

ANDREW SCOTT LTD

YSGOL GYFUN YSTALYFERA, NEATH PORT TALBOT

**ECOLOGICAL APPRAISAL REPORT AND SUMMARY OF ECOLOGY CREDITS
AVAILABLE UNDER BREEAM LAND USE AND ECOLOGY**

02 April 2020



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Document Ref: E2094401/ Doc 01 – 02 April 2020

Issue	Revision	Stage	Date	Prepared by	Approved by	Signed
1	-	Draft	02 April 2020	Ben Fowle (Senior Ecologist)	Dr. M Watts (Director)	
2	Minor edits Following NRW's PAC response	Final	11 May 2020	Ben Fowle (Senior Ecologist)	Dr. M Watts (Director)	

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SUMMARY

Soltys Brewster Ecology were commissioned to undertake an ecological appraisal of part of Ysgol Gyfun, Ystalyfera (YGY) as part of the third phase of its redevelopment, involving both demolition and construction works. . Being part-funded by Welsh Government, the scheme is required to achieve a score of 'excellent' under BREEAM assessment. As such, ecological baseline conditions at Phase 3 of the site were established in March 2020 through a combination of desk study and Extended Phase 1 Habitat Survey to establish the likely credit award available under the Land Use and Ecology categories of the BREEAM New Construction (2018) scheme (LE01 – LE05) and to indicate, where possible, opportunities for maximising credit award.

Desk based consultation confirmed that the site itself does not hold any form of statutory or non-statutory nature conservation designation. Local records received from the South East Wales Biodiversity records Centre (SEWBReC) indicate the presence of a number of protected or notable mammal species associated with the surrounding area although these primarily relate to use of other school building by bats and of Otters associated with nearby watercourses.

The Ecological Appraisal undertaken in March 2020 identified that the site was dominated by buildings ,hard standing and small areas of soft landscaping which included amenity grass planted shrubs and trees. With exception to the two Lime trees on site, the other habitats were considered of limited ecological interest and represent the most suitable areas of the site to support development.

No new features with potential to support roosting bats were identified on the buildings to be removed. Demolition works should adhere to the methods set out in previous reports highlighted within this document.

Other consideration would include the avoidance of the bird nesting season (March-August) for any vegetation clearance and building demolition/extension works. The use of native species or species of known benefit to biodiversity within the soft landscaping scheme would also be recommended and the provision of bird or bat boxes as part of the scheme (i.e. incorporated as part of the building or on retained trees) would provide localised enhancement for these groups.

A proposed site layout available at the time of reporting was used to assess potential credit awards under BREEAM LE01 - LE05. It is considered that at least 10 credits could be readily achieved, assuming the construction works are managed according to the hierarchy, the enhancement measures identified under LE04 were incorporated and that all 3 mandatory requirements and at least 4 additional requirements are complied with under LE05. In the absence of these measures, likely credit award would reduce to 2 credits.

1.0 INTRODUCTION

- 1.1 Soltys Brewster Ecology were commissioned by Andrew Scott Ltd to undertake an ecological appraisal to inform an assessment of the likely credit award under BREEAM (2018) Land Use & Ecology (LE01 – LE05) for the proposed third phase construction works at Ysgol Gyfun Ystalyfera (YGY). Three of the existing school buildings (Tawe, Swimming Pool and Maths) are approved for demolition (Application reference no: P2019/0419) with supporting survey work (bats) and mitigation already in place (Rob Colley Associates, 2019).
- 1.2 Demolition and construction works footprint of Phase 3 at YGY occupies an area of approximately 0.6 hectares and is centred at grid reference SN 77081 08842 (see location plan in Appendix I). The site is located east of Ystalyfera town and 350m North West of the river Tawe. To the North, West and South, the site is bordered by residential developments. Immediately adjacent to the East is a river with agricultural land, river and woodland further afield to the East and South East.
- 1.3 The current report presents the findings of an ecological desk study, Extended Phase 1 Habitat survey and Ground-based tree inspection undertaken at the site in March 2020. The report describes the existing ecological conditions as well as identifying any potential ecological constraints/ opportunities associated with the proposed development at the site.
- 1.4 In addition to the above this report also provides an indication of the potential credit award of proposed scheme under the BREEAM New Construction (2018) Land Use and Ecology category (LE01 – LE05), and suggests measures to maximise credit award where possible.

2.0 METHODOLOGY

- 2.1 In order to establish the baseline ecological conditions on site and in the adjoining habitats, a combination of desk-based consultation and Extended Phase 1 Habitat survey were undertaken in March 2020.

Desk study

- 2.2 The desk study primarily involved consultation with the South East Wales Biodiversity Records Centre (SEWBRc) in March 2020 to identify any records of rare, protected or notable flora and fauna within the site boundary and surrounding 1km area. In addition above a search for relevant information relating to the location and citation details (where available) for any sites designated for their nature conservation interest such as Sites of Special Scientific Interest (SSSIs) was undertaken online via the Defra's MAGIC Map. A review of previous site survey work completed to inform Phases 1 – 3 of the redevelopment was also undertaken where appropriate.

Extended Phase 1 Habitat Survey

- 2.3 The fieldwork was undertaken on 19 March 2020 by a suitably experienced ecologist¹ and followed standard Phase 1 Habitat Survey protocol (JNCC, 1990) as amended by the Institute of Environmental Assessment (1995). All habitats within and immediately adjacent to the site were classified and mapped as accurately as possible. Habitats considered having potential to support rare, protected or otherwise notable species of flora and fauna were noted, as were any direct signs of these species (e.g. Eurasian Badger *Meles meles* setts and dung-pits). Incidental observations of birds on or flying over the site were also recorded.
- 2.4 A map of habitats was drawn up and target notes were used to identify features of ecological interest. Where possible, habitats were cross-referenced to any relevant Wales priority habitats as described under the Environment Act (Wales), 2016.
- 2.5 The potential of the buildings within Phase 3 to support roosting bats has previously been undertaken (Rob Colley Associates, 2018) and mitigation and licensing measures have been set out (Rob Colley Associates, 2019). The current survey did not include a detailed inspection of these buildings although any trees present were assessed from the ground using binoculars for their potential to support roosting bats and, along with the buildings were categorised in relation to the bat roosting features (BCT, 2016). The categories are as follows:

- **Known or confirmed roost**

¹ Associate applicant of the Chartered Institute of Ecology and Environmental Management. with 4+yrs Phase I survey experience
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- **High** - A structure or tree with one or more potential roost sites that are obviously suitable for use by larger numbers of bats on a more regular basis and potentially for longer periods of time due to their size, shelter, protection, conditions and surrounding habitat.
- **Moderate** – A structure or tree with one or more potential roost sites that could be used by bats due to their size, shelter, protection, conditions and surrounding habitat but unlikely to support a roost of high conservation status.
- **Low** – A structure with one or more potential roost sites that could be used by individual bats opportunistically. Or, a tree of sufficient size & age to contain PRFs (Potential Roost Features) but with none seen from the ground or features seen with only very limited roosting potential.
- **Negligible** – Negligible habitat features on site likely to be used by roosting bats.

3.0 RESULTS

Desk Study

- 3.1 A review of the SEWBReC data search and Defra's MAGIC MAP confirmed that the site itself and surrounding 1km area does not contain any statutory nature conservation designations. Although several statutory sites exist slightly further afield in Powys.
- 3.2 Nant Y Rhos SSSI – a 2.5 ha species-rich fen meadow lies over 2km to the SE. A Local Nature Reserve, Nant Y Rhos is home to three wildflower meadows and broadleaved woodland. Based on the habitats present on the school site (dominated by amenity grassland, hardstanding/buildings and introduced shrub beds with planted trees) these Sites are not considered of particular ecological relevance to the current proposals. However, more mobile species such as birds and bats may use nearby off-site habitats for foraging opportunities.
- 3.3 SEWBReC data confirmed records of a number of species in the surrounding 1km area including Hedge Bedstraw *Galium mollugo*, Rough Hawkbit *Leontodon hispidus*, Wood Sedge *Carex sylvatica*, Thyme-Leaved Sandwort agg. *Arenaria serpyllifolia*, Devil's-bit Scabious *Succisa pratensis*, Otter *Lutra lutra*, Common Pippistrelle *Pipistrellus pipistrellus*, Soprano Pippistrelle *Pipistrellus pygmaeus*, Dipper *Cinclus cinclus*, Starling *Sturnus vulgaris*, Hobby *Hypotriorchis*, Tawny Owl *Strix aluco*, Swallow *Hirundinidae* Hedgehog *Erinaceus europaeus*, Badger *Meles meles*, Grass Snake *Natrix natrix*, and Stag Beetle.
- 3.4 Many of these records were associated with habitats in areas other than the site and were not considered of particular relevance to the school site based on the known habitat preferences of the species listed above. There are 19 records of Otter associated with the nearby river and a known Common Pippistrelle roost is located in one of the new school buildings (Primary block). Mobile species such as birds and bats in the surrounding area are considered of some relevance to the site. Although there is better quality off-site roosting and foraging opportunities a couple of trees on site may provide some foraging opportunities, albeit limited, and the presence of birds and bats typical of the area cannot be precluded.

Extended Phase 1 Habitat Survey

- 3.5 The distribution and extent of habitats within and adjacent to the site is illustrated with accompanying target notes in Appendix II. The site is dominated by buildings/hardstanding a few small areas of partially disturbed amenity grassland and some shrub beds which do not appear to be in good condition.

Amenity grassland

- 3.6 The existing school has a few small areas of amenity grassland (Target Note 1). The sward is kept short, has evidence of regular footfall. Amenity grass areas include partially bare & disturbed ground, with limited species diversity including Cock's Foot *Dactylis glomerata*, Perennial Rye-grass *Lolium perenne*, Annual Meadow Grass *Poa annua*, White Clover *Trifolium repens*, Daisy *Bellis perennis*, Dandelion *Taraxacum officinale*, Ribwort Plantain *Plantago lanceolata*, Creeping Buttercup *Ranunculus repens* and one small clump of Wood Avens *Geum urbanum*. The small areas of degraded amenity grassland were not considered of ecological importance to the site.

Planted Trees and Shrubs

- 3.7 A number of raised beds were identified within the school grounds on asphalt areas and along buildings or site borders. They did not show evidence of regular maintenance and were relatively species poor. A number of ornamental shrubs were accompanied by Wilson's Honeysuckle *Lonicera* sp., Holly *Ilex aquifolium*, Ivy *Hedera helix*, Bramble *Rubus fruticosus* agg., Ash *Fraxinus excelsior*, Daffodil *Narcissus* sp, Dandelion *Taraxacum officinale*, Common Chickweed *Stelaria media* and Sedge *Carex* sp.
- 3.8 There are 4no. tree pits within the proposed phase three construction site; two trees have been removed but two Lime trees remain standing in the northern part of the site. These are the only semi mature or mature trees present. A Monkey Puzzle tree is situated just north of the NW corner of site and is likely to be of Arboricultural relevance to site with regard to its RPA (Steve Ambler Trees, 2020).

Buildings and hardstanding

- 3.9 Due to the current use of the site as a school a number of associated buildings were present on site including the TAWE building, Swimming Pool & Gym, Maths and a Green House, all of which are due to be demolished and constructed from a combination of brick, prefabricated cement panels and glazing panels, with both pitched and flat roofs on single and multi-storey structures.

- 3.10 Areas of hardstanding consisted mainly of Tarmac/Ashphalt play areas and car parking and associated travel route for motorised vehicles.

Fauna

- 3.11 In the course of the survey, a search of field signs for protected or notable species was undertaken and the potential of the habitats to support these species considered. In the context of this report, these species meet any of the following criteria:

- Species protected by British or international law;
- Priority Species listed under Section 7 of the Environment (Wales) Act;
- Nationally rare or nationally scarce species;
- Species of Conservation Concern (e.g. JNCC Red List, RSPB/BTO Red or Amber Lists);

Bats

- 3.12 The site supported a small variety of buildings associated with its use as a school including the four school buildings mentioned in section 3.10.
- 3.13 Previous surveys for Bats were undertaken in June-July 2018 (Rob Colley Associates, 2018) and identified a small Pipistrelle sp. roost in the contiguous pool & gym building's tower. Its demolition is required to follow the submitted mitigation strategy (Rob Colley Associates, 2019) in accordance with the decision notice (Ref: P2019/0419). Part of the mitigation strategy included the installation of a bat box to the NE corner of the 'Double Decker' Building² prior to demolition. However, the subsequent EPS licence application specified for the bat box to be installed on the adjacent Primary School building instead. While this was not location described in the 2019 mitigation strategy under the Planning Reference (P2019/0419), NRW have not objected to this change from a 'Favourable Conservation Status (FCS) perspective in their Pre Application Consultation (PAC) response (Ref: PB/LG: S20.118a). As a result of this - and under the advice of NRW - section 3.13 of this report has been updated to reflect the change to the specified mitigation and its location. .
- 3.14 The other buildings within the site supported flat roofs (Target Notes 8 & 10) and none supported potential roost features which could be utilised by bats and were assessed as being of Negligible bat potential.
- 3.15 The two remaining Lime trees and Monkey Puzzle within the site boundary lack features suitable for use by roosting bats and were assessed as being of negligible potential to support roosting bats.

² Building location is shown on Page 2 of the Mitigation Strategy of 2019

Reptiles

- 3.16 With the only available amenity grassland being tightly mown and disturbed by human footfall with no direct links to habitats outside of the site, their presence on site is very unlikely. No suitable habitat is present and Reptiles are not considered to be of ecological relevance in within the context of the site.

Amphibians

- 3.17 There are no records and no suitable habitat on site for amphibians and as such are not considered of relevance to the report or works proposed within the context of the site.

Birds

- 3.18 During the walkover survey conducted on the 19th March, a number of bird species were noted on or flying over the site including Chaffinch *Fringilla coelebs*, Wood Pigeon *Columba palumbus*, Magpie *Pica pica*, Great Tit *Parus major*, Blue Tit *Cyanistes caeruleus*, , Pied Wagtail *Motacilla alba*, Robin *Erithacus rubecula*, Blackbird *Turdus merula*, Wren *Troglodytes troglodytes*, Common Gul *Larus canus* and House Sparrow *Passer domesticus*. Although the bird species present at the time of surveys are considered typical in terms of the displayed assemblage it would not be considered representative of the full range of species that the site could potentially support (in winter, during the breeding season etc.).

Badger

- 3.19 Three records of Badger were identified within the 1km search buffer of the site although no evidence of use of the site by Badger was found during the current survey and no suitable habitat for foraging or otherwise existed on site. Badgers are not considered to be of ecological relevance to the proposals within the context of the site.

4.0 POLICIES, PLANS AND LEGISLATION

- 4.1 The following international, national and local legislation and planning policies and plans pertaining to nature conservation and biodiversity are considered of some relevance to the site surveyed and to the proposed works.

Planning Policy Wales (2018)

- 4.2 This document set out the land use planning policies of the Welsh Government with Chapter 6 dealing with Distinctive and natural Places which covers Biodiversity and Ecological Networks. The advice contained within PPW is supplemented for some subjects by Technical Advice Notes (TAN's), with TAN 5 addressing Nature Conservation & Planning.
- 4.3 TAN 5 identifies a number of key principles, which the town and country planning system in Wales should consider. Those relevant are detailed below:
- Work to achieve nature conservation objectives through a partnership between local planning authorities, Natural Resources Wales (NRW), voluntary organisations, developers, landowners and other key stakeholders;
 - Integrate nature conservation into all planning decisions looking for development to deliver social, economic and environmental objectives together over time;
 - Ensure that the UK's international obligations for site, species and habitat protection are fully met in all planning decisions;
 - Look for development to provide a net benefit for biodiversity conservation with no significant loss of habitats or populations of species, locally or nationally;
 - Promoting approaches to development which create new opportunities to enhance biodiversity, prevent biodiversity losses, or compensate for losses where damage is unavoidable. Minimising or reversing the fragmentation of habitats and improving habitat connectivity through the promotion of wildlife corridors;
 - Local planning authorities should seek to protect trees, groups of trees and areas of woodland where they have natural heritage value or contribute to the character or amenity of a particular locality;
 - The presence of a species protected under European or UK legislation is a material consideration when a local planning authority is considering a development proposal which, if carried out, would be likely to result in disturbance or harm to the species or its habitat.

Environment (Wales) Act, 2016

- 4.4 Part 1 of the Environment Act Wales' came into force in May 2016 and sets out the approach to planning and managing natural resources at a national and local level with a general purpose linked to statutory 'principles of sustainable management of natural resources' defined within the Act.

Section 6 - Biodiversity and resilience of ecosystems duty

- 4.5 Section 6 of the Act places a duty on public authorities to 'seek to maintain and enhance biodiversity' so far as it is consistent with the proper exercise of those functions. In so doing, public authorities must also seek to 'promote the resilience of ecosystems'.

Section 7 - Biodiversity lists and duty to take steps to maintain and enhance biodiversity

- 4.6 This section lists living organisms and types of habitat in Wales which are considered of key significance to maintaining and enhancing biodiversity in relation to Wales. The Welsh Ministers are required to take all reasonable steps to maintain and enhance the living organisms and types of habitat included in any list published under this section, and encourage others to take such steps.

Wildlife and Countryside Act (As Amended) 1981

Under Part 1 of the Wildlife and Countryside Act 1981 all birds, their nests and eggs are protected by law and it is an offence, with certain exceptions, to:

- a) intentionally kill, injure or take any wild bird;
- b) intentionally take, damage or destroy the nest of any wild bird while it is in use or being built; and
- c) intentionally take or destroy the egg of any wild bird.

Other sections of the Act are also of relevance to the site and existing ecological features including Schedules 5 and Schedule 9 relating to the protection of animals (such as reptiles and bats) and non-native invasive weeds (such as Himalayan Balsa *Impatiens glandulifera*) respectively.

Local Planning Policy

The LDP for Neath Port Talbot was adopted in 2016 superseding the Unitary Development Plan, and provides the basis for decisions on land use planning in the County Borough up to 2026. Policies of relevance to the development include:

Policy SP 15

Biodiversity and Geodiversity. Important habitats, species and sites of geological interest will be protected, conserved, enhanced and managed through the following measures:

1. *The identification of the following Internationally and Nationally designated sites within the County Borough to enable their protection:*
 - (a) *Special Areas of Conservation (SACs) and Ramsar Sites;*
 - (b) *Sites of Special Scientific Interest (SSSIs);*
 - (c) *National Nature Reserves (NNRs).*
2. *The identification and protection of sites of regional and local importance;*
3. *The protection of important natural heritage features.*

Policy EN 6

Important Biodiversity and Geodiversity Sites Development proposals that would affect Regionally Important Geodiversity Sites (RIGS), Local Nature Reserves (LNRs), Sites of Interest for Nature Conservation (SINC)s, sites meeting SINC criteria or sites supporting Local Biodiversity Action Plan (LBAP) or S42 habitats or species will only be permitted where:

1. *They conserve and where possible enhance the natural heritage importance of the site; or*
2. *The development could not reasonably be located elsewhere, and the benefits of the development outweigh the natural heritage importance of the site. Mitigation and/or compensation measures will need to be agreed where adverse effects are unavoidable.*

Policy EN 7

Important Natural Features Development proposals that would adversely affect ecologically or visually important natural features such as trees, woodlands, hedgerows / field boundaries, watercourses or ponds will only be permitted where:

1. *Full account has been taken of the relevant features in the design of the development, with measures put in place to ensure that they are retained and protected wherever possible; or*
2. *The biodiversity value and role of the relevant feature has been taken into account and where removal is unavoidable, mitigation measures are agreed.*

5.0 AVAILABILITY OF BREEAM LAND USE AND ECOLOGY CREDITS

- 5.1 The following section provides an indication of the available credits and possible award under BREEAM 2018 Land Use and Ecology (LE01 – LE05). The indication of credit award set out in the following sections is based on the findings of the baseline ecological surveys only. It is important to note that confirmation of credit award is only possible through an appointed BREEAM assessor for this project and the indication of likely credit award set out in the following sections should only be used to inform a pre-assessment estimate.

LE 01 - Site Selection

- 5.2 One credit is available where at least 75% of the proposed development's footprint is on an area of land which has previously been occupied by a permanent structure, including any associated fixed surface infrastructure.
- 5.3 A second credit is available where:
- 1) A contaminated land professional's site investigation, risk assessment and appraisal have identified:
 - a) The degree of contamination
 - b) The contaminant sources or types
 - c) The options for remediating sources of contamination which present an unacceptable risk.
 - 2) The client or principal contractor confirms that remediation of the site will be carried out in accordance with the remediation strategy and its implementation plan as recommended by the contaminated land professional.
- 5.4 The site is currently dominated by areas of hard standing, buildings with small areas of amenity grassland introduced shrubs forming the only soft landscaping on site. Under the current proposed layout, over 75% of the development proposals are located within land defined as previously developed (i.e. bare ground, buildings, amenity grassland/ landscaped areas³) on that basis, the first credit is available under LE01. No evidence currently exists to suggest the land is contaminated, however if any evidence arises to the contrary the second credit would also be available under LE01.

³ Amenity grass/landscaped areas can only be considered as 'previously developed' under LE01 if an equivalent sized area is provided post development.

LE 02 – Identifying and understanding the risks and opportunities for the project

- 5.5 Under the Ecologist route (Route 2), one credit is available for tasks undertaken relating to survey and evaluation. Considerations required to achieve this credit are covered in the standard methodologies set out below. A second credit is available for determining the ecological outcomes for the site where relevant criteria to the chosen route of survey and evaluation has been achieved. Should the above criteria be achieved, a final exemplary credit is available where the wider site sustainability-related activities and the potential for ecosystem service related benefits are considered.
- 5.6 Under standard methodologies which comprise a preliminary ecological appraisal, it is reasonable to consider sections 1, 2, 3 & 6 of this document as meeting criteria for survey and evaluation via assessment route 2 (for sites where complex ecological systems are likely to be present. Criteria include:

Survey

1. Determining the zone of influence for the site including neighbouring land and habitats
2. Current flora, fauna (including permanent and transient species) and habitat characteristics (including but not limited to ecological features in or on built structures)
3. Habitat extent, quality, connectivity and fragmentation
4. Recent and historic site condition
5. Existing management and maintenance levels and arrangements
6. Existing ecological initiatives within the zone of influence
7. Identification of, and consultation with, relevant stakeholders impacted or affected by the site.
8. Local knowledge or sources of information.

Evaluation

1. Current value and condition of the site and, where relevant, the zone of influence in terms of:
 - a. Features including habitats, species, food sources and connectivity
 - b. Broader biodiversity and ecosystem services benefits or opportunities
2. Direct and indirect risks to current ecological value:
 - a. Sensitive areas and features on or near the site
 - b. Direct risks including those from, human activity (e.g. construction work), habitat fragmentation, and potentially harmful species
 - c. Indirect risks including water, noise and light pollution
3. Capacity and feasibility to enhance the ecological value
4. Habitat restoration and creation potential
5. Impact of the proposed design, construction works and operations on site.

- 5.7 Whilst determining ecological outcomes for the site, it is clear from design that the identified solutions have followed the hierarchy of action: avoidance, protection, reduction or limitation of negative impacts, onsite compensation and, enhancement, considering the capacity and feasibility within the site, or where viable, off site. Choice of location for works only affects predominantly hard standing as well as landscaped features and an area of amenity grass. These areas are of limited ecological value and therefore the loss of more valuable vegetation such as retained trees has been avoided.
- 5.8 A Suitably Qualified Ecologist (SQE) has been involved with the project ahead of the PAC submission and communications regarding design, ecological impacts and available credits under a BREEAM assessment formed part of the production of this report. Previous site surveys (Rob Colley Associates, 2018/2109) have also been completed to identify appropriate mitigation measures for roosting bats. The current document will be reviewed by the client and if - through project team liaison and collaboration with relevant stakeholders – this document serves to inform any design changes (e.g. recommendations to increase provision of green space) it should ensure ecological outcomes have been determined by appropriate solutions and measures and the further two credits would become available. Currently only one credit can be awarded under LE02.

LE 03 – Managing Negative Impacts on Ecology

- 5.9 Under the ecologist route (route 2) one credit is available for planning, liaison and implementation and data and up to two further credits are available for managing the negative impacts of the project (limitation or compensation).
- 5.10 The roles of the relevant stakeholders, such as design team and ecologist have been clearly defined at project stages which can influence design brief. There is little site preparation required from an ecological perspective for a project of this size and nature. Any relevant pre construction requirements relating to timing and methodologies are highlighted in section 6 of this document. The project has not yet reached site preparation and construction stages, however, should the identified measures and solutions in this document be implemented which are based on the information and data gathered during survey then the first credit available under LE03 would be achieved.
- 5.11 If the hierarchy of avoidance is implemented during and throughout construction stages, a credit could be achieved under managing negative impacts of the project. If the project demonstrated that there is no overall loss of ecological value - which has not been achieved based on the calculations made in LE04 - then an additional credit could be achieved under managing negative impacts of the project. On this basis, currently no credits can be awarded under LE03, but 3 credits are readily available based on the above.

Credit LE 04 – Change and Enhancement of Ecological Value

5.12 One credit is available for implementing measures recommended by a suitable qualified ecologist for the change and enhancement of ecological value through collaboration and consideration of data with a view for onsite enhancements before off site, within the zone of influence, where the former is not feasible. Although a proposed site plan was already available at the point of SBE involvement, it is assumed that ecological considerations were made and implemented into design. Solutions and measures to enhance ecological value on site can follow recommendations made in this document and as such, it is considered that the first credit under LE04 is readily achievable.

5.13 The site could be enhanced through:

- Provision for roosting bats – It is noted that is already implemented ahead of demolition works as per (Rob Colley Associates, 2019) bat mitigation measures. A range of products for buildings are now available that do not compromise the integrity of new buildings and require little, if any maintenance (e.g. Ibstock bat bricks <http://www.ibstock.com/sustainability-ecozone.asp> or Schwegler building boxes available from suppliers such as NHBS www.nhbs.com/browse/subject/422/schwegler-bat-boxes). Bat boxes suitable for trees would include the Schwegler 1FF or 2F Bat Boxes.
- Provision for nesting birds within the proposed development e.g. Sparrow Terraces, Swallow boxes, House Martin boxes and Swift boxes (boxes available from suppliers such as NHBS www.nhbs.com/browse/subject/426/bird-boxes)
- The use of native species or those of known benefit to wildlife within the soft landscaping scheme (for examples see <https://www.rhs.org.uk/science/pdf/conservation-and-biodiversity/wildlife/rhs-perfect-for-pollinators-garden-plants>).
- The adoption of good horticultural practice (i.e. no peat based compost to be used during landscaping, little or no use of residual pesticides or herbicides etc.).

5.14 A further three credits are available in this category based on the calculation of the change in ecological value occurring as a result of the project. Credits are awarded on a scale of 1 to 3 based on the calculation of the change in ecological value occurring as a result of the project. Calculations were undertaken in accordance with the process set out in GN36 – BREEAM, CEEQUAL, HQM Ecology Assessment Issues – Route 2.

- 5.15 Values of ecological features must be calculated both for Pre and Post Development conditions in order to correctly assess the change in ecological value across the site. This figure is calculated as a percentage for three different outputs:
- Linear foliage related habitats (such as hedgerows, lines of trees etc.)
 - Linear watercourses habitats (streams, rivers etc.)
 - Area based habitats (terrestrial non-linear features such as woodland, scrub, grassland etc.)
- 5.16 The lowest score for the above mentioned outputs is used to identify the reward level available for the development as follows:
- 75% and 94% - Minimising loss, **0 credits**
 - 95% and 104% - No net loss for the habitats assessed, **1 credit**
 - 105% and 109% - Net gain for the habitats assessed, **2 credits**
 - 110% and above – Significant net gain, **3 credits**
- 5.17 In order to undertake the calculations, the ‘Condition’ and ‘Distinctiveness’ of the assessed ecological features were assigned. Further details of how the scores were calculated can be found in Appendix III.
- 5.18 Before the calculations could be undertaken the risk factors were assessed. Assessments were made for spatial risk, delivery risk and temporal risk (See Table 5 Appendix III). The post-development calculations are then shown in Tables 6-10.
- 5.19 Based on the combination of an Extended Phase 1 Habitat Survey and Proposed Site Plan, calculations made for this site have revealed that current design will achieve a percentage change in area biodiversity units of 91% (See Table 3a in Appendix III) and as such no additional credits can currently be awarded for the second part of LE04. However, If a soft landscape specification can deliver a diverse species mix, age range and structure (as per the assessment criteria highlighted in Table 1 Appendix III) then the percentage change of biodiversity units would be calculated at 166% (See Table 3b in Appendix III), a significant net gain will be achieved. It is considered up to 3 additional credits are readily achievable under LE04 N.b this measure will simultaneously achieve further credits under LE03 see section 5.11.

LE 05 Long term ecology management and maintenance

- 5.20 One credit may be awarded within the section where all mandatory requirements and two additional measures are complied with. Two credits may be awarded when the requirements for the first credit are met and two further additional measures are complied with.
- 5.21 Mandatory requirements include:

- A suitably qualified ecologist (SQE) has been appointed prior to commencement of activities on site and they confirm that all relevant UK and EU legislation relating to protection and enhancement of ecology has been complied with during the design and construction process.
- A landscape and habitat management plan, appropriate to the site, is produced covering at least the first five years after project completion in accordance with BS 42020:2011 Section 11.1. This is to be handed over to the building occupants for use by the grounds maintenance staff.

5.22 The additional measures include: The principal contractor nominates a 'Biodiversity Champion' with the authority to influence site activities and ensure that detrimental impacts on site biodiversity are minimised in line with the recommendations of a suitably qualified ecologist.

- The principal contractor trains the site workforce on how to protect site ecology during the project. Specific training must be carried out for the entire site workforce to ensure they are aware of how to avoid damaging site ecology during operations on site. Training should be based on the findings and recommendations for protection of ecological features highlighted within a report prepared by a suitably qualified ecologist.
- The principal contractor records actions taken to protect biodiversity and monitor their effectiveness throughout key stages of the construction process. The requirement commits the principal contractor to make such records available where publicly requested.
- Where a new ecologically valuable habitat, appropriate to the local area, is created. This includes habitat that supports nationally, regionally or locally important biodiversity, and/or which is nationally, regionally or locally important itself; including any habitat listed in the UK Biodiversity Action Plan (UK BAP), Local Biodiversity Action Plan (LBAP), those protected within statutory sites (e.g. SSSIs), or those within non-statutory sites identified in local plans.
- Where flora and/or fauna habitats exist on site, the contractor programmes site works to minimise disturbance to wildlife. For example, site preparation, ground works, and landscaping have been, or will be, scheduled at an appropriate time of year to minimise disturbance to wildlife.
- A partnership has been set up by the design team with a local group that has wildlife expertise (e.g. local wildlife trust or similar local body) and the group has:
 - a) Provided advice early in the design process regarding protecting and/or providing habitat for species of local importance on the site.
 - b) Provided advice to ensure the design is in keeping with the local environment. In particular this should draw on their local knowledge of any features or species of eco-logical interest on or near the site.
 - c) Provided or will continue to provide on-going support and advice to the educational establishment to help them manage, maintain and develop the outdoor space in the longer term.

5.23 The first mandatory requirement has been partially met, relating to the appointment of a suitably qualified ecologist. The removal of vegetation outside the breeding bird season, and appropriate protection of any other protected species identified during the required surveys at the site would ensure all relevant UK and EU legislation relating to protection and enhancement of site ecology is met. The production of an appropriate landscape management plan would also be required to ensure all mandatory requirements are met. Subject to complying with all mandatory requirements and at least 4 additional measures, 2 credits could be awarded in this section.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 The combination of desk study and field surveys undertaken at the site identified a limited range of habitat types dominated by, hard standing and buildings, with small areas of amenity grassland, planted shrubs and two trees making up the soft landscaping. With exception to the two mature Lime trees – which may offer limited foraging opportunities to irregular visits by birds and bats –, the intrinsic ecological value of the habitats present on site is considered to be low. . On that basis, trees should be the only features considered to be retained as far as practicable as they contribute to the maintenance of the limited habitat connectivity within and adjacent to the site.

6.2 As mentioned in section 5.19, a soft landscape specification can deliver a diverse species mix, age range and structure (as per the assessment criteria highlighted in Table 1 Appendix III) then the percentage change of biodiversity units would be calculated at 166% (See Table 3b in Appendix III), a significant net gain and allowing an additional 3 credits to become available under LE04 as well as another under LE03.

Bats

6.3 A small pipistrelle bat roost exists in the tower of the Pool & Gym building (Rob Colley Associates, 2018). The approved mitigation strategy (Rob Colley Associates, 2019) must be adhered to as per the decision notice (ref: P2019/0419) for the demolition works.

6.4 All other buildings within the site affected by the proposed development were not found to be in use by roosting bats (Rob Colley Associates, 2018).

6.5 No trees within the site were identified as supporting features of potential value to roosting bats. To minimise impacts on bats and other species foraging/ commuting over the site it is also recommended that development seeks to minimise impacts on any retained habitats such as trees and hedgerows through sensitive design of site lighting (see Appendix III).

Birds

6.6 Given the chance of birds nesting on site, clearance of trees and scrub vegetation associated with any future development should be undertaken outside of the bird nesting season (i.e. clearance possible between September and February inclusive). Demolition of the school buildings outside the bird nesting season would also be recommended, although no nesting behaviours were observed during the survey it was early season (March) and birds using the roofs for nesting cannot be precluded. All wild birds are protected against killing and injury under the Wildlife and Countryside Act 1981 (as amended) and their nests against damage or destruction whilst in use or being built;

Other considerations

- 6.7 Further recommendations include the use of native species or species of known benefit to wildlife in any soft landscaping scheme associated with future development and the use of diverse seed mixes for lawn areas to enhance the habitat for local birds and invertebrates. The incorporation of bird boxes as part of any proposed development – i.e. as part of the new buildings or on retained trees - would also provide localised enhancement for these groups.

BREEAM

- 6.8 Credit award under BREEAM LE01 - LE05 was assessed using the proposed site layout included in Appendix I, which does not include any soft landscaping specifications. It is considered that 12 credits could be readily achieved, assuming construction works will be conducted according to the hierarchy, the enhancement measures identified under LE04 were incorporated and that all 3 mandatory requirements and at least 4 additional requirements are complied with under LE05. In the absence of these measures, likely credit award would reduce to 2 credits.

REFERENCES

Bat Conservation Trust (2016) *Bat Surveys for Professional Ecologists – Good Practice Guidelines*. Bat Conservation Trust, London.

Bat Conservation Trust (2018) *Bats and artificial lighting in the UK – Bats and the Built Environment series*. Bat Conservation Trust, London.

Eaton MA, Aebischer NJ, Brown AF, Hearn RD, Lock L, Musgrove AJ, Noble DG, Stroud DA and Gregory RD (2015) Birds of Conservation Concern 4: the population status of birds in the United Kingdom, Channel Islands and Isle of Man. *British Birds* 108, 708–746

Institute for Environmental Assessment (1995) *Guidelines for Baseline Ecological Assessment*. E & FN Spon, Hong Kong.

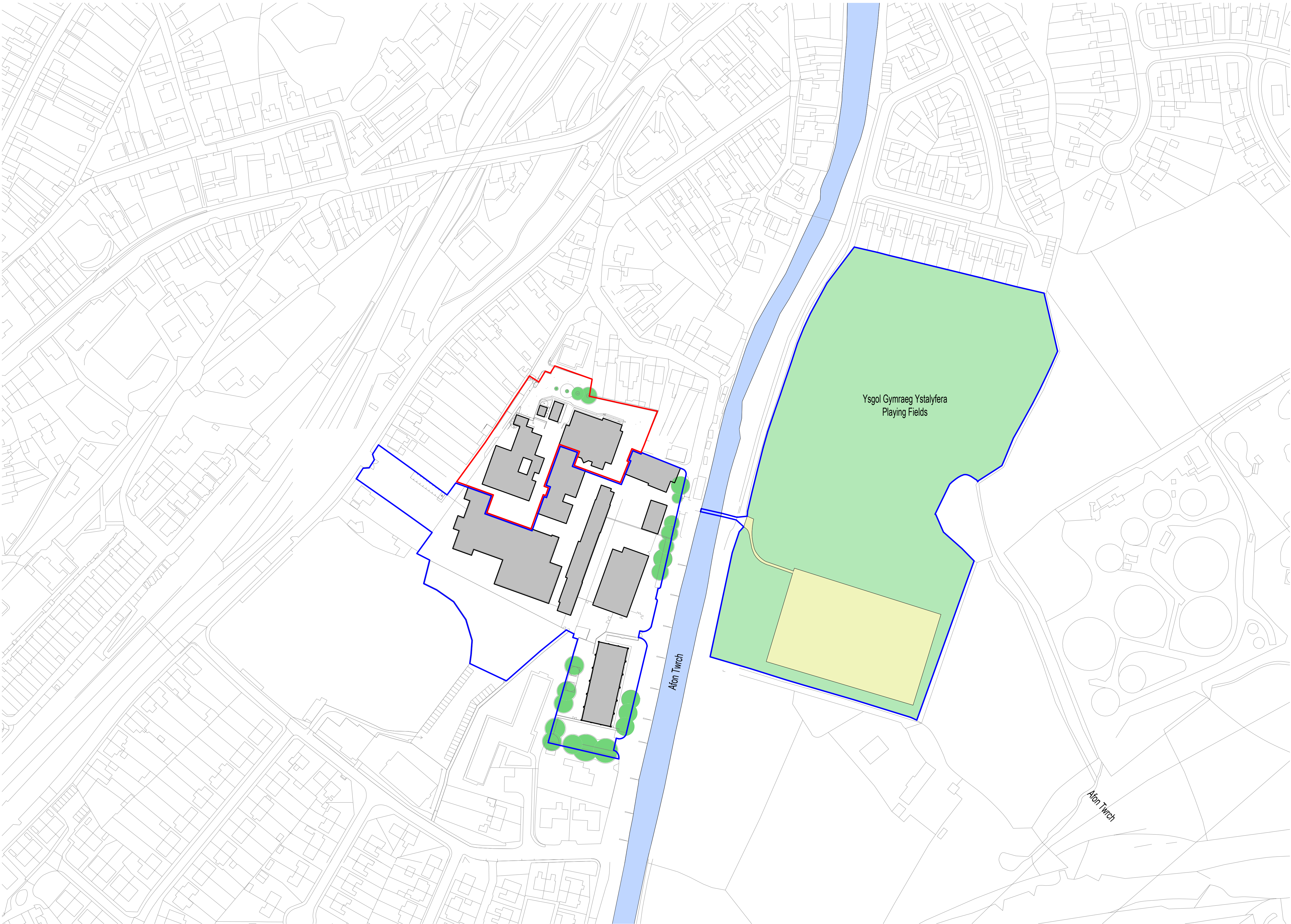
Joint Nature Conservation Committee (JNCC) (1990) *Handbook for Phase I Habitat Survey. A technique for environmental audit*. JNCC, Peterborough.

Mitchell-Jones, A.J. (2004) *Bat mitigation guidelines; January 2004*. English Nature. Peterborough.

Rob Colley Associates (2019) *Ysgol Gymraeg Bro Dur Ystalyfera – Bats: Methodology/Mitigation Strategy*

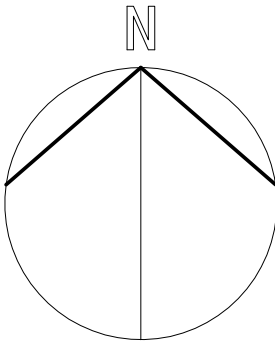
Rob Colley Associates (2019) *Ysgol Gymraeg Bro Dur Ystalyfera – Bat & Owl Survey*

APPENDIX I SITE LOCATION PLAN & PROPOSED LAYOUT PLAN



Location Plan - Ysgol Gymraeg Ystalyfera
1 : 1250

Construction (Design and Management) Regulations
Design risk assessments are carried out throughout the design stages of this project in accordance with company procedures and manuals. Where reasonably possible all areas of risk applicable to design and end use of the construction have been identified and then eliminated, mitigated or recorded as a residual risk. Note that general risks of which a competent designer or contractor should be aware are not included. This drawing is to be read in conjunction with the Pre-construction Information and all related documents prepared in accordance with the current Construction (Design and Management) Regulations 2015 and all applicable Health and Safety Legislation as currently amended.



P01	Site Boundaries amended RE CE CE	26/03/2020
P00	First Issue RE CE CE	16/03/2020
REV	DESCRIPTION DRAWN BY CHECKED BY APPROVED BY	DATE
RIBA PLAN OF WORK 2013 WORKSTAGE	LEVEL OF MODEL DEFINITION (LoD)	
Stage 3 - Developed Design	LoD 3 - Approximate Model	
PURPOSE OF ISSUE - SUITABLE FOR ...	BS1192 STATUS	
Information	Status S2 - Information	



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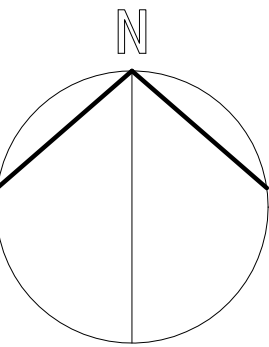
PROJECT TITLE
Ysgol Gymraeg Ystalyfera - Phase 3

DRAWING TITLE
Location Plan - Ysgol Gymraeg Ystalyfera

PROJECT No 19194 SCALE @ A1 1 : 1250

DRAWING No	PROJECT	ORIGINATOR	VOLUME	LEVEL	TYPE	ROLE	NUMBER	REVISION
19194-001	YG-Y-LAW-X-X-DR-	A-039101	P01					

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Reg. Co. No. 2724178, VAT Reg. No. 134 2148 06



LEGEND:

- Site Boundary
- Land owned by Client

- Existing buildings
- Proposed buildings / structures
- Soft landscaping
- Brick pavers to match existing (blue)
- Brick pavers to match existing (yellow)
- Hardstanding - tarmacadam

P01 Detail added. Issued for comment/design intent | RE | CE | CE 26/03/2020
P00 First Issue. Indicative layout only | RE | CE | CE 21/02/2020
REV. DESCRIPTION | DRAWN BY | CHECKED BY | APPROVED BY | DATE
RIBA PLAN OF WORK 2013 WORKSTAGE LEVEL OF MODEL DEFINITION (LoD)
Stage 3 - Developed Design LoD 3 - Approximate Model
PURPOSE OF ISSUE - SUITABLE FOR ... BS1192 STATUS
Employer / User Group Approval

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PROJECT TITLE
Ysgol Gymraeg Ystalyfera - Phase 3

DRAWING TITLE
Proposed Site Plan

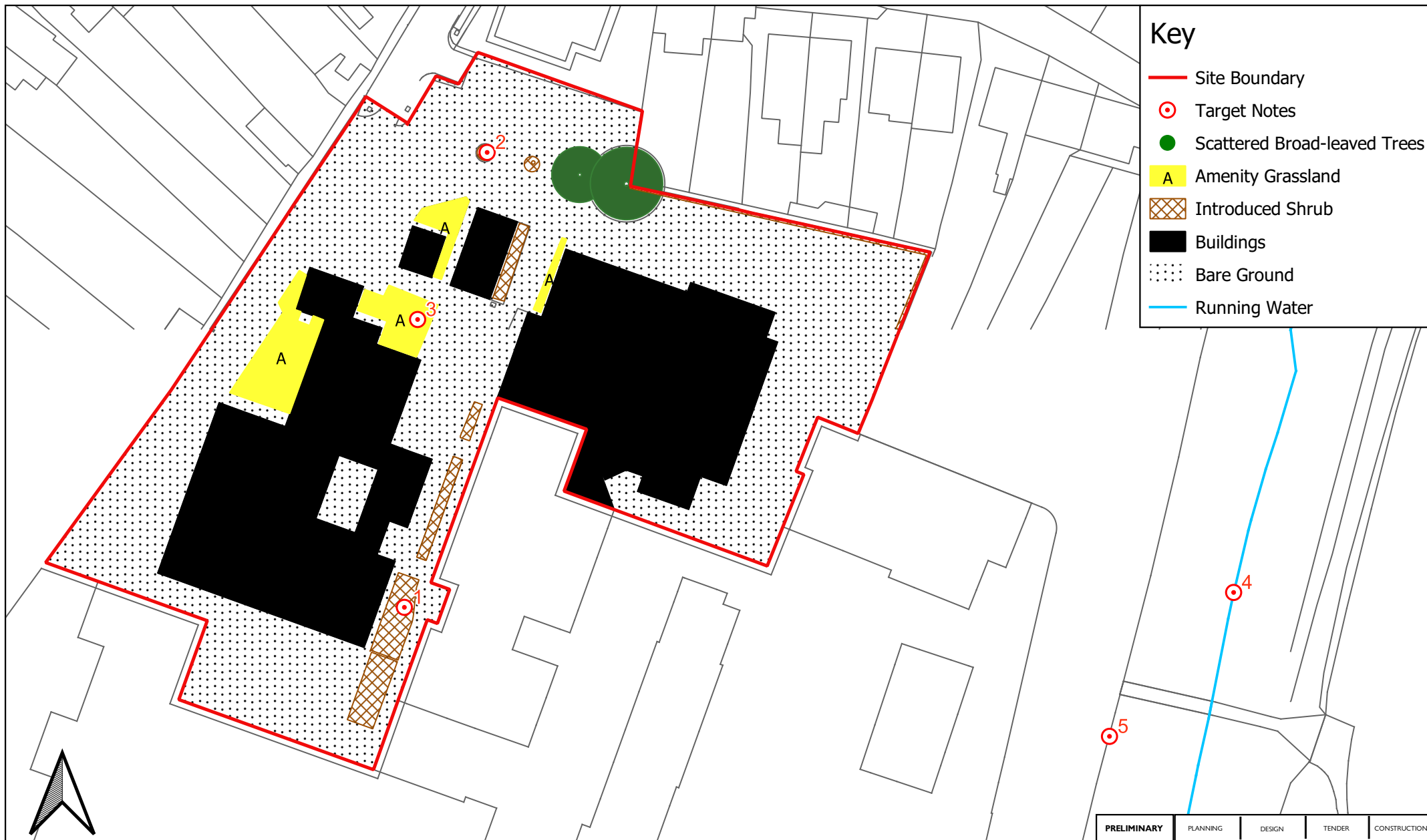
PROJECT No 19194 SCALE @ A1 1:200

DRAWING No	PROJECT	ORIGINATOR	VOLUME	LEVEL	TYPE	ROLE	NUMBER	REVISION
19194-001	YG-LAW-X-X-DR-	A-069001	P01					

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APPENDIX II TARGET NOTES TO ACCOMPANY PHASE 1 HABITAT SURVEY MAP



client
Andrew Scott Ltd
project
Ysgol Gyfun Ystalyfera

drawing no.
E2094401/001

drawing title
Phase I Habitat Map

drawn
BF
approved
MW
date
02 April 2020

PRELIMINARY PLANNING DESIGN TENDER CONSTRUCTION

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Ysgol Gyfun Ystalyfera, Neath Port Talbot

Target Notes Phase I Survey, March 2020

Target Note	Description/comment
General	Day-time inspection of existing habitat types and assessment of bat roost potential of trees within Phase3 areas of the Ystalyfera School redevelopment
Note 1 – Shrub Bed	North extent. Planted shrubs and ornamentals. Not strictly maintained. Species included: Wilson's Honeysuckle, Holly, Ivy, Ornamental Spindle, Bramble, Ash trees along edge 
Note 2 – Tree Pit Planters	A number of tree pit planters were located amongst the hard standing within the schools phase three area. Some of the trees were removed others (Lime) remained. Other species within the planters included: Wilson's Honeysuckle <i>Lonicera</i> sp., Holly <i>Ilex aquifolium</i>, Ivy <i>Hedera helix</i>, Bramble <i>Rubus fruticosus</i> agg., Ash <i>Fraxinus excelsior</i>, Daffodil <i>Narcissus</i> sp, Dandelion <i>Taraxacum officinale</i>, Common Chickweed <i>Stelaria media</i> and Sedge <i>Carex</i> sp. 

Target Note	Description/comment
Note 3 – Amenity grassland patches	A few scattered untarmacked areas existed alongside school buildings at a small number of locations. Generally these were maintained as a short sward and fall into the category of amenity grassland. Species to be found here included: Cock's Foot <i>Dactylis glomerata</i>, Perennial Rye-grass <i>Lolium perenne</i>, Annual Meadow Grass <i>Poa annua</i>, White Clover <i>Trifolium repens</i>, Daisy <i>Bellis perennis</i>, Dandelion <i>Taraxacum officinale</i>, Ribwort Plantain <i>Plantago lanceolata</i>, Creeping Buttercup <i>Ranunculus repens</i> and one small clump of Wood Avens <i>Geum urbanum</i> 

Note 4 – Afon Twrch	The Afon Twrch (pictured below facing north) flows south along the eastern boundary of the school and separates it from the playing fields and proposed astro pitch to the east. Pebble and cobble substrate, a reinforced vertical right-bank (west side) and a gentle vegetated earth and cobble left-bank profile. Although not wide, the left bank has complex vegetation (four or more types) including a canopy. It is considered the river provides foraging opportunities to Otter, Birds and Bats. 
Note 5 – Japanese Knotweed	A single small stand was observed on the right (east) bank, south of the footbridge. 

APPENDIX III RESULTS TABLES FOR LE04 CALCULATIONS

Table 1 - Condition Assessment:

CONDITIONS ASSESSMENT	Habitat types				
	Pre-Development			Post-Development	
	Buildings and hardstanding	Amenity Grassland	Introduced Shrubs	Buildings and hardstanding	Introduced Shrubs
Commonly used habitat condition assessment criteria in the FEP					
A diverse age range	0	0	0	0	0
A diverse species mix	0	0	0	0	0
Diverse structure/diverse form	0	0	0	0	0
Presence of protected species	0	0	0	0	0
None or a limited presence of invasive species	1	1	1	1	1
No or limited damage for example by machinery	1	0	1	1	1
Habitat Condition Score	0	1	1	0	1

**Habitat condition scores and bands: Good (meets all FEP criteria) = 3, Moderate (fails one FEP criteria) = 2, Poor (fails two or more FEP criteria) = 1. Hardstanding and buildings should be given a zero score.*

Table 2 - Distinctiveness Assessment:

Distinctiveness Band	Distinctiveness Score	Habitat Types Included
High	6	Habitats of principal Importance i.e. those which meet the criteria (JNCC 2011) as they are not included in the assessment. This excluded ancient woodland and other habitats which are irreplaceable
Medium	4	Other Semi-natural Habitats that do not fall within the scope of Habitats of Principal Importance definitions, i.e. all other areas of woodland (e.g. mixed woodland), other grassland (e.g. semi-improved grasslands), uncultivated field margins, road verge and railway embankments (excluding those that are intensively managed).
Low	2	Improved grassland, arable fields (excluding and uncultivated margins), built up areas, domestic gardens, regularly disturbed bare ground (e.g. quarry floor, landfill sites etc.), verges associated with transport corridors.
Negligible	0	Hardstanding and buildings

Table 3a – Biodiversity Percentage Change – current proposals

FINAL RESULTS - CURRENT		Habitats Pre Development		
	Total	Buildings & Hardstanding	Amenity grassland	Introduced Shrub
Pre-Development Area Biodiversity Units (B)	0.082	0.000	0.045	0.037
Pre-Development Area Lost Unit (D)	0.045	0.000	0.045	0.000
		Habitats Post Development		
		Buildings & Hardstanding	Amenity grassland	Introduced Shrub
Post-Development Area Biodiversity Units Created (E)	0.037	0	0	0.037
Post-Development Area Biodiversity Units Enhanced (F)	0.000	0	0	0
Total Post Development Area Biodiversity Units (G)	0.074			
equal to (B-D) + (E+F)				
Percentage Change Area Biodiversity Units	91%			

equal to $(G / B) \times 100$

*Reward levels available: 75-94% = Minimising loss, 95-104% = No net loss, 105-109% = Net gain, 110% or above = Significant net gain.

Table 3b – Biodiversity Percentage Change once recommendations are implemented

FINAL RESULTS – WITH PROPOSED ENHANCEMENTS		Habitats Pre Development		
	Total	Buildings & Hardstanding	Amenity grassland	Introduced Shrub
Pre-Development Area Biodiversity Units (B)	0.082	0.000	0.045	0.037
Pre-Development Area Lost Unit (D)	0.045	0.000	0.045	0.000
Habitats Post Development				
		Buildings & Hardstanding	Amenity grassland	Introduced Shrub
Post-Development Area Biodiversity Units Created (E)	0.075	0	0	0.075
Post-Development Area Biodiversity Units Enhanced (F)	0.023	0	0	0.023
Total Post Development Area Biodiversity Units (G)	0.135			
equal to (B-D) + (E+F)				
Percentage Change Area Biodiversity Units	166%			
equal to (G / B) x100				

*Reward levels available: 75-94% = Minimising loss, 95-104% = No net loss, 105-109% = Net gain, 110% or above = Significant net gain.

Table 4 - Pre development (Pre-D) calculations

Habitat type	Distinctiveness	x	Condition	x	Area (ha)	=	Pre-D Area Biodiversity Units B
Buildings and hardstanding	0	x	0	x	0.5731	=	0
Amenity grassland	2	x	1	x	0.0223	=	0.045
Introduced Shrubs	2	x	1	x	0.0185	=	0.037
Total (B)						=	0.082

Post Development (Post-D)

Table 5 – Scores for Spatial, Delivery and Temporal Risk Assessments

		Buildings and Hardstanding	Amenity Grassland	Introduced Shrubs
Location of Habitat Creation / Enhancement – Spatial Risk				
Habitat being created or enhanced is within 500m of the area of loss or in the same ecological network identified in a local (county or equivalent) biodiversity, green infrastructure or offsetting strategy	Score Risk Factor 1	0.5	0.5	0.5
Habitat type being created or enhanced contributes to and is in a location identified in a local (county or equivalent) biodiversity, green infrastructure or offsetting strategy	Score Risk Factor 0.67			
Habitat being created is not making a contribution to local (county or equivalent) biodiversity, green infrastructure or offsetting strategy	Score Risk Factor 0.50			
		0.50	0.50	0.50
Delivery Risk Assessment				
Very High	Score Risk Factor 0.10	1	1	1
High	Score Risk Factor 0.33			
Medium	Score Risk Factor 0.66			
Low	Score Risk Factor 1			
		1.00	1.00	1.00
Temporal Risk Assessment – Years to Target Condition				
5	Score Risk Factor 0.84	0.84	0.84	0.84
10	Score Risk Factor 0.71			
15	Score Risk Factor 0.59			
20	Score Risk Factor 0.50			
25	Score Risk Factor 0.42			
30	Score Risk Factor 0.36			
>30	Score Risk Factor 0.33			
		0.84	0.84	0.84

Table 6 - Identify Area Based Habitat Lost Values

Habitat type	Distinctiveness	x	Condition	x	Area Lost (m ²)	=	Pre-D Area Biodiversity Units D
Buildings and hardstanding (C)	0	x	0	x	0.2015	=	0
Amenity grassland	2	x	1	x	0.0223	=	0.045
Introduced Shrubs	4	x	1	x	0.0000	=	0.000
Total (D)						=	0.045

Table 7 - Identify Area Based Habitat Gained (Created)

	Post-D distinctive-ness	x	Post-D Target Condition	x	Post-D Areas (ha)	x	Delive-ry Risk	x	Temporal risk	x	Spatial risk	=	Post D Area Biodiversity Units Created Due to Development (per habitat type) E
Buildings and hardstanding (C)	0	x	0	x	0.2015	x	1	x	0.84	x	0.5	=	0
Amenity grassland	2	x	1	x	0.0000	x	1	x	0.84	x	0.5	=	0.000
Introduced Shrubs	2	x	1	x	0.0000	x	1	x	0.84	x	0.5	=	0.037
Total (E)												=	0.037

* Source = Soltys Brewster Consulting (personal communication)

** Based on 7 new trees at 20cm girth (RPZ = 20m2)

Table 8 - Identify Area Based Habitat Gained (if Enhanced*)

	Post-D distincti-veness	x	Post-D Target Condit-ion	x	Post-D Areas (ha)	x	Post-D Bio-diversity Units of Enhanced Areas	x	Delivery Risk	x	Tempor-al risk	x	Spatial risk	=	Post D Area Biodiversity Units Created Due to Development (per habitat type) F
Buildings and hardstanding (C)	0	x	0	x	0.2015	x	0.0000	x	1	x	0.84	x	0.5	=	0
Amenity grassland	2	x	1	x	0.0000	x	0.0000	x	1	x	0.84	x	0.5	=	0
Introduced Shrubs	2	x	2	x	0.0000	x	0.0000	x	1	x	0.84	x	0.5	=	0.023
Total (F)														=	0.023

*Assuming Enhancement recommendations are undertaken.

**Based on 50% of retained woodland.

Table 9a - Total Post Development Area Biodiversity Units

(B	-	D)	+	(E	+	F)	=	Total Post-D Area Biodiversity Units G
(0.082	-	0.045)	+	(0.037	+	0)	=	0.074

Table 10a - Percentage Change Area Biodiversity Units

(G	/	B)	x	100	=	Percentage change in Area Based Biodiversity Units rounded to the nearest whole percentage*
(0.074	/	0.082)	x	100	=	91%

*Reward levels available: 75-94% = Minimising loss, 95-104% = No net loss, 105-109% = Net gain, 110% or above = Significant net gain.

Table 9b - Total Post Development Area Biodiversity Units *if Enhanced*

(B	-	D)	+	(E	+	F)	=	Total Post-D Area Biodiversity Units G
(0.082	-	0.045)	+	(0.075	+	0.023)	=	0.135

Table 10b - Percentage Change Area Biodiversity Units *if Enhanced*

(G	/	B)	x	100	=	Percentage change in Area Based Biodiversity Units rounded to the nearest whole percentage*
(0.135	/	0.082)	x	100	=	166%

*Reward levels available: 75-94% = Minimising loss, 95-104% = No net loss, 105-109% = Net gain, 110% or above = Significant net gain.

APPENDIX IV ADVICE SHEET ON THE USE OF STREET LIGHTING AND BATS

APPENDIX VI BATS AND ARTIFICIAL LIGHTING IN THE UK GUIDANCE NOTE

The following is an extract from the Bat Conservation Trust and Institution of Lighting Professionals (2018) guidance note on Bats and Artificial Lighting in the UK. Section 3 contains advice on how to mitigate for the impacts of artificial lighting on bats. Full citation:

Bat Conservation Trust & Institution of Lighting Professionals (2018) *Bats and artificial lighting in the UK. Guidance Note 08/18*. Bat Conservation Trust, London.

3. Mitigation of artificial lighting impacts on bats

This section provides a simple process which should be followed where the impact on bats is being considered as part of a proposed lighting scheme. It contains techniques which can be used on all sites, whether a small domestic project or larger mixed-use, commercial or infrastructure development. It also provides best-practice advice for the design of the lighting scheme for both lighting professionals and other users who may be less familiar with the terminology and theory.

The stepwise process and key follow-up actions are outlined in the flowchart overleaf, and are followed throughout the chapter.

The questions within this flow chart should be asked as early as possible, so that necessary bat survey information can be gathered in advance of any lighting design or fixing of overall scheme design.

Effective mitigation of lighting impacts on bats depends on close collaboration from the outset between multiple disciplines within a project. 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 as early in your project as possible in order to ensure mitigation is as effective as it can be and to minimise delays and unforeseen costs.

Step 1: Determine whether bats could be present on site

If your site has the potential to support bats or you are at all unsure, it is highly recommended that an ecologist is appointed to advise further and conduct surveys, if necessary. This information should be collected as early as possible in the design process, and certainly before lighting is designed, so as to avoid the need for costly revisions.

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 newly proposed lighting may impact local bat populations:

- Woodland or mature trees
- Hedgerows and scrub
- Ponds and lakes
- Ditches, streams, canals and rivers
- Infrequently managed grassland
- Buildings – pre 1970s or in disrepair

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.
- 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, as long as the original source is credited.
- Local authority planning portals – 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.

The professional directory at the website of the Chartered Institute of Ecology and Environmental Management (www.cieem.net) will provide details of ecologists in your area with the relevant

Step 1

Could bats be present on site?

Consult local sources of ecological information or seek advice from an ecologist

Step 2

Determine the presence of – or potential for – roosts, commuting habitat and foraging habitat and evaluate their importance.

Appoint ecologist to carry out daytime and, if necessary, night-time bat surveys and to evaluate the importance of the site's features and habitats to bats.

Step 3

Avoid lighting on key habitats and features altogether.

No illumination of any roost entrances and associated flightpaths, nor on habitats and features used by large numbers of bats, by rare species or by highly light-averse species.

Step 4

In other locations of value for bats on site, apply mitigation methods to reduce lighting to a minimum.

Spatial design

Building design

Landscaping

Set dark habitat buffers and acceptable lux limits with ecologist guidance

Step 5

Demonstrate compliance with lux limits and buffers.

Lighting professional to prepare final lighting scheme design and/or lux calculations or undertake baseline light surveys as necessary. Post-completion bat and lighting monitoring may be required.

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.

It should be noted that the measures discussed in this document relate only to the specific impacts of lighting upon 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 be necessary in order to avoid, mitigate or compensate for this legally and according to the ecologist's evaluation.

Step 2: Determine the presence of – or potential for – roosts, commuting habitat and foraging habitat and evaluate their importance

Your ecologist will visit the site in order to record the habitats and features present and evaluate their potential importance to bats, and the likelihood that bats could be affected by lighting both on and immediately off site. This may also include daytime building and tree inspections. On the basis of these inspections further evening surveys may be recommended, either to determine the presence of roosts 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 (ideally May to 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).

The resulting report will detail the relative conservation importance of each habitat feature to bats (including built structures, if suitable). 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 recorded or 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)

The evaluation of ecological importance for each feature is most commonly expressed on a geographic scale from Site level to International level, or alternatively in terms of that feature's role in maintaining the 'favourable conservation status' of the population of bats using it.

The ecologist should set out where any key bat roost features and/or habitat areas (ie flightpath habitat and broader areas of foraging habitat) lie on a plan of the site or as an ecological constraints and opportunities plan (ECOP) together with their relative importance. The ECOP and report can then be used to help guide the design of the lighting strategy as well as the wider project.

Step 3: Avoid lighting on key habitats and features altogether

As has been described in 'Artificial lighting', above, 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 24-hour operation. However in the public realm, while lighting can increase the perception of safety and security, measureable benefits can be subjective. Consequently, lighting design should be flexible and be able to fully take into account the presence of protected species

and the obligation to avoid impacts on them.

Sources of lighting which can disturb bats are not limited to roadside or external 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. Additionally, glare (extremely high contrast between a source of light and the surrounding darkness – linked to the intensity of a luminaire) may affect bats over a greater distance than the target area directly illuminated by a luminaire and must also be considered on your site.

It is important that a competent lighting professional is 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. Your lighting professional will be able to make recommendations about placement of luminaires tailored to your specific project.

Where highways lighting schemes are to be designed by the local planning authority (LPA) post-planning, an ecology officer should be consulted on the presence of important bat constraints which may impact the design and illuminance in order for the scheme to remain legally compliant with wildlife legislation.

Where adverse impacts upon the 'favourable conservation status' of the bat population using the feature or habitat would be significant, an absence of artificial illumination and glare, acting upon both the feature and an appropriately-sized buffer zone is likely to be the only acceptable solution. Your ecologist will be best placed to set the size of such a buffer zone but it should be sufficient to ensure that illumination and glare is avoided and so the input of a lighting professional may be required. Further information on demonstrating an absence of illumination via lux/illuminance contour plans is provided in Step 5.

Because different species vary in their response to light disturbance (as discussed in section 1 'Bats'), your ecologist will be able to provide advice tailored to the specific conditions on your project, however examples of where the no-lighting approach should be taken in particular include:

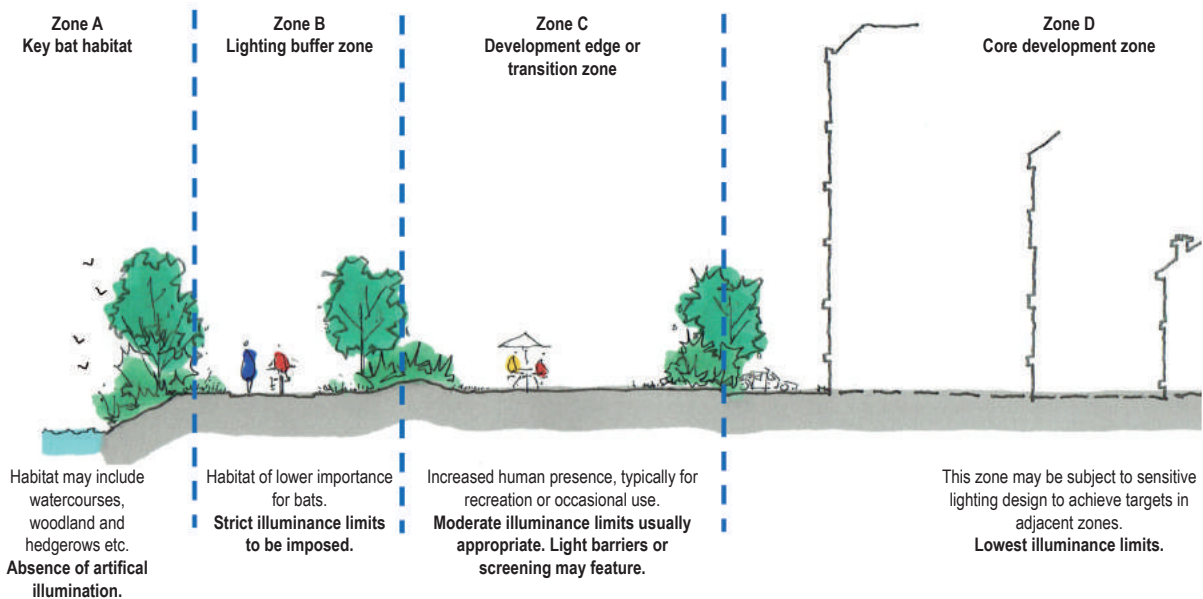
- Roosting and swarming sites for all species and their associated flightpath/commuting habitat.
- Foraging or commuting habitat for highly light-averse species (greater and lesser horseshoe bats, some *Myotis* bats, barbastelle bats and all long-eared bats).
- Foraging or commuting habitat used by large numbers of bats as assessed through survey.
- Foraging or commuting habitat for particularly rare species (grey long-eared bat, barbastelle, small *Myotis*, Bechstein's bat and horseshoe bats).
- Any habitat otherwise assessed by your ecologist as being of importance to maintaining the 'favourable conservation status' of the bat population using it.

Completely avoiding any lighting conflicts in the first place is advantageous because not only would proposals be automatically compliant with the relevant wildlife legislation and planning policy, but they could avoid costly and time-consuming additional surveys, mitigation and post-development monitoring. Furthermore, local planning authorities are likely to favour applications where steps have been taken to avoid such conflicts.

Step 4: Apply mitigation methods to reduce lighting to agreed limits in other sensitive locations – lighting design considerations

Where bat habitats and features are considered to be of lower importance or sensitivity to illumination, the need to provide lighting may outweigh the needs of bats. Consequently, a balance between a reduced lighting level appropriate to the

Example of illuminance limit zonation



ecological importance of each feature and species, and the lighting objectives for that area will need to be achieved.

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.

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

Dark buffers, illuminance limits and zonation

Dark buffer zones can be used as a good way to separate habitats or features from lighting by forming a dark perimeter around them. Buffer zones rely on ensuring light levels (levels of illuminance measured in lux) within a certain distance of a feature do not exceed certain defined limits. The buffer zone can be further subdivided into zones of increasing illuminance limit radiating away from the feature. Examples of this application are given in the figure above.

Your 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 (as informed by species and numbers of bats, as well as the type of use).

Appropriate luminaire specifications

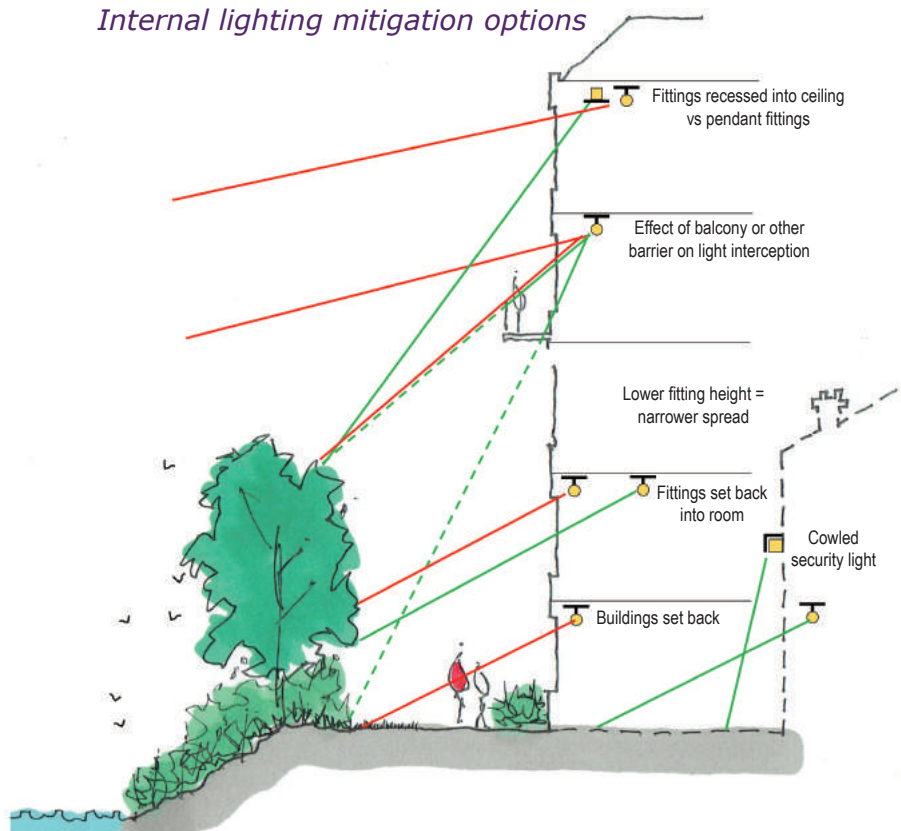
Luminaires come in a myriad of different styles, applications and specifications which a lighting professional can help to select. The following should be considered when choosing luminaires.

- All luminaires should lack UV elements when manufactured. Metal halide, 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 spectrum (ideally <2700Kelvin) should be adopted to reduce blue light component.
- Luminaires should feature peak wavelengths higher than 550nm to avoid the component of light most disturbing to bats (Stone, 2012).
- Internal luminaires can be recessed where installed in proximity to windows to reduce glare and light spill. (See figure overleaf.)
- The use of specialist bollard or low-level downward directional luminaires to

retain darkness above can be considered. However, this often comes at a cost of unacceptable glare, poor illumination efficiency, a high upward light component and poor facial recognition, and their use should only be as directed by the lighting professional.

- Column heights should be carefully considered to minimise light spill.
- Only luminaires with an upward light ratio of 0% and with good optical control should be used – See ILP Guidance for the Reduction of Obtrusive Light.
- Luminaires should always be mounted on the horizontal, ie no upward tilt.
- Any external security lighting should be set on motion-sensors and short (1min) timers.
- As a last resort, accessories such as baffles, hoods or louvres can be used to reduce light spill and direct it only to where it is needed.

Internal lighting mitigation options



- Taller buildings may be best located toward the centre of the site or sufficiently set back from key habitats to minimise light spill.
- Street lights can be located so that the rear shields are adjacent to habitats or optics selected that stop back light thereby directing light into the task area where needed.

Sensitive site configuration

The location, orientation and height of newly built structures and hard standing can have a considerable impact on light spill (see figure above for examples of good internal lighting design). Small changes in terms of the placement of footpaths, open space and the number and size of windows can all achieve a good outcome in terms of minimising light spill on to key habitats and features.

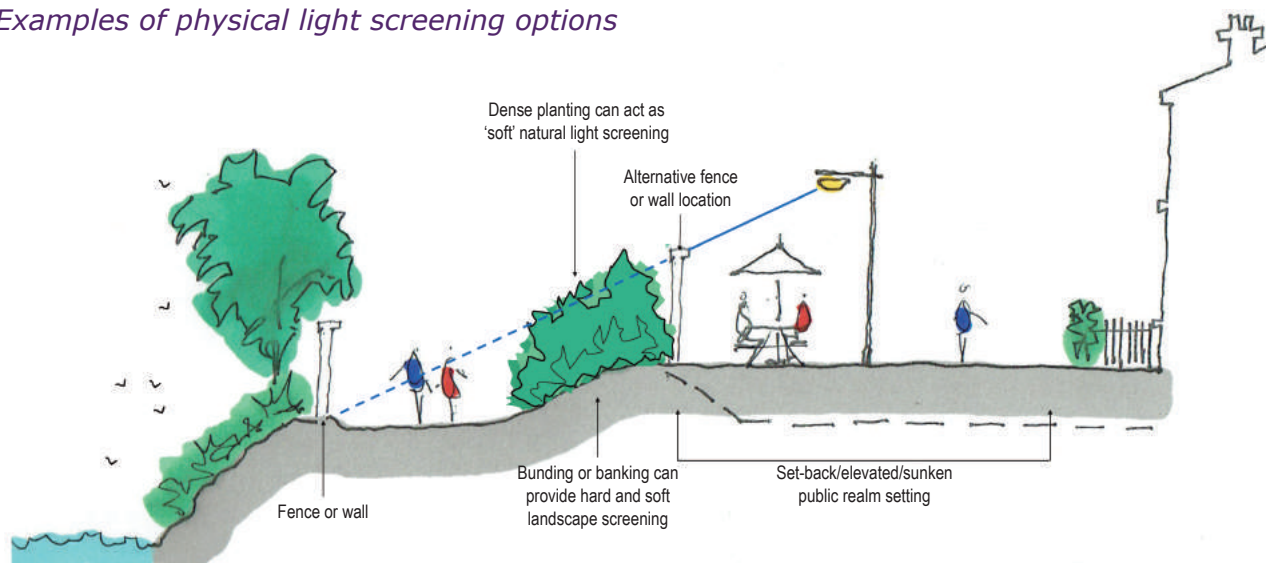
- It may be possible to include key habitats and features into unlit public open space such as parks and gardens.
- Buildings, walls and hard landscaping may be sited and designed so as to block light spill from reaching habitats and features.

Screening

Light spill can be successfully screened through soft landscaping and the installation of walls, fences and bunding (see figure overleaf for example of physical light-screening options). 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.

The planting of substantial landscape features integrated to the wider network of green corridors such as hedgerows, woodland and scrub is encouraged by

Examples of physical light screening options



planning policy and would make a long-term positive contribution to the overall bat habitat connectivity and light attenuation. A landscape architect can be appointed to collaborate with your ecologist on maximising these natural light screening opportunities.

It should be noted that newly planted vegetation (trees, shrubs and scrub) is unlikely to adequately contribute to light attenuation on 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 'instant hedgerows' or other similarly dense or mature planting, including 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.

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

Glazing treatments

Glazing should be restricted or redesigned wherever the ecologist and lighting professional determine there is a likely significant effect upon key bat habitat and features. Where windows and glass

facades etc cannot be avoided, low transmission glazing treatments may be a suitable option in achieving reduced illuminance targets.

Products available include retrofit window films and factory-tinted glazing. 'Smart glass', which can be set to automatically obscure on a timer during the hours of darkness, and automatic blinds can also be used but their longevity depends on regular maintenance and successful routine operation by the occupant, and should not be solely relied upon.

Depending on the height of the building and windows, and therefore predicted light spill, such glazing treatments 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

The provision of new, additional or alternative bat flightpaths, commuting habitat or foraging habitat could result in appropriate compensation for any such habitat being lost to the development. Your ecologist will be able to suggest and design such alternative habitats although particular consideration 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 should be given.

Dimming and part-night lighting

Depending on the pattern of bat activity across the key features identified on site by your ecologist, it may be appropriate for an element of on-site lighting to be controlled either diurnally, seasonally or according to human activity. A control management system can be used to dim (typically to 25% or less) or turn off groups of lights when not in use.

It should be noted that these systems depend on regular maintenance and a long-term commitment for them to be successful. Additionally, part-night lighting should be designed with input from an ecologist as they 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. 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 human 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.

Step 5: Demonstrate compliance with illuminance limits and buffers

Design and pre-planning phase

It may be necessary to demonstrate that the proposed lighting will comply with any agreed light-limitation or screening measures set as a result of your ecologist's recommendations and evaluation. This is especially likely to be requested if planning permission is required.

A horizontal illuminance contour plan can be prepared by a suitably experienced and competent lighting professional (member of the Chartered Institution of Building Services Engineers (CIBSE), Society of Light and Lighting (SLL), Institution of

Lighting Professionals (ILP) or similar to ensure competency) using an appropriate software package to model the extent of light spill from the proposed 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.

Such calculations and documentation would need to be prepared in advance of submission for planning permission to enable the LPA ecologist to fully assess impacts and compliance.

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 horizontal calculation plane representing 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. Vertical planes will enable a visualisation of the effects of illumination at the various heights at which different bat species fly.
- Models should include light from all luminaires and each should be set to the maximum output anticipated to be used in normal operation on site (ie no dimming where dimming is not anticipated during normal operation).
- 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 one.

- Where dimming, PIR or variable illuminance states are to be used, an individual set of calculation results should accompany each of these states.
- 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 contour plan should be accompanied by a table showing their minimum and maximum 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 and transmissivity of windows. It should be assumed that blinds or curtains are absent or fully open although low-transmittance glazing treatments may be appropriate. 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. It is acknowledged that in many circumstances, only a 'best effort' can be made in terms of accuracy of these calculations.
- 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.

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 below 0.2 lux on the horizontal plane and 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 (Stone, 2012).

Baseline and post-completion light monitoring surveys

Baseline, pre-development lighting surveys may be useful where existing on- or off-site lighting is suspected to be acting on key 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, where screening should be implemented or establish a new illuminance limit reduced below existing levels. For example, where baseline surveys establish that on- and 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. Further information and techniques to deal with modeling pre-development lighting can be found in ILP publication PLG04 *Lighting Impact Assessments* due to be published late 2018.

Baseline lighting surveys must be carried out by a suitably qualified competent person. 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, for example, 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.

Baseline measurements should be taken systematically across the site or features in question. That is, 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.

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.

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

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.

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

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 that the lighting specification (including luminaire heights, design and presence of shielding etc) is as proposed.

All lighting surveys should be conducted by a suitably qualified competent person and 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.

Results should always be reported to the LPA as per any such planning condition. A 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.

4. References

- Azam, C., Kerbiriou, C., Vernet, A., Julien, J.F., Bas, Y., Plichard, L., Maratrat, J., Le Viol, I. (2015). Is part-night lighting an effective measure to limit the impacts of artificial lighting on bats? *Global Change Biology* 21:4333–4341.
- Bat Conservation Trust. (2009). Bats and lighting in the UK- bats and the built environment series www.bats.org.uk
- Blake, D., Hutson, A.M., Racey, P.A., Rydell, J., Speakman, J.R. (1994). Use of lamplit roads by foraging bats in southern England. *J. Zool.* 234, 453–462.
- Bruce-White, C. and Shardlow, M. (2011). A Review of the Impact of Artificial Light on Invertebrates. Buglife.
- Boldogh, S., D. Dobrosi & P. Samu 2007. The effects of the illumination of buildings on house-dwelling bats and its conservation consequences. *Acta Chiropterologica* 9, 527–534.
- Campaign to Protect Rural England. (2016). Night Blight: Mapping England's light pollution and dark skies.
- Cinzano, P., Falchi, F. and Elvidge, C. D. (2001). The first World Atlas of the artificial night sky brightness. *Monthly notices of the Royal astronomical society.* 328, pp. 689-707.
- Downs, N. C. et al (2003) The effects of illuminating the roost entrance on the emergence behaviour of *Pipistrellus pygmaeus*. *Biological Conservation* 111, 247-252
- Duverg , P. L., G. Jones, J. Rydell & R. D. Ransome (2000). The functional significance of emergence timing in bats. *Ecography* 23, 32-40.
- Fabio Falchi, Pierantonio Cinzano, Dan Duriscoe, Christopher C. M. Kyba, Christopher D. Elvidge, Kimberly Baugh, Boris A. Portnov, Nataliya A. Rybnikova and Riccardo Furgoni. (2016). The new world atlas of artificial night sky brightness. *Sci. Adv.* 2016; 2 : e1600377
- Fure, A (2012) Bats and Lighting – six years on. *The London Naturalist* No. 85
- Garland L & Markham, S. (2007) Is important bat foraging and commuting habitat legally protected? (self published)
- Gaston KJ, Visser ME, H lker F. (2015) The biological impacts of artificial light at night: the research challenge. *Philosophical Transactions of the Royal Society B: Biological Sciences.* 2015;370(1667):20140133. doi:10.1098/rstb.2014.0133.
- Institution of Lighting Engineers (2011) Guidance Notes for the Reduction of Obstructive Light
- James D. Hale, Alison J. Fairbrass, Thomas J. Matthews, Gemma Davies, Jon P. Sadler. (2015) The ecological impact of city lighting scenarios: exploring gap crossing thresholds for urban bats. *Global Change Biology*, 2015; DOI: 10.1111/gcb.12884
- Jones, G., Rydell, J. (1994). Foraging strategy and predation risk as factors influencing emergence time in echolocating bats. *Philos. T. R. Soc. B.* 346, 445–455.
- Frank van Langevelde, Marijke Braamburg-Annegarn, Martinus E. Huigens, Rob Groendijk, Olivier Poitevin, Jurri n R. van Deijk, Willem N. Ellis, Roy H.A. van Grunsven, Rob de Vos, Rutger A. Vos, Markus Franz n and Michiel F. WallisDeVries (2017) Declines in moth populations stress the need for conserving dark nights. *Global Change Biology* DOI: 10.1111/gcb.14008
- Mitchell-Jones, A. J. (2004) Bat Mitigation Guidelines. English Nature
- Packman, C., Zeale, M., Harris, S. & Jones, G. (2015). Management of bats in churches – a pilot. English Heritage Research Project: 6199.
- Rich, C., Longcore, T. (2006). Ecological consequences of artificial night lighting. Washington, DC, USA. Island Press.

- Rowse, E. G., D. Lewanzik, E. L. Stone, S. Harris, and G. Jones (2016). Dark Matters : The Effects of Artificial Lighting on Bats. In: Bats in the Anthropocene: conservation of bats in a changing world (C. C. Voigt and T. Kingston, Eds.).
- Russo, D., Cistrone, L., Libralato, N., Korine, C., Jones, G. and Ancillotto, L. (2017), Adverse effects of artificial illumination on bat drinking activity. *Anim Conserv.* doi:10.1111/acv.12340
- Rydell J & Racey, P A (1993) Street lamps and the feeding ecology of insectivorous bats. Recent Advances in Bat Biology Zool Soc Lond Symposium abstracts.
- Speakman, J. R. (1991). Why do insectivorous bats in Britain not fly in daylight more frequently? *Funct. Ecol.* 5, 518-524.
- Spoelstra, K., van Grunsven, R.H.A., Donners, M., et al (2015). Experimental illumination of natural habitat—an experimental set-up to assess the direct and indirect ecological consequences of artificial light of different spectral composition. *Philos. T. R. Soc. B.* 370, 20140129.
<http://dx.doi.org/10.1098/rstb.2014.0129>.
- Spoelstra K, van Grunsven RHA, Ramakers JJC, Ferguson KB, Raap T, Donners M, Veenendaal M, Visser ME. (2017) Response of bats to light with different spectra: light-shy and agile bat presence is affected by white and green, but not red light. *Proc. R. Soc. B* 284: 20170075.
<http://dx.doi.org/10.1098/rspb.2017.0075>
- Stone, E.L., Jones, G., Harris, S. (2009). Street lighting disturbs commuting bats. *Curr. Biol.* 19, 1123–1127.
- Stone, E.L., Jones, G., Harris, S. (2012). Conserving energy at a cost to biodiversity? Impacts of LED lighting on bats. *Glob. Change Biol.* 18, 2458–2465.
- Stone, E.L., Harris, S., Jones, G. (2015a). Impacts of artificial lighting on bats: A review of challenges and solutions. *Mammal. Biol.* 80, 213-219.
- Stone, E.L., Wakefield, A., Harris, S., Jones, G. (2015b). The impacts of new street light technologies: experimentally testing the effects on bats of changing from low-pressure sodium to white metal halide. *Philos. T. R. Soc. B.* 370, 20140127.
- Voigt CC, Roeleke M, Marggraf L, Pētersons G, Voigt-Heucke SL (2017) Migratory bats respond to artificial green light with positive phototaxis. *PLoS ONE* 12(5): e0177748.
- Voigt CC, Rehnig K, Lindecke O, Pētersons G. (2018) Migratory bats are attracted by red light but not by warm-white light: Implications for the protection of nocturnal migrants. *Ecology and Evolution*.
- Wakefield, A., Stone, E.L., Jones, G., Harris, S. (2015). Light-emitting diode street lights reduce last-ditch evasive manoeuvres by moths to bat echolocation calls. *R. Soc. Open Sci.* 2, 150291.
<http://dx.doi.org/10.1098/rsos.150291>.