present on site?
2: Determine the presence of – or potential for – bat roosting, commuting or foraging habitat on your site.
3: Avoid any lighting on Key Habitats.
4: On Supporting Habitat, apply mitigation methods and sensitive design to reduce lighting to a minimum.
5: Demonstrate compliance of proposals with lighting limits, buffers and other mitigation.

Figure 3. Ecology process for lighting.

Step 1: Could bats be present on site?

4.6 If there is no ecological data for your site, an ecologist should be contacted at the earliest opportunity to advise on an initial survey and any potential follow-on surveys. This information should be collected as early as possible in the design process, and certainly before lighting is being specified, so as to avoid the need for costly revisions.

4.7 If any of the following habitats occur on site, and are adjacent to or connected with any of these habitats on or off site, it is possible that proposed lighting may impact local bat populations (please note this list is indicative and advice should be sought from an ecological consultant):

- Woodland, individual mature trees or lines of trees
- Hedgerows and scrub
- Ponds, lakes and other wetland
- Ditches, streams, canals and rivers
- Infrequently managed grassland, or parks, gardens and Public Open Space
- Buildings - Especially, **but not limited to**, those in disrepair or built pre 1970s
- Gravel pits, quarries, cliff faces, caves and rock outcrops
- Any building or habitat known to support protected species
- Any additional scenarios as advised by your Local Planning Authority (LPA)

4.8 If you are unsure about whether bats may be impacted by your project, and an ecologist has not yet been consulted, sources of information on the presence of bats within the vicinity of your site include the following.

- Local Environmental Records Centres (LERC) - Will provide third-party records of protected and notable species for a fee. Search http://www.alerc.org.uk/ for more information
- The Wildlife Assessment Check is a free online tool designed by the Partnership for Biodiversity in Planning to support small-to-medium scale developments by helping identify whether ecological advice should be sought prior to submitting a planning application. The WAC is available online at www.biodiversityinplanning.org/wildlife-assessment-check/
- National Biodiversity Network Atlas - Provides a resource of third-party ecological records searchable online at https://nbnatlas.org - typically this is less complete than LERC data. Please note: Some datasets are only accessible on a non-commercial basis, while most can be used for any purpose, provided the original source is credited
- Local Authority Planning Portal - Most local planning authorities have a searchable online facility detailing recent planning applications. These may have been accompanied by ecological survey reports containing information on bat roosts and habitats

- Defra's MAGIC map - Provides an online searchable GIS database including details of recent European Protected Species licences, and details of any protected sites designated for bat conservation

4.9 The professional directory at the website of the Chartered Institute of Ecology and Environmental Management (www.cieem.net) provides details of ecologists in your area with the relevant skills/experience. The early involvement of a professional ecologist can minimise the likelihood of delays at the planning stage (if applicable) and ensure your project is compliant with conservation and planning legislation and policy.

Step 2: Determine the presence of/potential for bat roosts or habitat and evaluate their importance

4.10 Once a potential risk to bats has been identified, the ecologist will visit the site in order to record the habitats and features present, and evaluate their potential importance to bats. Additionally, they should consider the likelihood that bats could be affected by lighting both on and immediately off site. This survey may also include daytime building and tree inspections, and the deployment of automated bat detectors. On the basis of these inspections, further evening surveys may be recommended, either to determine the presence or likely absence of bats within buildings and/or trees, or to assess the use of the habitats by bats by means of a walked survey. Such surveys may be undertaken at different times during the active season (May - September) and should also involve the use of automated bat detectors left on site for a period of several days. The surveys should be carried out observing the recommendations within the Bat Conservation Trust's Bat Surveys for Professional Ecologists: Good Practice Guidelines (Collins, 2016), and the Interim Guidance Note: Use of Night Vision Aids for Bat Emergence Surveys (BCT, May 2022), or as superseded.

4.11 The resulting report will detail the relative conservation importance of each habitat feature to bats, including the roost-supporting potential of any built structures or trees. The ecologist's evaluation of the individual features will depend on the specific combination of contributing factors about the site, including:

- The conservation status of species likely to be present
- Geographic location
- Type of bat activity likely (breeding, hibernating, night roosting, foraging etc.)
- Habitat quality
- Habitat connectivity off-site
- The presence of nearby bat populations or protected sites for bats (usually identified in a desk study)

4.12 The evaluation will enable the ecologist to determine the presence of any Key Habitats or Supporting Habitats for bats. The whereabouts of these habitats should be set out on a plan of the site or as an Ecological Constraints and Opportunities Plan (ECOP), see Case Study 3. The bat habitat plan/ECOP and report can then be used to help guide the design of the lighting strategy (see next steps) as well as the wider project.

4.13 Key Habitats are those which are considered essential for the function and stability of local bat populations, while Supporting Habitats may be of lesser significance or usage. Habitats falling within neither category are considered to be of negligible or very low importance to bats.

4.14 Examples of Key Habitats include:

- Roosting and swarming sites for all species and their associated flightpaths and commuting habitat
- Foraging or commuting habitat for highly light-averse species (greater and lesser horseshoe bats, some Myotis bats, barbastelle bats and all long-eared bats) or nationally/locally rare species
- Foraging or commuting habitat supporting relatively large numbers of bats or high activity rates as assessed through survey
- Any habitat otherwise assessed by the ecologist as being of elevated importance in maintaining the 'favourable conservation status' of the bat population using it

Step 3: Avoid lighting on any Key Habitats

4.15 An adverse impact from illumination onto a Key Habitat feature is likely to have a significant effect on the bats using it. Therefore, an absence of artificial illumination and glare acting upon both the feature and an appropriately sized buffer zone is most often the only acceptable solution. An ecologist will be best placed to set the size of such a buffer zone according to the species present and the level of usage, and these can be tens of metres if unattenuated light spill or glare from local sources is predicted. The input of a lighting professional should be sought when determining the distances of light spill from new sources and likelihood of glare. It is recommended that proposals are communicated by them to the Principal Designer and the Highways Designer, (if applicable) as in some circumstances these decisions may influence highway function (e.g. visibility departures). Further information on demonstrating an absence of illumination within proposals via lux/illuminance contour plans is provided in Step 5.

4.16 As detailed in Section 2.1, there is no legal duty requiring any place to be lit. British Standards and other policy documents allow for deviation from their own guidance where there are significant ecological/environmental reasons for doing so. It is acknowledged that in certain situations lighting is critical in maintaining safety, such as some industrial sites with 24hr operation, or in high-risk security situations. Nevertheless, these are not exempt from

the statutory protection afforded to bats, their roosts and commuting routes directly associated with roosts, and good design principles recommended under industrial documents such as the Institution of Lighting Professionals' GN01: The Reduction of Obtrusive Light remain best practice. However, in the public realm, while lighting can increase the perception of safety and security, measurable, objective benefits on safety and security are less well established. Consequently, lighting design should be holistic, taking into consideration the relevant British Standards or local policies concerning lighting but, through a risk assessment-style process, be able to fully take into account the presence of protected species and the likely adoption of mitigation approaches through proper engagement with local communities (see Case Study 4).

4.17 Completely avoiding any lighting conflicts in the first place is advantageous, because proposals would be automatically compliant with the relevant wildlife legislation and planning policy, and costly, time-consuming additional surveys, mitigation and post-development monitoring would be avoided. Furthermore, LPAs are likely to favour applications where steps have been taken to avoid such conflicts.

4.18 Sources of lighting which can have the potential to disturb bats are not limited to roadside, footpath or security lighting, but can also include light spill via windows, permanent but sporadically operated lighting such as sports floodlighting, and in some cases car headlights. It is important to note that these situations often comprise many complex variables, and light emission is often difficult to predict or model accurately.

4.19 A competent lighting professional should be involved in the design of proposals as soon as potential impacts (including from glare) are identified by the ecologist, in order to avoid planning difficulties, or late-stage design revision. The lighting professional will be able to make recommendations about placement of luminaires tailored to the project.

Glare

4.20 Glare (extremely high contrast between a source of light and the surrounding darkness - linked to the 'intensity' of a luminaire) may additionally affect bats over a greater distance than the area directly lit by a luminaire. Glare impacts on bats and other wildlife should be considered on the site alongside best practice advice on reducing obtrusive light (see ILP GN01).

Highways

4.21 Where highways lighting schemes are to be designed by the LPA, the ecology officer (or planning officer) should be consulted on the presence of important bat constraints, determined in Step 2, which may impact the design of the lighting scheme in order to ensure compliance with wildlife legislation.

LPA-specific guidance

4.22 Some LPAs have Supplementary Planning Documents (SPD) or other guidance concerning the management of potential development impacts on particular species of bats, or in relation to certain protected sites, such as Special Areas of Conservation (SACs). These should be consulted for particular advice concerning lighting. For example, the North Somerset and Mendip Bats SAC Guidance on Development SPD provides a methodology for calculating the specification of compensatory habitat required to off-set certain development impacts on the bat population of the SAC. In it, retained or created habitats that are subject to lighting above certain lux levels, are considered to be lost to development, with implications for compensation requirements [1].

Environmental Impact Assessment (EIA)

4.23 For plans and projects subject to the Environmental Impact Assessment (EIA) Regulations screening process, it is important for LPAs to understand the nature of mitigation measures at this relatively early stage. Under current EIA Regulations, schemes planning to avoid likely significant effects on the environment through either embedded design measures, such as sensitive site configuration or strategic land/building usage etc., or by other robust mitigation, may be exempt from EIA and therefore less costly. However, the over-reliance on conditions to effect environmental mitigation may be open to legal challenge.

Step 4: On Supporting Habitat, apply mitigation methods and sensitive design to reduce lighting to a minimum

4.24 Supporting Habitats may be less frequently used by bats compared to Key Habitats, or support fewer, or more light-opportunistic species. Consequently, a balance between a reduced lighting level appropriate to the ecological importance of each feature and species, and the lighting objectives for that area will need to be achieved.

4.25 It is important to reiterate the legal protection from disturbance that bats receive under the Wildlife and Countryside Act 1981, as amended. Where the risk of offences originating from lighting is sufficiently high, it may be best to apply the avoidance approach in Step 3. (see Case Study 5).

4.26 Advice from an ecologist and lighting professional will be essential in finding the right approach for the site according to their evaluation. The following are techniques which have been successfully used on projects to limit lighting impacts on bats, and are often used in combination for best results.

[1] https://n-somerset.gov.uk/sites/default/files/2020-03/North%20Somerset%20and%20Mendip%20Bats%20SAC%20guidance%20supplementary%20planning%20document.pdf

Dark buffers and concentric zonation

4.27 A buffer zone subdivided to into smaller zones of increasing illuminance limit further away from the Supporting Habitat would ensure light levels (illuminance - measured in lux) do not exceed certain defined limits. This has the effect of a gradual decrease in lighting from the developed zone, rather than a distinct cut-off, which may provide useable area for the project which also limits lighting impacts on less sensitive species, or less well-used habitat.

4.28 The ecologist (in collaboration with a lighting professional) can help determine the most appropriate buffer widths and illuminance limits according to the value of that habitat to bats. Figure 4 gives an example of a multi-zoned approach which includes Key Habitat (Zone A) which would receive no ALAN, and Supporting Habitat (Zones B and C) which would act as a 'light attenuation zone', but remain within the public realm, and so receive reduced light levels.

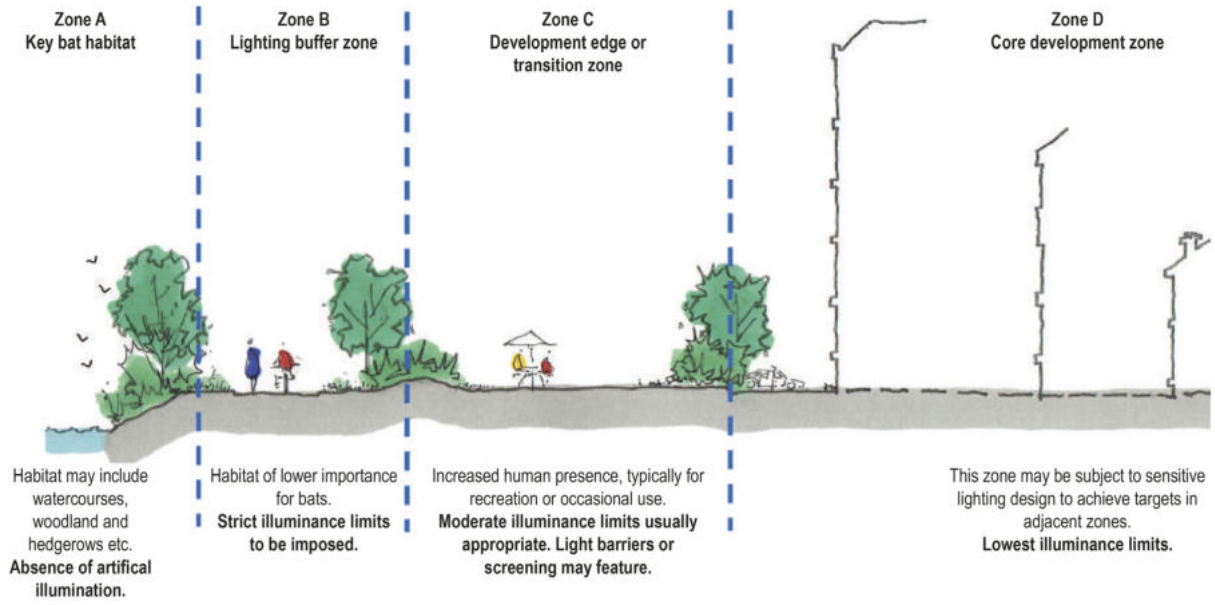


Figure 4. Example of illuminance limit zonation.

Appropriate luminaire specifications

4.29 Light sources, lamps, LEDs and their fittings come in a myriad of different specifications which a lighting professional can help to select. However, the following should be considered when choosing luminaires and their potential impact on Key Habitats and features:

- All luminaires should lack UV elements when manufactured. Metal halide, compact fluorescent sources should not be used
- LED luminaires should be used where possible due to their sharp cut-off, lower intensity, good colour rendition and dimming capability
- A warm white light source (2700Kelvin or lower) should be adopted to reduce blue light component

- Light sources should feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats (Stone, 2012)
- Internal luminaires can be recessed (as opposed to using a pendant fitting - See Figure 5) where installed in proximity to windows to reduce glare and light spill
- Waymarking inground markers (low output with cowls or similar to minimise upward light spill) to delineate path edges (see Case Study 1)
- Column heights should be carefully considered to minimise light spill and glare visibility. This should be balanced with the potential for increased numbers of columns and upward light reflectance as with bollards
- Only luminaires with a negligible or zero Upward Light Ratio, and with good optical control, should be considered - See ILP GN01
- Luminaires should always be mounted horizontally, with no light output above 90° and/or no upward tilt
- Where appropriate, external security lighting should be set on motion-sensors and set to as short a possible a timer as the risk assessment will allow. For most general residential purposes, a 1 or 2 minute timer is likely to be appropriate
- Use of a Central Management System (CMS) with additional web-enabled devices to light on demand
- Use of motion sensors for local authority street lighting may not be feasible unless the authority has the potential for smart metering through a CMS
- The use of bollard or low-level downward-directional luminaires is strongly discouraged. This is due to a considerable range of issues, such as unacceptable glare, poor illumination efficiency, unacceptable upward light output, increased upward light scatter from surfaces and poor facial recognition which makes them unsuitable for most sites. Therefore, they should only be considered in specific cases where the lighting professional and project manager are able to resolve these issues. See Case Study 6
- Only if all other options have been explored, accessories such as baffles, hoods or louvres can be used to reduce light spill and direct it only to where it is needed. However, due to the lensing and fine cut-off control of the beam inherent in modern LED luminaires, the effect of cowls and baffles is often far less than anticipated and so should not be relied upon solely

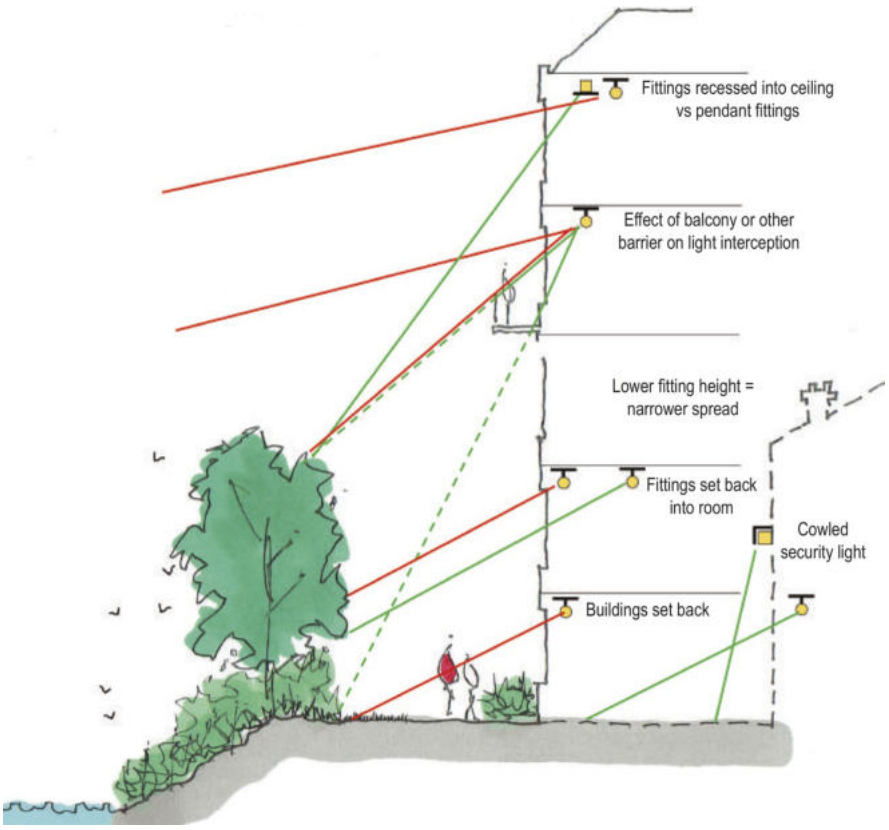


Figure 5. Internal lighting mitigation options.

Sensitive site configuration

4.30 The location, orientation and height of newly built structures, and hard standing, relative to each other can have a considerable impact on light spill. Small changes in terms of the placement of footpaths, open space and windows can all help to achieve a better outcome in terms of minimising light spill onto Key Habitats and features.

- Key or Supporting Habitat is often located alongside, or to the rear of buildings, on new developments. In this case, the removal or reduction of windows can be the most effective way to permanently limit light spill, potentially alongside the internal reconfiguration of the building, to ensure high-use spaces are not as impacted by loss of natural light
- It may be possible to include Key or Supporting Habitat into unlit public open space such as parks. However, avoid including into residential gardens, as uncontrolled and inappropriate lighting may be introduced by residents following occupation
- It is often considered better for a residential scheme to specify good quality downward-directional external light fittings for security, and/or at the front entrance, on short PIR timers, rather than risk the imposition of poor quality and poorly controlled lighting at a later date
- Buildings, walls and hard landscaping may be sited and designed so as to block light spill from reaching habitats and features

- Paved surfaces should not be located within Key Habitat or buffer zones, unless they form part of unlit public open space
- Taller buildings may be best located toward the centre of the site, or sufficiently set back from Key Habitats, to minimise the effect of their light spill
- Column mounted luminaires can be located so that the rear shields are adjacent to habitats, or narrow optics selected that direct light into the task area where needed

Physical screening

4.31 Light spill can be successfully screened through landscaping and the installation of walls and fences, or even banks and bunds (See Figure 6). In order to ensure that fencing makes a long-term contribution, it is recommended that it is supported on concrete or metal posts. Fencing can also be over planted with hedgerow species or climbing plants to soften its appearance and provide a vegetated feature which bats can use for navigation or foraging.

4.32 The planting of substantial landscape features integrated to the wider network of green corridors such as hedgerows, woodland and scrub would make a long-term positive contribution to the overall connectivity of bat habitat and light attenuation. It would also contribute to any local Nature Recovery and Green Infrastructure policies and help achieve obligatory Biodiversity Net Gain targets. A landscape architect can be appointed to collaborate with the ecologist on maximising these natural light screening opportunities.

4.33 It should be noted that newly planted vegetation (trees, shrubs and scrub) is unlikely to adequately contribute to light attenuation upon Key Habitats for a number of years, until it is well established. Sufficient maintenance to achieve this is also likely to be required. Consequently, this approach is best suited to the planting of dense, mature or translocated vegetation. In some cases, it is appropriate to install temporary fencing, or other barrier, to provide the desired physical screening effects until the vegetation is determined to be sufficiently established.

4.34 Given the fact that planting may be removed, die back or inadequately replaced over time, it should never be relied on as the sole means of attenuating light spill.

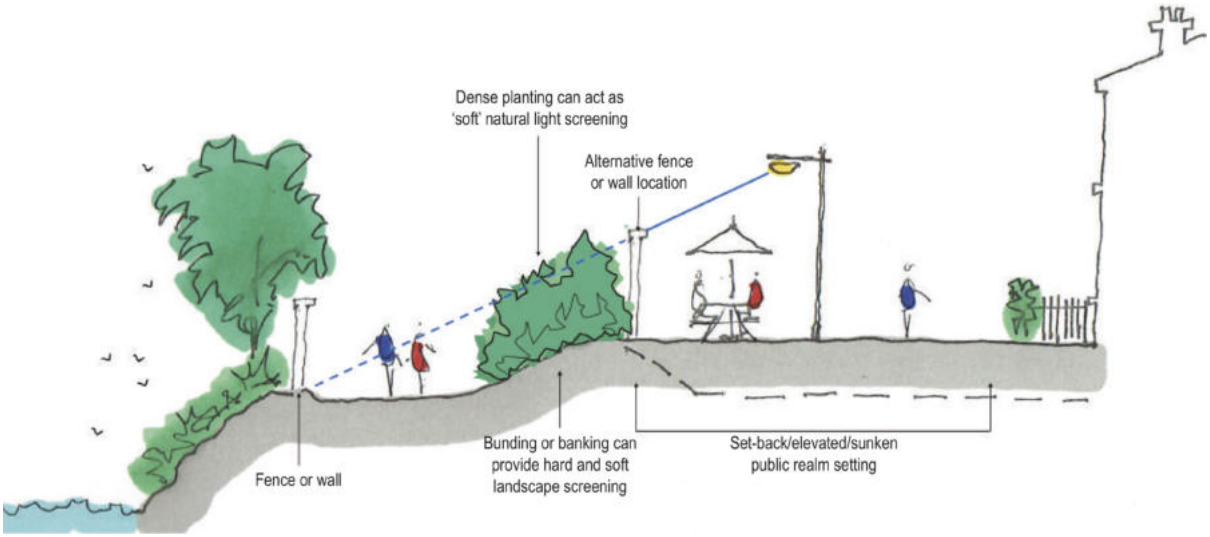


Figure 6. Examples of physical light screening options.

Dimming and part-night lighting

4.35 Depending on the pattern of bat activity across the Supporting Habitat identified by the ecologist, it may be appropriate for an element of on-site lighting to be controlled by dimming or switching either diurnally, seasonally, or according to human activity (light on demand). This is known as Part-Night Lighting (PNL). It is important to state that PNL is not likely to be appropriate where Key Habitats are at risk, especially as PNL often results in lighting when bats are most active.

4.36 A Central Management System (CMS) can be specified by the lighting engineer to dim or turn off individual or groups of luminaires when not in use or during less busy times. Dimming can be precisely controlled, with dimming states often being as low as 10 or 20%. However, due to the electrical difficulties of maintaining a dimming state of under 10%, luminaires should be set to off below this point.

4.37 Lighting could be set to a low output state by default, to turn up to a pre-determined output in response to a trigger, and be combined with a timeclock or photocell to further add an element of seasonal or diurnal control. For example, Passive Infrared (PIR), Artificial Intelligence enabled cameras, on demand controls, or pressure sensors may be used to trigger lights to come on or dim in response to movements, either by vehicles (for example at car parks or industrial loading bays) or by pedestrians (for example a footpath leading from residential development through an area of Supporting Habitat). The timeclock or photocell could ensure that this response only occurs during a set window of hours after sunset and before sunrise, or during certain months.

4.38 Where some trigger is used to temporarily modify lighting states, it will be necessary to specify the timed trigger window during which the response is maintained beyond the last triggering activity. For most typical residential purposes, 1-2 minutes is likely to be sufficient, however risk assessments must

be performed in line with BS5489-1. The proposed system of lighting control will be determined by the outcome of the risk assessment. Where used in locations which receive distinct busy periods, such as cycle paths used by commuters, care will be needed to ensure lighting responds adequately to permit safe usage, but avoids both over-illumination and potentially disruptive dimming states of lighting groups.

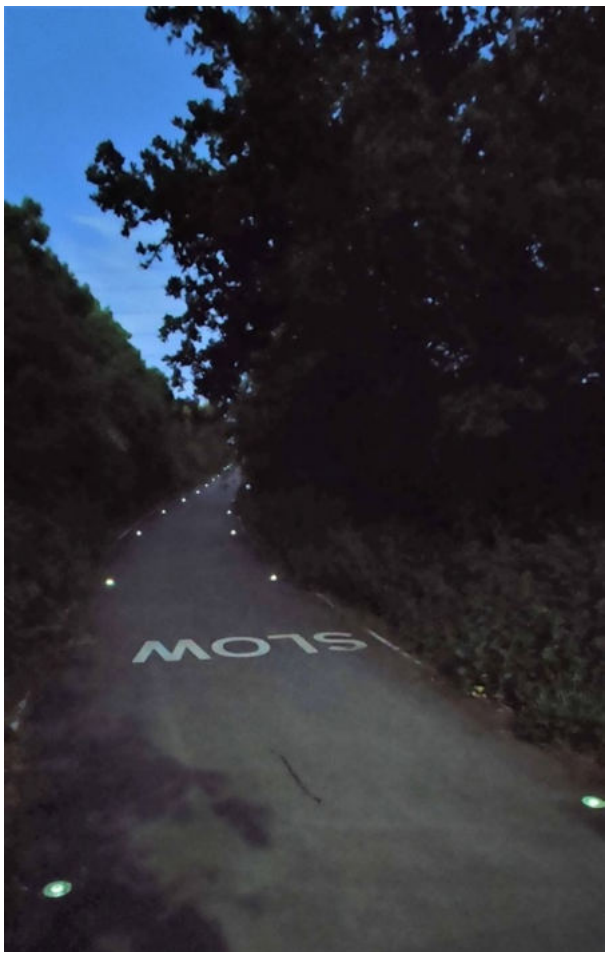


Photo 4: Waymarkers installed on a multi-user path in Worcester. Image credit: Cody Levine.

4.39 Alternative lighting designed for subtle waymarking, rather than illumination, may be more appropriate, such as very low-wattage, ground-level luminaires (photo 4). This lighting option can have a number of additional benefits such as a reduced risk of vandalism, lower carbon footprint during manufacture and fitting and no requirement for cabling. However, it should be noted that these systems depend on regular maintenance and a long-term commitment for them to be successful, as well as a clear view of the sky for solar-powered options. Due to this, proposals and potential planning conditions should be considered in liaison with maintenance teams, to ensure success (and any handover of assets) post install. See Case Study 1 for further information.

4.40 Part-Night Lighting should be designed with input from an ecologist as it may still produce unacceptably high light levels when active or dimmed. Part-Night Lighting is not usually appropriate where lights are undimmed during key bat activity times, as derived from bat survey data or within riparian habitats (see research chapter 1.27). Research has indicated that impacts upon commuting bats are still prevalent where lighting is dimmed during the middle of the night at a time when illumination for humans' use is less necessary (Azam et. al., 2015) thus this approach should not always be seen as a solution, unless backed up by robust ecological survey and assessment of nightly bat activity. In this case, designing areas to be lit to avoid retained Key Habitat, or the provision of sufficient alternative dark corridors, may be the only solution.

Glazing treatments on buildings

4.41 As mentioned, glazing should be restricted and reduced wherever the ecologist and lighting professional determine there to be a likely significant effect upon bats' Key Habitat and associated features.

4.42 Where Supporting Habitat is present, glazing treatments such as tinted, frosted or low transmission glazing treatments are not generally considered suitable ways of fully mitigating light spill. In the case of frosted or 'frit' glazing, windows typically remain luminous surfaces in their own right, defeating the objective of reducing lighting impacts. Although promisingly named, low-transmission glazing (glazing with a lower visible light transmittance) often makes only a very small difference to light spill in practice - a window's fundamental objective is to transmit light!

4.43 Automatic blinds should be discouraged as their longevity depends on regular maintenance and successful routine operation by the occupant. Such blinds are generally only suited to commercial situations where maintenance can be incorporated into the long-term regime routine for the building.

4.44 Depending on the height of the building and windows, and therefore predicted light spill, glazing treatments or window design restrictions may not be required on all storeys. This effect can be more accurately determined by a lighting professional.

Creation of alternative valuable bat habitat on site

4.45 The provision of new, additional or alternative bat flightpaths, commuting or foraging habitat is encouraged and could result in appropriate compensation for any such habitat being lost to the development. The ecologist will be able to suggest and design such alternative habitats, although particular consideration should be given as to its connectivity to other features, the species to be used, the lag time required for a habitat to sufficiently establish and the provision for its ongoing protection and maintenance.

4.46 As almost all new development will be required to result in at least 10% Biodiversity Net Gain (BNG), opportunities to improve habitat connectivity for bats should always be considered. Further to the 10 principles at the core of BNG, the implementation of sensitively sited habitat features for bats would be a clear contribution to 'additionality'. Particularly when considering achieving BNG off-site, assessment should be made of the impacts of altering the type and proportion of bat-suitable habitats, both within and beyond the site, upon the potential Core Sustenance Zone of any maternity roosts which use them.[2]

[2] https://cdn.bats.org.uk/uploads/pdf/Bat-Species-Core-Sustenance-Zones-and-Habitats-for-Biodiversity-Net-Gain.pdf

Step 5: Demonstrate compliance with illuminance (lux) limits and buffers within proposals and, where appropriate, the operational scheme

4.47 Once it has been determined through the above process how Key and Supporting Habitats will be protected, or impacts on them mitigated or compensated for, it will be necessary to demonstrate how this will be achieved. For a planning application, this information is increasingly required prior to determination in order for the LPA to make an informed decision and discharge statutory duties towards protected species legislation and policies. This is most likely to be the case for 'Full' planning applications. For 'Outline', phased or complex applications, this information is, at times, deemed a 'Reserved Matter', for which detail will normally follow at a later date before final consent is granted, or in the discharging of reserved matters. Incidences include EIAs and should be made prior to determination. It is appropriate for a pre-commencement planning condition to be imposed on a consented application which would require that an ecologically sensitive lighting plan is prepared, or is achievable.

4.48 In all cases where impacts from lighting on bats are possible, the LPA will require some form of documentation to be produced by the lighting engineer, either in collaboration with the ecologist, or working to the constraints set out within the bat habitat plan/ECOP (see Step 2), in order to demonstrate compliance. Usually, this will take the form of a 'Lighting Strategy', 'Lighting Design' or 'Lighting Impact Assessment', depending on the level of detail in the application. A Lighting Strategy may simply set out the agreed lighting parameters, objectives and likely mitigation requirements (e.g. unlit zones and any other bat mitigation), together with a plan. A Lighting Design/Impact Assessment would provide finalised details, consisting of a plan to show modelled illuminance from all proposed (and existing, where necessary) light sources, taking into account all site configuration, physical screening and glazing measures adopted. It would usually be accompanied by an explanatory document detailing the specification of each luminaire, as well as all assessment assumptions made and any other rationale for lighting mitigation, such as recessed light fittings or part-night lighting.

4.49 In the case of Outline or phased applications, the precise detail of architectural materials, glazing, landscaping etc. might not be known at the time of submission, therefore a Lighting Strategy may be the most appropriate document to provide. As described above, the bat mitigation objectives derived from the ecologist's bat habitat plan/ECOP should be referenced. It is worth being aware of the potential for matters such as highways (incorporating highways-specific lighting needs) to be fixed at Outline consent stage, which can make the resolution of bat mitigation requirements at a later stage challenging. This highlights the importance of inter-discipline collaboration and early communication of ecological constraints.

4.50 In the case of small or simple planning applications, where significant impacts upon bats from lighting are of a low likelihood, the production of a full Lighting Design package may be disproportionately costly and time-consuming. It may therefore be appropriate to provide a simplified document produced between

the ecologist and lighting engineer, setting out design decisions undertaken and the likely achievability of the recommendations within the ECOP according to the lighting engineer's professional judgment.

Lighting contour plans

4.51 A horizontal illuminance contour plan can be prepared by a suitably experienced and competent lighting professional (Member of the Institution of Lighting Professionals (ILP), Chartered Institution of Building Services Engineers (CIBSE), Society of Light and Lighting (SLL) or similar to ensure competency) using an appropriate software package to model 'Day 1', extent of light spill from the proposed, retained and, possibly, existing luminaires. The various buffer zone widths and illuminance limits which may have been agreed can then be overlaid to determine if any further mitigation is necessary. In some circumstances, a vertical illuminance contour plot may be necessary to demonstrate the light in sensitive areas, such as entrances to roosts or the Key Habitat associated with it (see Appendix).

4.52 Such calculations and documentation would enable the LPA ecologist to fully assess impacts and compliance.

4.53 Because illuminance contour plots and plans may need to be understood and examined by non-lighting professionals, such as architects and local planning authority ecologists, the following should be observed when producing or assessing illuminance contour plans, to ensure the correct information is displayed.

- A calculation showing output of luminaires to be expected at 'Day 1' of operation should be included, where the luminaire and/or scheme Maintenance Factor is set to 1. Schemes using Constant Light Output (CLO) luminaires should also be calculated using 'Day 1' output
- Where deemed necessary by a lighting professional, models should be issued so that all luminaires (i.e. internal and external, or between different phases/plots) can be assessed and each should be set to the maximum output anticipated to be used in normal operation on site (i.e. no dimming where dimming is not anticipated during normal operation)
- Where dimming, PIR, or variable illuminance states are to be used, an individual set of calculation results should accompany each of these states
- A horizontal calculation plane representing levels of illuminance at ground level should always be used
- Vertical calculation planes should be used wherever appropriate, for example along the site-facing aspects of a hedgerow or façade of buildings containing roosts, to show the illumination directly upon the vertical faces of the feature. Vertical planes can also show a cross-sectional view within open space (however, they will only face one direction.) Vertical planes will enable a visualisation of the effects of illumination at the various heights at which different bat species fly. An ecologist can

advise on the most appropriate dimensions to use according to the likely locations of bat flight around the site's habitats

- The contours (and/or coloured numbers) for 0.2, 0.5, 1, 5, and 10 lux must be clearly shown, as well as appropriate contours for values above these
- Each illuminance/lux contour plan should be accompanied by a table showing their minimum and maximum illuminance/lux values
- Where buildings are proposed in proximity to key features or habitats, plots should also model the contribution of light spill through nearby windows, making assumptions as to internal luminaire specification, internal lighting levels, and visible light transmittance of windows. It should be assumed that blinds or curtains are absent or fully open. Assumptions will need to be made as to the internal luminaire specification and levels of illuminance likely to occur on 'Day 1' of operation. These assumptions should be clearly stated and guided by the building/room type and discussions between architect, client and lighting professional. Consideration may also need to given to the site topography, and differences in ground levels between key features and lit areas or buildings. It is acknowledged that in many circumstances, only a 'best effort' can be made in terms of accuracy of these calculations as it is often not possible to account for all 'real world' conditions and variables which influence light. Note that evidence-based professional judgement is needed to assess whether light from windows should undergo a full assessment, dependent on factors such as the distance between light source and critical habitats
- Modelled plots should not include any light attenuation factor from new or existing planting, due to the lag time between planting and establishment and the risk of damage, removal or failure of vegetation. This may result in difficulties in the long-term achievement of the screening effect and hamper any post-construction compliance surveys
- The illuminance contour plots should be accompanied by an explanatory note from the lighting professional to list where, in their opinion, sources of glare acting upon the key habitats and features may occur, and what has been done/can be done to reduce their impacts

4.54 **N.B.** It is acknowledged that, especially for vertical calculation planes, very low levels of light (<0.5 lux) may occur even at considerable distances from the source if there is little intervening attenuation. It is therefore very difficult to demonstrate 'complete darkness' or a 'complete absence of illumination' on vertical planes where some form of lighting is proposed on site, despite efforts to reduce them as far as possible and where horizontal plane illuminance levels are zero. Consequently, where 'complete darkness' on a feature or buffer is required, it may be appropriate to consider this to be where illuminance is at or below 0.2 lux on the horizontal plane, and at or below 0.4 lux on the vertical plane. These figures are still lower than what may be expected on a moonlit night and are in line with research findings for the illuminance found at hedgerows used by lesser horseshoe bats, a species well known for its light averse behaviour. [xvi]

Baseline and post-completion light monitoring surveys

4.55 Baseline, pre-development lighting surveys may be useful where existing on or off-site lighting is suspected to be acting on Key and Supporting Habitats and features, and so may prevent the agreed or modelled illuminance limits being achieved. This data can then be used to help isolate which luminaires might need to be removed, or where screening should be implemented, or establish a new illuminance limit reduced below existing levels. For example, where baseline surveys establish that on or off-site lighting illuminates potential Key Habitat, improvements could be made by installing a tall perimeter fence adjacent to the habitat, and alterations to the siting and specification of new lighting, to avoid further illumination.

4.56 Baseline lighting surveys must be carried out by a suitably qualified competent person with the correct equipment. As a minimum, readings should be taken at ground level on the horizontal plane (to give illuminance hitting the ground), and in at least one direction on the vertical plane at between either 1.5m or 2m above ground (to replicate the likely location of bats using the feature or site). The orientation should be perpendicular to the dominant light sources, or perpendicular to the surface/edge of the feature in question (such as a wall or hedgerow), in order to produce a 'worst case' reading. Further measurements at other orientations may prove beneficial in capturing influence of all luminaires in proximity to the feature, or principal directions of flight used by bats. This should be discussed with the ecologist.

4.57 Baseline measurements should be taken systematically across the site or features in question, with time, date and time of sunset also recorded. They will need to be repeated at intervals to sample across the site or feature, either in a grid or linear transect, as appropriate. The lighting professional will be able to recommend the most appropriate grid spacing.

4.58 Measurements should always be taken in the absence of moonlight, either on nights of a new moon or heavy cloud, to avoid artificially raising the baseline. As an alternative, moonlight can be measured at a place where no artificial light is likely to affect the reading.

4.59 As all illuminance level contours will be produced from modelled luminaires at 100% output, baseline measurements should, wherever practicable, be taken with all lights on and undimmed, and with blinds or screens over windows removed. Cowls and other fittings on luminaires can remain in place.

4.60 Where possible, measurements should be taken during the spring and summer, when vegetation is mostly in leaf, in order to accurately represent the baseline during the principal active season for bats, and to avoid artificially raising the baseline.

4.61 The topography of the immediate surrounding landscape should be considered in order to determine the potential for increased or decreased light spill beyond the site.

Post-construction/operational phase compliance-checking

4.62 Post-completion lighting surveys are often required where planning permission has been obtained on the condition that the proposed lighting levels are checked to confirm they are in fact achieved on site, and test that the lighting specification (including luminaire heights, design and presence of shielding etc.) is as proposed.

4.63 All lighting surveys should be conducted by a suitably qualified competent person. They should be conducted using the same measurement criteria and lighting states used in the preparation of the illuminance contour plots and/or baseline surveys, as discussed above. It may be necessary to conduct multiple repeats over different illumination states, or other conditions specific to the project.

4.64 Depending on the potential for residual impacts on bats, and the scale of the proposed scheme, it is often appropriate to factor in bat monitoring surveys. These should have the aim of confirming an absence of significant changes in bat presence, species assemblage or behaviour between lit and unlit areas, compared to baseline results. Results should always be reported to the LPA as per any such planning condition. A 'Statement of Conformity' or similar report should be prepared in order to provide an assessment of compliance by the lighting professional, and a discussion of any remedial measures which are likely to be required in order to achieve compliance. Any limitations or notable conditions such as deviation from the desired lighting state, or use of blinds/barriers should be clearly reported. Ongoing monitoring schedules can also be set, especially where compliance is contingent on automated lighting and dimming systems, or on physical screening solutions.

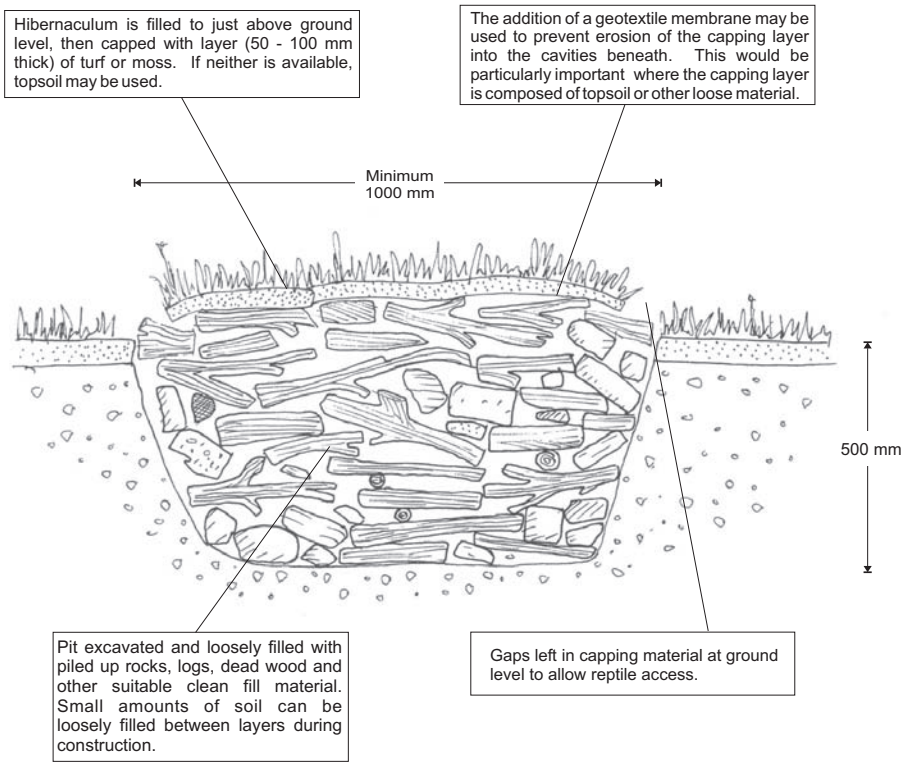
Conclusion

4.65 **In summary,** the importance of integrating avoidance measures (as per the first step of the mitigation hierarchy) into developmental design, cannot be overemphasised. Retaining ecologically functional 'dark corridors' and Key Habitats for bats within schemes (in preference to seeking lighting mitigation strategies), avoids costly and time-consuming additional surveys, mitigation and post-development monitoring. Furthermore, LPAs are likely to favour applications where steps have been taken to avoid such conflicts. This master-planning work needs to be informed by robust ecological survey data and lighting assessments, carried out by the relevant experts at the earliest opportunity in the project. Ultimately, light levels should always be designed to minimise potential environmental impact, and maximise the potential of habitat and species enhancement work, through multidisciplinary working and evidence-based new, or retrofit, scheme design.

APPENDIX VI EXAMPLE OF REPTILE HIBERNACULA

Hibernaculum on free-draining ground

Where ground conditions allow, the hibernaculum should be incorporated into a shallow pit. This design is more likely to remain frost-free, and will be less obtrusive and thus unlikely to be subject to interference.



Hibernaculum on impermeable ground

Where ground conditions are impermeable, then an 'above-ground' or mounded design should be utilised in order to prevent the hibernaculum from flooding. This design should also be used if it is not possible to excavate a pit for any other reason.