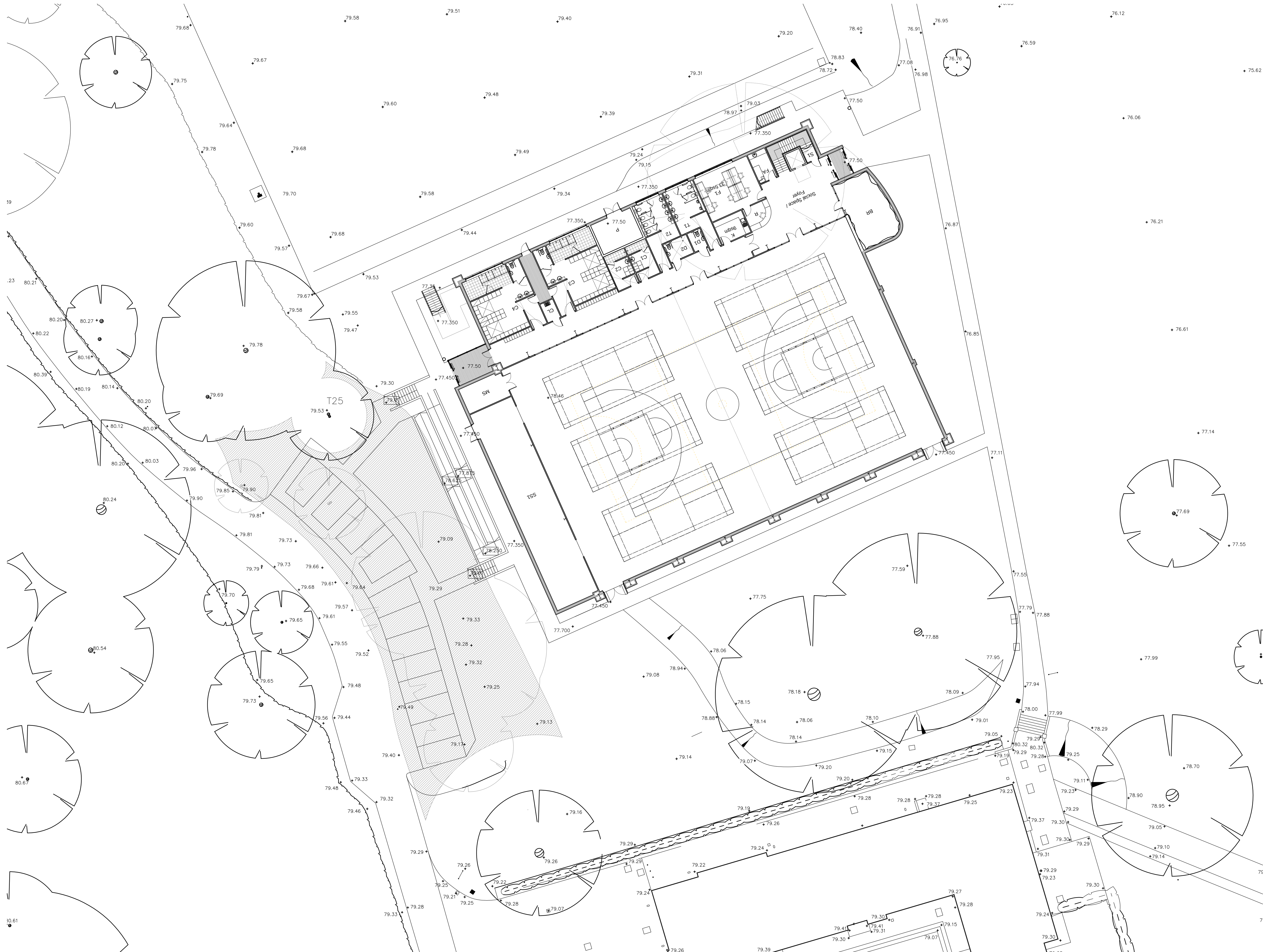


## APPENDIX I PROPOSED SITE LAYOUT

## Leighton Park School



## Proposed New Sports Facility

NOTES:

Do Not Scale.

Report all discrepancies, errors and omissions.

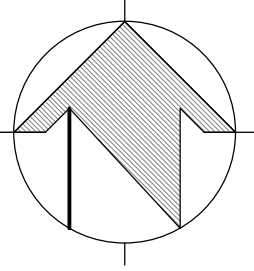
Verify all dimensions on site before commencing any work on site or preparing shop drawings.

All materials, components and workmanship are to comply with the relevant British Standards, Codes of Practice, and appropriate manufacturers recommendations that from time to time shall apply.

For all specialist work, see relevant drawings.

This drawing and design are copyright of Clague LLP  
Registration number OC335948.

| Rev | Date | Description |
|-----|------|-------------|
|-----|------|-------------|

BALL HALL LIMITED

## Ball Hall

Project Title

## Proposed New Sports Hall

Leighton Park School

## Shinfield Road

## Reading

RG2 7ED

### Drawing Description

## Proposed Site Plan

Scale

1:200 @ A1

Date \_\_\_\_\_

March 2018

Drawn by

B

Checked by

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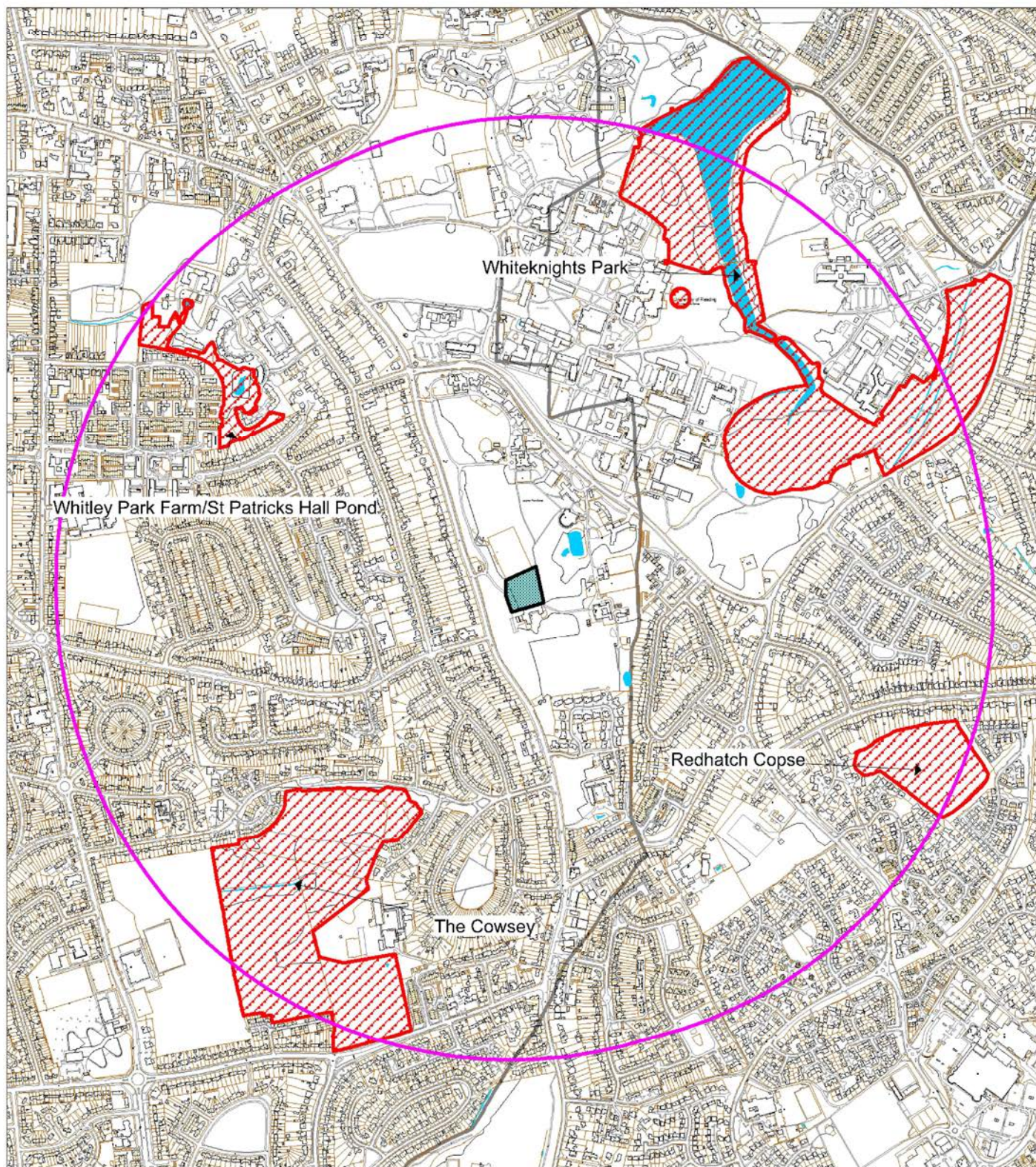
Drawing Number

### Revision

23527A / 03

## APPENDIX II DESK-STUDY INFORMATION RECEIVED FROM TVERC

# Leighton Park School, Reading Designated Wildlife Sites

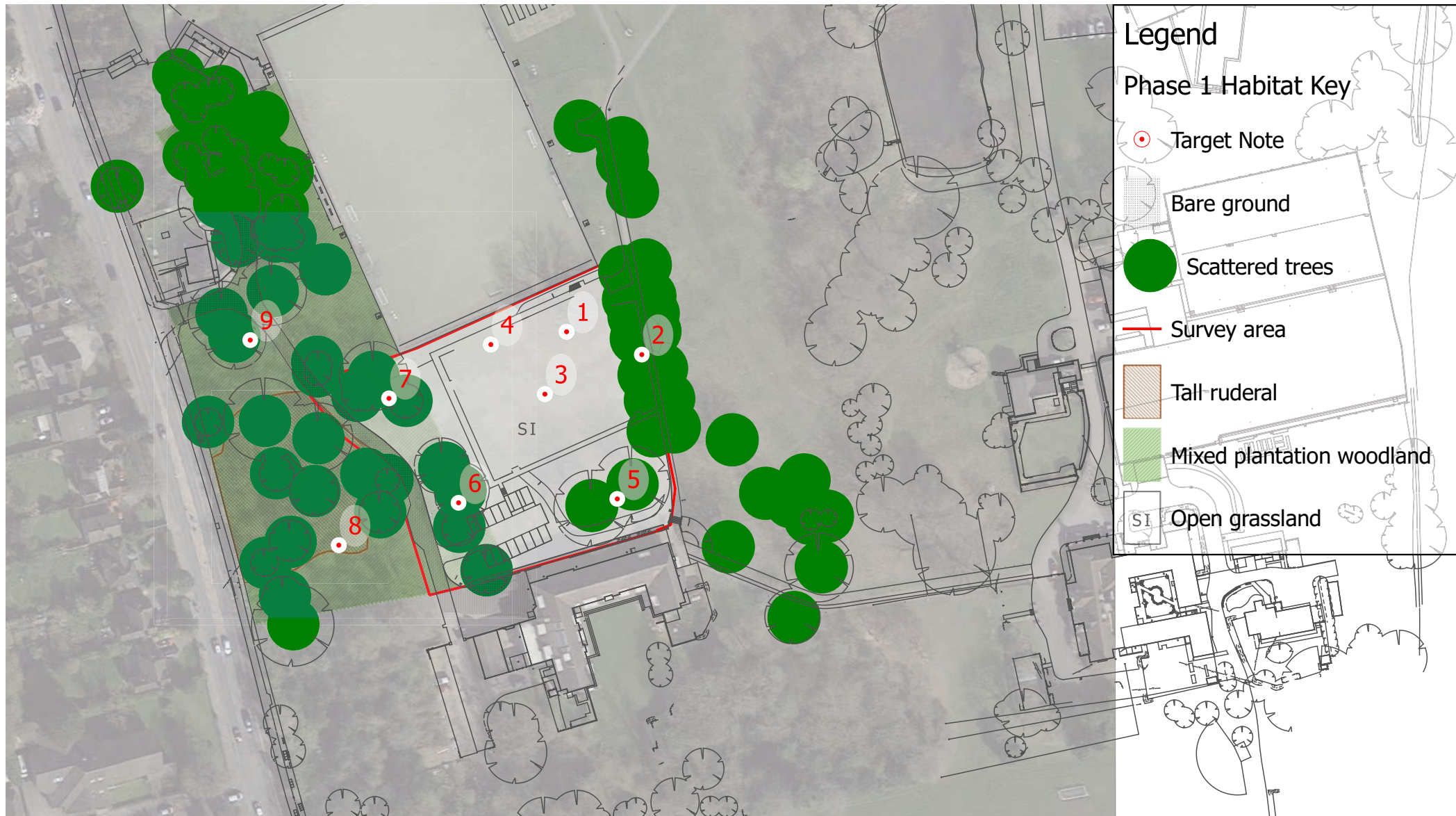


 Local Wildlife Sites

Scale: 1:25000

 Search Area  
 Site Boundary

## APPENDIX III PHASE 1 HABITAT SURVEY MAP AND TARGET NOTES



## Legend

### Phase 1 Habitat Key

● Target Note

□ Bare ground

● Scattered trees

— Survey area

▨ Tall ruderal

▨ Mixed plantation woodland

SI Open grassland

PRELIMINARY PLANNING DESIGN TENDER CONSTRUCTION

Client  
Leighton Park School  
**Project**  
**New Sports Hall**

Drawing Title:  
Phase I Habitat Map

Project Code/Drawing Number  
E1884301/D01

BF

MW

21 September 2018

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| Target Note<br>Aug 2018                                                                                                                                                                                                                | Image                                                                               | Notes                                                                                                                                                                                          |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Birds heard and /or seen on or flying over site included: Blackbird <i>Turdus merula</i> , Wood Pigeon <i>Columba palumbus</i> , Carrion Crow <i>Corvus corone</i> , Red Kite <i>Milvus milvus</i> and Robin <i>Erithacus rubecula</i> |                                                                                     |                                                                                                                                                                                                |
| TN1 –<br>Felled turkey Oak                                                                                                                                                                                                             |   | Fallen Turkey Oak. Stem and limbs have been cross cut and all arisings have been removed and log pile created in mixed plantation woodland.                                                    |
| TN2 –<br>Willow saplings                                                                                                                                                                                                               |  | Two lines of Willow saplings have been planted along path bordering the eastern edge of site, presumable to reduce the effect of water run-off and rain as the ground gets boggy in the winter |

**TN3 –**  
Open  
Grassland



Open Grassland and associated with habitat characteristic of wood pasture and parkland. Intrinsically on its own it would be species poor semi improved grasslands. Species present included Cock's Foot, Sweet Vernal and Yorkshire Fog. Tall fescue, Ribwort Plantain, Common Bent occurred very frequently with species such as Ragwort., Creeping Thistle and Bird's Foot Trefoil being locally abundant in a few areas. Other commonly occurring species present included Bramble, Broad-leaved Dock, Hedge Bindweed, Alexanders, Hogweed., Curled Dock, Perennial Ryegrass, Annual Meadow-grass, Daisy and Dandelion e. There are also a number of sapling turkey oaks in the vicinity of the previous tree which are beginning to grow.

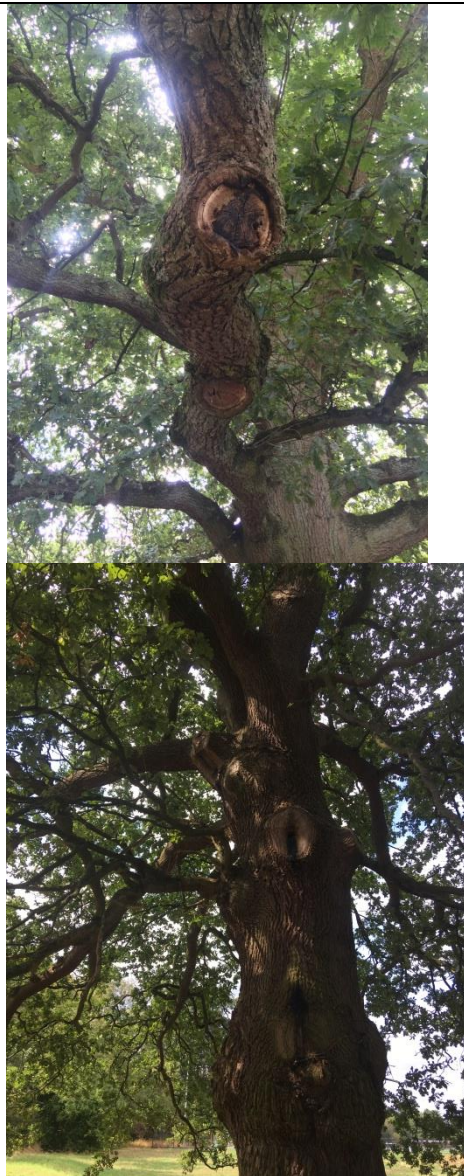
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**TN4 –  
Fox Den**

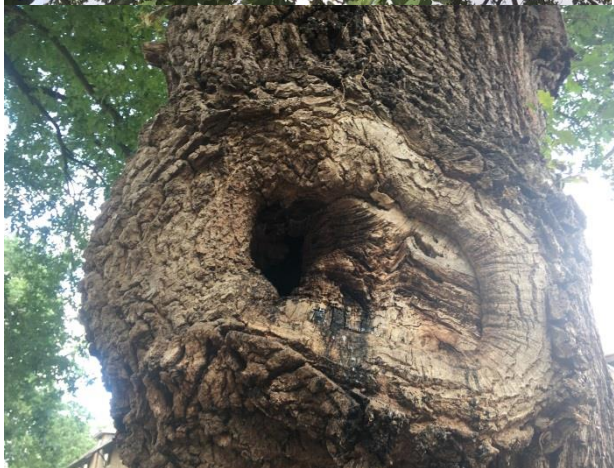


Disused Fox den within site in the northern section of the open grassland. Single entrance. Although the shape of entrance has a 'D' shape characteristic of badger sett entrances, lack of badger evidence, entrance dimensions (narrow and tall) and sightings of fox locally would suggest fox. Either way the burrow has no evidence of current activity.

**TN5 –  
Veteran  
Oaks**



High potential Oaks, in the southern section of the site have numerous potential roost features such as rot holes, split limbs etc. Two are located in the south of the open grassland and another on the very south west corner of site.



**TN6 –**  
Low  
potential  
tree group



Low potential group of Oak, Ash, Hazel bordering the south west edge. Bat potential is generally associated with the maturer trees.

**TN7 –**  
Moderate  
potential  
Ash trees



A number of Ash trees with roost features of moderate potential.

**TN8 –**  
Tall  
Ruderal



Tall ruderal vegetation  
amongst the mixed plantation  
woodland. Species included:

**TN9 –**  
Moderate  
potential  
Ash and  
Oak trees



Total of two trees with  
moderate potential (Ash and  
Oak) for roosting Bats

## APPENDIX IV      ADVICE NOTE ON BATS & LIGHTING (2014)

The following advice in relation to Bats and lighting provides a summary of the review of available evidence compiled by the Bats and Lighting Research Project at the University of Bristol. The full report should be reviewed for further information on any of the summary points identified below. The citation for the full report is:

**Stone, E.L. (2013) *Bats and lighting: Overview of current evidence and mitigation guidance. Lighting Research Project, University of Bristol.***

### Introduction

Urbanisation and development affect bat habitats, either through direct loss or disturbance from light and noise pollution or human activities. Changes in habitat affect the quantity, quality and connectivity of foraging, drinking and roosting resources available to bats. Linear landscape features such as hedgerows, river banks and canals are important for bats, often being used for foraging and commuting (Limpens & Kapteyn 1991; Verboom *et al.* 1999).

Bat habitats and roosts are under increasing pressure and disturbance from suburban development and its associated artificial lighting. Connectivity of habitat and foraging areas to roosts is fundamental to the survival of many bat populations (Verboom & Huitema 1997). Lighting schemes can damage bat foraging habitat directly through loss of land and spatial exclusion of bats due to high illuminance, or indirectly by severing commuting routes from roosts, through light spillage polluting hedgerows, tree lines and watercourses (Racey 2006). Lighting around roosts has also been shown to delay emergence, causing bats to miss the peak in insect prey abundance (Downs *et al.* 2003).

### Legislation pertaining to lighting in Britain

There is no legal duty for a lighting authority to illuminate roads in Britain and lighting is installed because the perceived benefits outweigh the negatives. Recent research by The Highways Agency (in England) found that the safety benefits of motorway lighting were 1/3 lower than previously thought. Additional field trials to switch-off lights on motorways have found lower numbers of accidents when lights were off than when illuminated (<http://www.highways.gov.uk/knowledge/30236.aspx>). A number of authorities have been trialling part night lighting solutions and even complete removal. The results have been mixed but a significantly large number of projects have shown no detriment from implementation of these changes.

### Street lighting (A roads, B roads, pedestrian lighting)

There are over 7.5million street lights in the UK (Anon. 2009). Common light types used for external applications in the UK.

## Common types of street light used in the Britain.

|                                        | Colour              | % UV    | Correlated colour temperature (k) <sup>1</sup> | Approx % of UK Lighting stock |
|----------------------------------------|---------------------|---------|------------------------------------------------|-------------------------------|
| Low pressure sodium (LPS / SOX)        | Yellow/orange       | 0.0     | 1807                                           | 44%                           |
| High pressure sodium (HPS / SON)       | Pinkish / off white | 0.3     | 2005-2108                                      | 41%                           |
| Compact fluorescent                    | Warm white          | 0.5-1.0 | 2766-5193                                      | 15%                           |
| Metal Halide (e.g. Philips CosmoPolis) | Blue-white          | 2.0-7.0 | 2720-4160<br>CosmoPolis 2720                   | N/A                           |
| Light emitting diode (LED)             | White/warm white    | - 0.0   | 2800-7000                                      | N/A                           |

## Predicting the impacts of lighting on bats

There are many aspects of ecological light pollution which are yet to be investigated, and so a precautionary approach is important. It is important to consider the following when predicting the impacts of lighting on bats:

### i. Impacts may be cumulative

Lighting is one of many anthropogenic impacts on bats and so it is important to consider impacts of lighting in the context of the site and other conditions affecting the species or colony. For example even a small amount of lighting may have a disproportionate impact on bats at sites where there are already high levels of disturbance, therefore impacts must be assessed in the context of other disturbances on the colony/roost in question.

### ii. Impacts will vary according to site, species and behaviour

The impacts of lighting on bats is species specific and varies according to the specific behaviour being affected. Impacts on a site by site basis can be based on knowledge of the species involved and the type of behaviour affected.

### iii. Impacts may occur over different temporal scales

Some impacts may occur over very short time frames making them more obvious (e.g. spatial avoidance) and therefore more likely to be recorded. However, lighting may impact behaviours over longer time scales (e.g. reduced breeding success) and may be harder to record and therefore underestimated.

### iv. Impacts may occur at both the individual or population level

Lighting may impact on a few individuals in a colony or population, i.e. causing temporary avoidance of a commuting route used by a small percentage of bats occupying a roost. However, there may be effects at the population level, e.g. reduced juvenile growth rates due to reduced foraging or delayed emergence caused by lighting (e.g. see Boldogh *et al.* 2007).

### v. Impacts may be indirect occurring at the ecosystem or community level

---

<sup>1</sup> refers to the colour appearance of the light emitted by a light source and is measured in degrees Kelvin (K). The CCT of a light source is calculated by relating the colour of the lamp to the light colour of a reference source when heated to a particular temperature. CCT gives a general measure of the “coolness” or “warmth” of the light source: CCT ratings below 3200K are considered warm whereas ratings above 4000K are considered cool. CCT gives an indication of the general appearance of the light, but not its spectral power distribution, and so two lamps that appear the same may have different colour rendering properties.

Lighting can impact bats via changes at the ecosystem level. Lighting may lead to a competitive advantage for some species which benefit from the increased foraging opportunities provided by moths attracted to lights with high UV content. This may lead to competitive exclusion of those species unable to take advantage of new artificially illuminated areas (Arlettaz *et al.* 2000). Indirect effects include effects on bats' insect prey. Bats have a competitive advantage over moths at street lights (Svensson & Rydell 1998), which interferes with the relationship between predator and prey.

A summary of the key impacts per species according to behaviour types is provided in Table 5.1. These are based on current knowledge and may change as more evidence emerges, so are given as guidance only and specific levels of impact will vary on a site by site basis. Low impact does not mean there is no impact, but suggests that impact is likely to have a negligible impact on the population. Further research is required to have high confidence in many of these predictions and therefore they should be used as guidance only.

**Table 5.1 Summary of predicted impacts of lighting according to bat behaviour.**

| Impact Behaviour | High                                                                                                              | Medium                                                                                                            | Low                                                                                                               |
|------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| Maternity roost  | All species                                                                                                       | -                                                                                                                 | -                                                                                                                 |
| Night roost      | <i>Rhinolophus hipposideros</i><br><i>Rhinolophus ferrumequinum</i><br><i>Myotis</i> spp.<br><i>Plecotus</i> spp. | <i>Pipistrellus</i> spp.<br><i>Nyctalus</i> spp.<br><i>Eptesicus serotinus</i><br><i>Barbastella barbastellus</i> | -                                                                                                                 |
| Emergence        | All species                                                                                                       | -                                                                                                                 | -                                                                                                                 |
| Foraging         | <i>Rhinolophus hipposideros</i><br><i>Rhinolophus ferrumequinum</i><br><i>Myotis</i> spp.<br><i>Plecotus</i> spp. | -                                                                                                                 | <i>Pipistrellus</i> spp.<br><i>Nyctalus</i> spp.<br><i>Eptesicus serotinus</i><br><i>Barbastella barbastellus</i> |
| Commuting        | <i>Rhinolophus hipposideros</i><br><i>Rhinolophus ferrumequinum</i><br><i>Myotis</i> spp.<br><i>Plecotus</i> spp. | -                                                                                                                 | <i>Pipistrellus</i> spp.<br><i>Nyctalus</i> spp.<br><i>Eptesicus serotinus</i><br><i>Barbastella barbastellus</i> |
| Swarming         | All species                                                                                                       | -                                                                                                                 | -                                                                                                                 |
| Hibernation      | All species                                                                                                       | -                                                                                                                 | -                                                                                                                 |

## Key messages and recommendations:

### Emergence and roosting

- Current evidence demonstrates that external light disturbance at emergence and return will have negative impacts for bats (especially *Rhinolophus*, *Myotis*, and *Plecotus* spp.) and should be avoided.
- Internal illumination of roosts is likely to impact negatively on long-term population growth and survival and should be avoided for all species.
- Direct illumination of a roost exit/entrance may cause roost abandonment for all species (particularly for *Rhinolophus* and *Myotis* spp.) and should be avoided.

### Commuting

- Light disturbance along commuting routes will cause avoidance behaviour for *R. hipposideros* and *Myotis* spp. and should be avoided.

### Foraging

- Light disturbance can reduce the availability of foraging areas for some species.
- A precautionary approach must be taken and illumination of foraging areas avoided, particularly for light sensitive species.

### Hibernation

- There is limited evidence of the impact of lighting on hibernating bats. However illumination of hibernation sites should be avoided during the hibernation period.

### Swarming

- There is a lack of evidence regarding the impact of lighting on bat swarming behaviour and so illumination of known or potential swarming sites should be avoided under the precautionary principle.

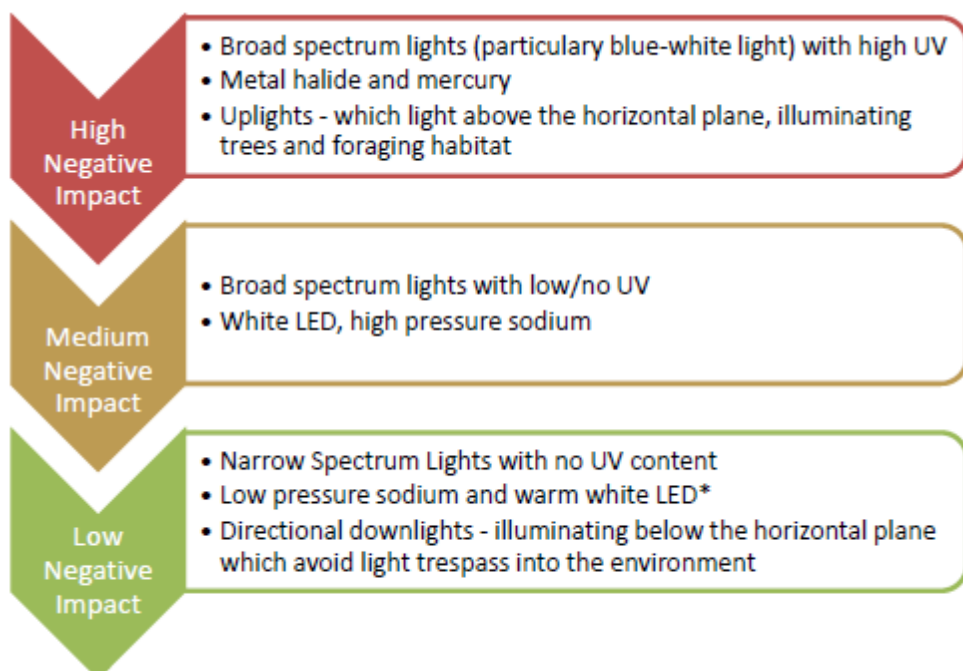
### Summary of impacts of light types on bats

Light technology is rapidly developing and new light types are being installed and trialled across the UK. There is a general trend towards white light due to the increased colour rendering and increased perceived brightness for the human eye. Humans perceive white light as brighter than yellow light and so lower light intensities can be used to achieve the same perceived brightness. Commonly used emerging lamps include white LED (Philips Stela and DW Windsor Monaro), warm-white LED, and ceramic metal halide (e.g. Philips 5. CosmoPolis). Some companies are testing new light types to find a wildlife friendly lamp which has little or no impact on wildlife e.g. QL Philips Clearsky lamps which are said to prevent migrating birds from colliding with offshore platforms. To date no such product has been rigorously tested on bats. However, there is little evidence of the comparative impacts of different light types on different bat species and behaviours.

The figures overleaf provides a general summary of the **relative** impacts of light types on bats. However, there is a lack of evidence regarding the comparative impacts of different light types on bats and these summaries should be considered general rules of thumb until more detailed information is available.

## Summary of the current evidence of the relative impacts of different light types on bats

| Light type           | Species                                                                        | Impact                                                                                                                                                                                   | Evidence                                                             |
|----------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| White LED            | <i>Rhinolophus hipposideros</i> and <i>Myotis</i> spp.                         | Reduced activity and spatial avoidance of commuting routes                                                                                                                               | Stone <i>et al.</i> , 2012                                           |
| Warm white LED       | Unknown at present                                                             | Unknown - though likely to have less impact on light sensitive species than white light types                                                                                            |                                                                      |
| Low pressure sodium  | <i>Nyctalus noctula</i>                                                        | Increased activity and foraging                                                                                                                                                          | Rydell & Baagoe 1996                                                 |
|                      | <i>Pipistrellus</i> spp.                                                       | No significant increase in activity compared to dark areas                                                                                                                               | Blake <i>et al.</i> , 1994                                           |
| High pressure sodium | <i>Rhinolophus hipposideros</i> and <i>Myotis</i> spp.                         | Reduced activity and spatial avoidance of commuting routes; delayed commuting time                                                                                                       | Stone <i>et al.</i> , 2009; 2011                                     |
|                      | <i>Pipistrellus</i> spp., <i>Nyctalus noctula</i> , <i>Eptesicus serotinus</i> | Increased activity and foraging                                                                                                                                                          | Rydell & Baagoe 1996                                                 |
| Compact fluorescent  | Unknown at present                                                             | Unknown - though likely to have a similar impact on light sensitive species as other white light types                                                                                   |                                                                      |
| Mercury vapor lamps  | <i>P. pipistrellus</i> and <i>Pipistrellus</i> spp.<br><i>Eptesicus</i> spp.   | Increased activity<br>(Rydell (1991) recorded increased activity of <i>Eptesicus nilssonii</i> (a species not present in the UK) at mercury vapor lamps in Sweden in spring April – May) | Haffner & Stutz 1985; Blake <i>et al.</i> 1994, Rydell & Racey 1995. |

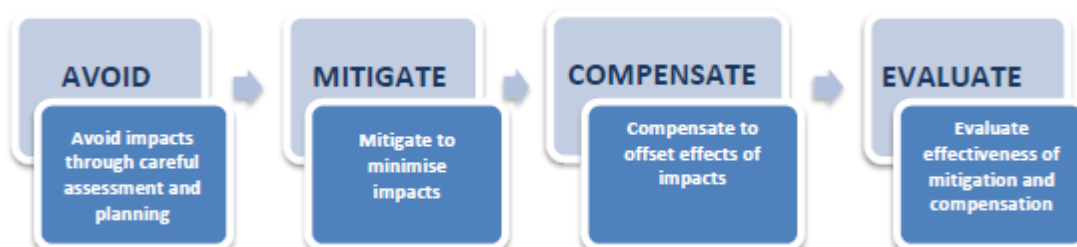


## Approach to mitigation of artificial lighting

When mitigating the impacts of artificial lighting on bats it is important to ask the following key questions:

1. Do we need to light?
2. Where does the light need to be?
3. What is the light required for?
4. How much light is actually needed to perform the tasks required ?
5. When is the light required?

The following approach should be taken when developing a mitigation strategy:



## Mitigation Strategies

Mitigation strategies will vary on a site by site basis according to the required level of lighting, use of the area, the surrounding habitat, the species of bat and specific behaviour affected.

### No light

Where possible the ideal scenario would be to have no light at all at locations used by bats. This may be possible with good planning and involvement of lighting engineers at the survey and pre-planning stage. This may involve switching off existing units on site and ensuring areas used by bats have no new light units installed and will have no light trespass from nearby lights. If possible sites should contain light exclusion zones (dark areas) which are interconnected to allow bats to move freely from their roosts along commuting routes to their foraging grounds without being subject to artificial illumination.

### Variable lighting regimes (VLR)

In many cases it is not feasible to have light exclusion zones in all in the areas occupied by bats at a site. In such cases new generation lighting controlled by CMS systems may be preferable to enable variable lighting regimes (VLR) to suit both human and wildlife use of the site. VLR involve switching off or dimming lights for periods of the night. Many county councils are adopting VLR using CMS controlled units, switching off/dimming lights when human activity is low (e.g. 12.30 – 5.30am). This technology could also be used to create a lighting regime that switches off lights during periods of high bat activity, such as commuting or emergence. Lights can also be dimmed (e.g. to 30% power) for periods of the night to reduce illumination and spill. The exact regime of lighting at a site will depend on the nature of public use and type and amount of bat activity, and will therefore vary between sites.

### Habitat creation

- **Light barriers:** vegetation can be planted (e.g. hedgerows or trees) to reduce light spill so acts as a light barrier. Careful consideration should be given to the minimum size of the habitat required to restrict any light trespass when used as a light barrier. The size and depth of the corridor will vary according to the distance from the light source, light intensity, light spread and light type.

- **Dark corridors:** dark corridors can be created to encourage/guide bats away from lit areas or around lit obstacles (such as roads). Corridors should be placed with consideration for the use of the landscape as a whole in relation to key commuting routes, linking foraging sites and roosts. Corridors can be composed of man-made or natural materials (e.g. fences, brick walls, tree lines or hedges). Corridors with outgrown vegetation are preferable as they create dark fly ways sheltered from predators and the elements. Heavily clipped low hedges or tree-lines are less suitable. To increase their effectiveness dark corridors should be:
  - i. Well-connected within the bat landscape – linking to existing flight paths, roosts or foraging areas;
  - ii. Outgrown with mature vegetation providing shelter for bats from the weather and predators as they fly;
  - iii. Planted with native species to encourage insect populations, thereby allowing bats to forage along the corridors;
  - iv. Located away from roads to avoid traffic noise which will reduce the foraging efficiency of passive listening bats (Schaub 2008); and
  - v. Monitored/maintained long-term to ensure they remain functional, e.g. have not been removed or altered in a way that will reduce effectiveness.

### Spacing and height of units

Increasing the spacing between light units can reduce the intensity and spread of the light to minimise the area illuminated and give bats an opportunity to fly in relatively dark areas between lights. Reducing the height of light units will keep the light as close to the ground as possible, reducing the volume of illuminated space. This will also give bats a chance to fly over the light units in the dark area above the light (as long as the light does not spill above the vertical plane). There are many low level lighting options for pedestrian and cycle path lighting which minimise spill and reduce overall illumination including: low level illuminated bollards, down-lights, handrail lighting or footpath lighting.

### Reducing intensity

Reducing light intensity will reduce the overall amount and spread of illumination. For some bat and insect species this may be sufficient to minimise disturbance or the magnitude of any negative impacts. However, some species may require very low light levels to have little/no impact on bat behaviour. Stone *et al.*, (2012) found that levels as low as 3.6lux caused spatial avoidance of a preferred commuting route by *Rhinolophus hipposideros*. Average light levels recorded along preferred commuting routes of *Rhinolophus hipposideros* under natural unlit conditions were 0.04 lux across eight sites (Stone 2011). When mitigating the impacts of lighting for such species very low lux levels may not be suitable for human needs. In such cases reducing intensity may not be an option and alternative strategies may be preferable (e.g. dark corridors or light barriers). A “light threshold” below which there is little impact on bats may not exist for some species which may be light averse regardless of intensity (e.g. possibly *Rhinolophus hipposideros*). Light intensity can be reduced by:

- **Dimming:** CMS technology can be used to reduce the power of lights on request (e.g. by 80%) and can be used as part of a VLR for periods of high bat activity;
- **Changing the light source:** new technologies such as ceramic metal halide (e.g. Philips CosmoPolis, 45 watts) often have a lower wattage compared to old lamp types (e.g. HPS, 75 watts), and can be used to reduce light intensity. However, there is a trade-off between reduced intensity and the pattern of light distribution. Some older light types such as HPS, produce a heterogeneous light environment whereby light intensity declines steeply away from the light source. However some new technologies such as LEDs produce a uniform light distribution resulting in a loss of dark refuges between the lamps (Gaston *et al.* 2012). In such cases it may be preferable to increase the spacing between the units to create dark refuges. In addition when changing the light source it is important to consider the effects of the spectral content of the light; or

- *Creating light barriers:* light intensity can be reduced at a particular site by creating a light barrier which restricts the amount of light reaching the sensitive area. Barriers can be in the form of newly planted vegetation walls, fences or buildings.

### **Changing the light type**

When selecting a light type it is important to consider the colour appearance and rendering of the lamps in relation to human and bat vision. Different light types are likely to have different effects on bats, and these effects will be species and behaviour specific. Choosing the light type (colour/spectral distribution) will inevitably be a compromise between the environmental and public requirements. Currently there is a lack of evidence of the comparative impacts of light types on bats. However, the following key principles can reduce potential negative impacts on bats and wildlife in general:

- *Avoid blue-white short wavelength lights:* these have a significant negative impact on the insect prey of bats. Use alternatives such as warm-white (long wavelength) lights as this will reduce the impact on insects and therefore bats
- *Avoid lights with high UV content:* (e.g. metal halide or mercury light sources), or reduce/completely remove the UV content of the light. UV has a high attractiveness to insects leading to direct insect mortality at street lights thereby reducing the availability of insect prey (Bruce-White & Shardlow 2011). Use UV filters or glass housings on lamps which filter out a lot of the UV content.

### **Reducing spill**

Lighting should be directed only where it is needed to avoid trespass (spilling of light beyond the boundary of area being lit). Attention should be paid to avoid the upward spread of light near to and above the horizontal plane to minimise trespass and sky glow. Trespass can be minimised either prior to installation with careful lighting design and selection of appropriate lamp units, or post installation using a range of lamp modifications to restrict and direct light.

#### *Prior to installation:*

- Ensure a low beam angle of the lights (ideally less than 70° above the horizontal) (ILP, 2011)
- Install full horizontal cut off units (with no light more than 90° above the horizontal)
- Avoid the use of upward light (e.g. ground recessed luminaires or ground mounted floodlights up-lighting trees, buildings and vegetation)
- For security lighting use 'variable aim' luminaries which allow you to change the beam angle by moving the lamp
- LED lamps allow for directional lighting as individual/groups of LED bulbs can be switched off to direct light to specific angles and most luminaires are full cut off

#### *Post installation:*

- Install directional accessories on existing light units to direct light away from sensitive areas and minimise spill (e.g. baffles, hoods and louvres)
- Where possible change the angle of the lamp housing to reduce the angle of the beam below 70°