



· LIGHTING DESIGN · ELECTRICAL · SMART CITIES ·  
ENERGY REDUCTION · LIGHTING IMPACT

# FLAX BOURTON

## TECHNICAL REPORT

### TO DISCHARGE PLANNING CONDITION 23

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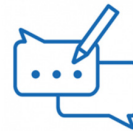
Quality



Knowledgeable



Dependable



Clear Advice

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## 1. INTRODUCTION

### 1.1. Executive Summary

1.1.1. This Technical Report has been written by DFL (Designs for Lighting Ltd), a lighting design consultancy specialising in Lighting Impact Assessments, obtrusive light mitigation, and detailed lighting design.

1.1.2. This Technical Report proposed to discharge the following planning condition:

*[Bats - Lighting - No lighting shall be installed until a full and final specification for external and internal lighting consistent with but not limited to Lighting Strategy (DFL, January 2023), and accompanying Horizontal Illuminance Plan including:*

- i. details of the model and location of the proposed lighting,*
- ii. existing lux levels affecting the site,*
- iii. the proposed lux levels including lighting contour plans; and*
- iv. measures to minimise internal and external light spill to below 0.2-0.5 lux onto nearby habitats through mitigation such as PIR sensors and timers, placement and type of fittings and physical barriers to prevent light spill such as low transmittance glazing, solid fencing and automated blackout blinds'*

1.1.3. The Lighting Strategy within this document, proposes good practice and outlines a suitable approach for the proposed lighting, aiming to set out a minimally obtrusive approach to the lighting, whilst ensuring it is necessary and considers the sensitivity of nearby human, environmental and ecological receptors.

1.1.4. The Application Site is Cambridge Batch Garage, Weston Road, Long Ashton, Bristol, North Somerset shown in **Figure 1**. Only plots 8 and 10 have been modelled as they are closest to sensitive areas and are used as a worst case indication of spill light.

1.1.5. Lighting associated with the Proposed Development will comply with relevant British Standards and Institution of Lighting Professionals (ILP) guidance to ensure obtrusive light is minimised in accordance with best practice.

1.1.6. This report outlines the following:

- Relevant obtrusive light policies in direct relation to the Proposed Development;

- Relevant National and Local Policies;
- Why the Proposed Development requires artificial lighting; and
- Details as to how lighting will be implemented for the Proposed Development.

1.1.7. It has been determined that the Application Site is considered to be in an E2 Environmental Zone.

1.1.8. Through careful design and mitigation, this Lighting Strategy ensures the lighting installation at the proposed development will be in accordance with British Standards, Guidance and Local Policy.



*Figure 1: The Application Site location and boundary*

## 2. LEGISLATIVE FRAMEWORKS AND LOCAL POLICIES

### 2.1. National Policies

#### **Environmental Protection Act 1990 / Clean Neighbourhoods and Environment Act 2005**

2.1.1. Since 2005, artificial light has been incorporated as a potential statutory nuisance. An amendment to section 79 of the Environmental Protection Act 1990, contained within the Clean Neighbourhoods and Environment Act 2005 states:

*“Artificial light emitted from premises so as to be prejudicial to health and nuisance constitutes a ‘Statutory Nuisance’ and it shall be the duty of every local authority to cause its area to be inspected from time to time to detect any statutory nuisances which ought to be dealt with under section 80 and, where a complaint of a statutory nuisance is made to it by a person living within its area, to take such steps as are reasonably practicable to investigate the complaint”*

#### **National Planning Policy Framework 2023**

2.1.2. The National Planning Policy Framework (NPPF) sets out the government’s planning policies for England and how they are expected to be applied and provides a framework for local plans. With regard to light pollution, the NPPF was updated in December 2023 and states that the following elements are to be considered:

*“Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:*

- *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and*

- *limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.”*

### **Planning Practice Guidance**

2.1.3. Guidance for assessing the effects of proposed artificial lighting is outlined in the planning practice guidance (PPG). The guidance states:

*“Does an existing lighting installation make the proposed location for a development unsuitable, or suitable only with appropriate mitigation? For example, this might be because:*

- *the artificial light has a significant effect on the locality; and/or*
- *users of the Proposed Development (e.g., a hospital) may be particularly sensitive to light intrusion from the existing light source.*

*Where necessary, development proposed in the vicinity of existing activities may need to put suitable mitigation measures in place to avoid those activities having a significant adverse effect on residents or users of the proposed scheme, reflecting the agent of change principle. Additional guidance on applying this principle is set out in the planning practice guidance on noise.*

- *Will a new development, or a proposed change to an existing site, be likely to materially alter light levels in the environment around the site and/or have the potential to adversely affect the use or enjoyment of nearby buildings or open spaces?*
- *Will the impact of new lighting conflict with the needs of specialist facilities requiring low levels of surrounding light (such as observatories, airports and general aviation facilities)? Impacts on other activities that rely on low levels of light such as astronomy may also be a consideration but will need to be considered in terms of both their severity and alongside the wider benefits of the development.*
- *Is the development in or near a protected area of dark sky or an intrinsically dark landscape where new lighting would be conspicuously out of keeping with local nocturnal light levels, making it desirable to minimise or avoid new lighting?*



- › *Would new lighting have any safety impacts, for example in creating a hazard for road users?*
- › *Is a proposal likely to have a significant impact on a protected site or species? This could be a particular concern where forms of artificial light with a potentially high impact on wildlife and ecosystems (e.g. white or ultraviolet light) are being proposed close to protected sites, sensitive wildlife receptors or areas, including where the light is likely to shine on water where bats feed.*
- › *Does the Proposed Development include smooth, reflective building materials, including large horizontal expanses of glass, particularly near water bodies? (As it may change natural light, creating polarised light pollution that can affect wildlife behaviour.)”*

## **2.2. Relevant Local policies**

2.2.1. The relevant Local Planning Authority (LPA) for the Proposed Development is the North Somerset Council with policies detailed within the North Somerset Council Core Strategy adopted January 2017 to the lighting associated with the Proposed Development.

The applicable policies are:

### **CS3: Environmental Impact and Flood Risk Management.**

*‘Development that, on its own or cumulatively, would result in air, water or other environmental pollution or harm to amenity, health or safety will only be permitted if the potential adverse effects would be mitigated to an acceptable level by other control regimes, or by measures included in the proposals, by the imposition of planning conditions or through a planning obligation.’*

### **CS12: Achieving high quality design and place-making.**

*‘Development proposals should demonstrate a commitment to designing out crime through the creation of safe environments (both private and public) that benefit from natural surveillance, visible streets and open spaces, lighting and other security measures. Achieving Secured by Design certification will help to demonstrate how designing out crime has been taken into account.’*

## 3. BRITISH STANDARDS AND GUIDANCE

### 3.1. British Standards

3.1.1. No British Standards are applicable to this development.

### 3.2. Guidance

#### 3.2.1. **Guidance Notes for the Reduction of Obtrusive Light (Institution of Lighting Professionals GN01:2021)**

The Lighting Strategy is informed by industry guidance notes which aim to reduce the potential for obtrusive light to occur, which is typically caused by poorly designed and installed exterior artificial lighting. The Lighting Strategy is informed by the most relevant sections of GN01/21 that has recently been published to reduce the potential for obtrusive light from a wide range of exterior lighting applications.

#### 3.2.2. **GN08:2023 Bats and Artificial Lighting in the UK – Bat Conservation Trust and Institution of Lighting Professionals.**

This document is aimed at lighting professionals, lighting designers, planning officers, developers, bat workers/ecologists and anyone specifying lighting. It is intended to raise awareness of the impacts of artificial lighting on bats, and mitigation is suggested for various scenarios. However, it is not meant to replace site-specific ecological and lighting assessments.

### 3.3. Specifications

3.3.1. Institution of Lighting Professionals (ILP) PLG 04 “Guidance on Undertaking Environmental Lighting Impact Assessments”, 2013

3.3.2. PLG 04 is used to ensure that the Lighting Impact Assessment is correctly carried out:

*“...this document is designed to provide an explanation of, and guidance on, the process for producing a Lighting Assessment...to remove or minimise environmental problems”.*

## 4. DESKTOP STUDY

### 4.1. Site Description and Context

4.1.1. The Baseline survey is based on a desktop assessment of the surrounding environment.

4.1.2. The Application Site is located to the northeast of the village of Flax Bourton. On the site currently is a car dealership. To the north of the site lies agricultural land and with sporadic agricultural buildings. The Site is separated by existing hedgerow into two distinct parts and the boundaries are predominantly characterised by established hedgerows and trees. An indicative boundary of the site and proposed layout can be seen in **Figure 1**.

4.1.3. The Proposed Development comprises the redevelopment of the site for residential use. This consists of eleven dwellings of varying sizes are proposed, alongside required infrastructure and landscaping with vehicular access from Walton Road. The Site Layout Plan is shown in **Figure 2**.

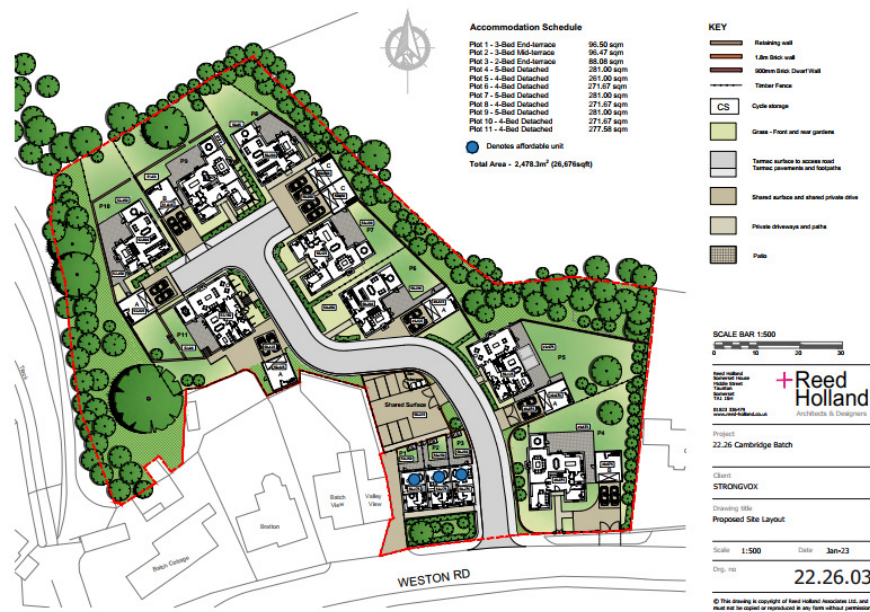
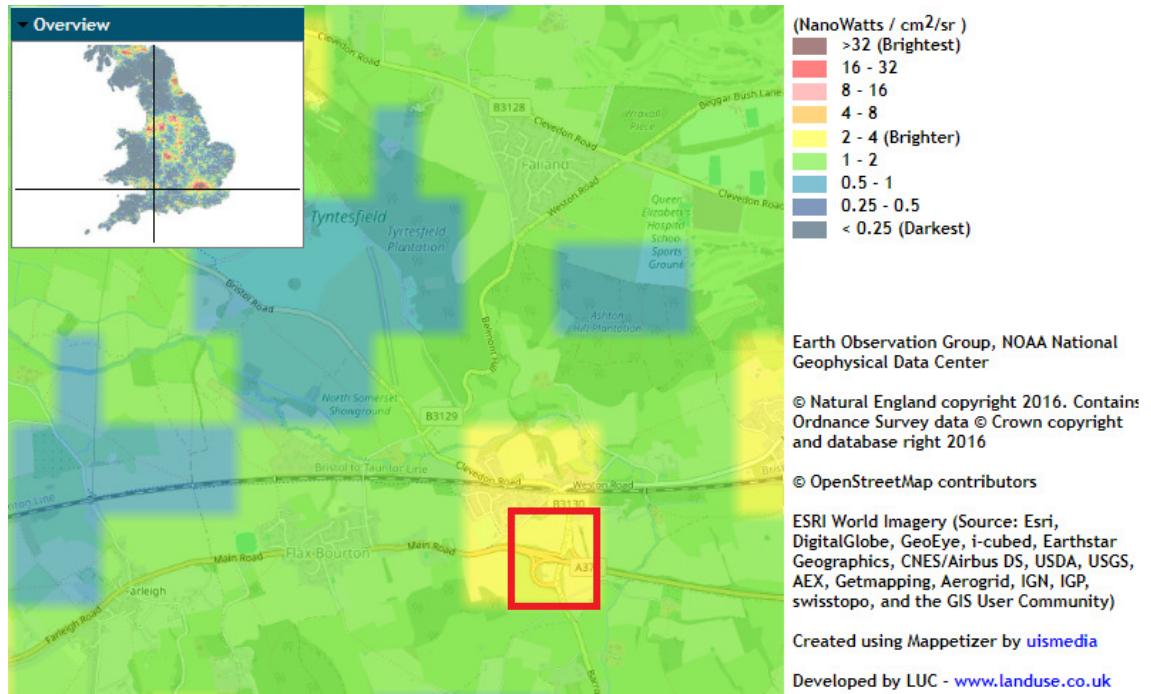


Figure 2: Proposed Development Site layout plan

### 4.2. CPRE Night Blight Mapping

4.2.1. To inform the Environmental Zone classification, the CPRE Night Blight Mapping confirms the skyward radiance within the vicinity of the Application Site is between 2 - 4 Nano Watts/cm<sup>2</sup>/sr. As shown in **Figure 3**, the likely levels of skyglow within the vicinity of the Application Site are similar to those expected within an E2 zone.



**Figure 3: Surrounding areas/roads**

Notes for Figure 3

- The CPRE Mapping data is satellite-based information and indicates upward light spill based on sky glow.
- The NightBlight Map is a visual representation of light pollution as a view from above the earth's atmosphere.
- CPRE Mapping data is not used in isolation and is only used to assist in concluding the environmental zone.

The Environmental Zone criteria detailed within **Table 1** and **Table 2** informs the basis of the Lighting Strategy. The Application Site is considered to be located within an E2 Environmental Zone, because it is a sparsely inhabited rural area.

Zone	Surrounding	Lighting Environment	Examples
<b>E0</b>	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA Dark Sky Parks.
<b>E1</b>	Natural	Intrinsically dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, etc.
<b>E2</b>	Rural	Low district brightness (SQM ~ 15 to 20)	Sparsely inhabited rural areas, Village or relatively dark outer suburban locations.
<b>E3</b>	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres or suburban locations.
<b>E4</b>	Urban	High district brightness	Town / City centres with high levels of night-time activity.

**Table 1: Environmental Zone Descriptions**

*Notes:*

1. Where an area to be lit lies on the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.
2. Rural zones under protected designations should use a higher standard of policy.
3. Zone E0 must always be surrounded by an E1 Zone.
4. Zoning should be agreed with the local planning authority and due to local requirements a more stringent zone classification may be applied to protect special/specific areas.
5. SQM (Sky Quality Measurements) referenced by the International Dark-Sky Association (IDA), the criteria for E0 being revised in mid-2019 but not retrospective.
6. Astronomical observable dark skies will offer clearer views of the Milky Way and of other objects such as the Andromeda galaxy and the Orion Nebula.
7. Although values of SQM 20 to 20.5 may not offer clear views of astronomical dark sky objects such as the Milky Way, these skies will have their own relative intrinsic value in the UK.

Environmental Zones	Sky Glow ULR (Max %)	Light Trespass (Into Windows) E <sub>v</sub> (lux)		Building Luminance Average, Pre-curfew
		Pre- Curfew	Post-Curfew	Average L (cd/m <sup>2</sup> )
<b>E0</b>	0	0	0	0
<b>E1</b>	0	2	0 (1*)	0
<b>E2</b>	2.5	5	1	5
<b>E3</b>	5	10	2	10
<b>E4</b>	15	25	5	25

**Table 2: Obtrusive Light Criteria**

- > ULR (Upward Light Ratio) is the maximum permitted percentage of luminaire flux that goes directly into the sky.
- > E<sub>v</sub> is Vertical Illuminance in Lux.
- > L is Luminance in Candelas per square metre; and
- > Curfew refers to a time when the local planning authority has agreed that the lighting installation should be switched off; this typically refers to 23h00 – 07h00.
- > (\*) Permitted only from public road lighting installations up to a maximum of 1.0 lux.

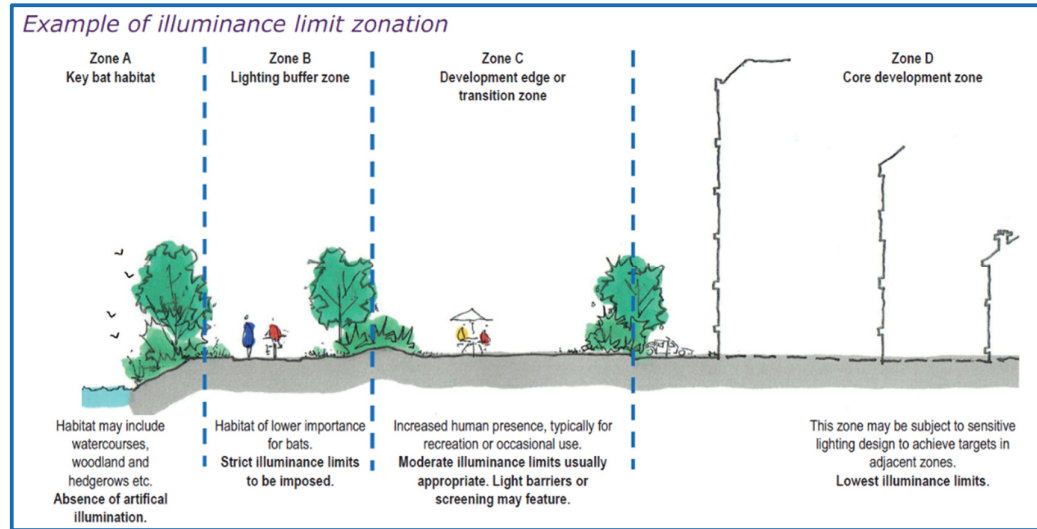
### 4.3. Ecology

4.3.1. The Site is bounded by native hedgerows, semi-mature trees, all considered to be of local ecological importance. These native hedgerows and trees are identified within the Ecological Impact Assessment Report (Ethos Environmental Planning) that was submitted to North Somerset Council in June 2023. This report therefore confirms that these boundaries are to be treated as sensitive receptors with evidence that there is some use of these hedgerows by bats as flight corridors. Guidance for artificial lighting and bats was updated in Autumn 2023, the guidance states the following:

*“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 adverse behaviour (Stone, 2012).”*

*“A warm white light source (2700Kelvin or lower) should be adopted to reduce blue light component.”*

*“A buffer zone subdivided to into smaller zones of increasing illuminance limit further away from the Supporting Habitat would ensure light levels (illuminance - measured in lux) do not exceed certain defined limits. This has the effect of a gradual decrease in lighting from the developed zone, rather than a distinct cut-off, which may provide useable area for the project which also limits lighting impacts on less sensitive species, or less well-used habitat.” (see Figure 4).”*



**Figure 4: Example of lighting zonation near sensitive boundaries and known ecological habitat**

## 5. ASSESSMENT METHODOLOGY

### 5.1. Methodology

- 5.1.1. The assessment has been carried out in accordance with the published guidance documents from the ILP. These quantify the levels of direct upward light, light intrusion, viewed source intensity and glare regarded as acceptable for varying Environmental Zones.
- 5.1.2. This Technical Report is desk-top based study. The methodology employed for this assessment is appropriate to the location of the site. It comprises a desk-top study of the legislative, policy and guidance context; consultation with the design team; and evaluation of the likely effects of the proposed lighting using appropriate assessment criteria.
- 5.1.3. The desktop study involved research into relevant legislation, policy and guidance relating to obtrusive light and lighting within the Local Authority. It also involved studying of ordnance survey maps, plans and aerial photography to identify likely receptor locations.

### 5.2. Study Area

- 5.2.1. The desktop study area was determined by assessing the potential impact that the Proposed Development would have on nearby sensitive areas within the limits of the planning condition.

### 5.3. Potential Effects from Artificial Light

- 5.3.1. The following potential effects can arise from inappropriately designed artificial lighting:

#### **Effects from light intrusion from exterior lighting on residents (through windows)**

- 5.3.2. Light intrusion (or light spill) is the term for the spilling of light beyond the boundary of the area being lit. The ILP Guidance Notes places a limit on the amount of vertical Illuminance which falls upon the centre of a dwelling window. The suggested maximum values quoted are relative to the amount of light measured as a baseline without the presence of the obtrusive light source.



### **Effects from viewed source intensity on residents and sightseers**

- 5.3.3. Table 4 within ILP GN01/21 advises limits on luminaire intensity or viewed source intensity from luminaires to an observer. The greatest effects are usually encountered from poorly aimed floodlights or security lighting, or from lighting which is located too close to properties.

### **Effects from upward light (or sky glow)**

- 5.3.4. Light emitted above the horizontal either directly from luminaires or indirectly as reflected light from surfaces such as the landscape or buildings, has the potential to cause sky glow. The ILP “Guidance Notes for the Reduction of Obtrusive Light” places limits on the percentage of direct upward light emitted from the luminaires in their installed attitude, which is dependent upon the Environmental Zone in which the Application Site lies.
- 5.3.5. Indirect upward light is subject to surface reflectance properties. It is not easily quantifiable but is unlikely to be as significant as direct upward light from luminaires.

### **Effects from disability glare on transport users**

- 5.3.6. The lighting is designed to be installed such that glare is minimised in accordance with the ILP guidance notes GN01:21 (Table 4 within ILP GN01/21).

### **Effects from light on bat roosts and insects**

- 5.3.7. Light falling on a roost access point will at least delay some species of bats from emerging and this shortens the amount of time available to them for foraging. As the main peak of nocturnal insect abundance occurs at and soon after dusk, a delay in emergence means this vital time for feeding is missed.
- 5.3.8. Insects and foraging in addition to causing disturbance to bats at the roost, artificial lighting can also affect the feeding behaviour of bats. There are two aspects to this - one is the attraction that light from certain types of lamps has to a range of insects, the other is the presence of lit conditions causing bats to exhibit their light adverse behaviours.

## **5.4. Classification of Environmental Zone**

- 5.4.1. The ILP Guidance Notes quantify the levels of Obtrusive light regarded as acceptable for varying Environmental Zones (E0 to E4) as shown in Table 1.
- 5.4.2. The Application Site is representative of “Sparsely inhabited rural areas”; therefore the lighting of the Proposed Development will follow E2 Environmental Zone criteria in accordance with ILP Guidance Notes

## **5.5. Obtrusive Light Limitations**

- 5.5.1. In the absence of suitable statutory guidance, the ILP “Guidance Notes for the Reduction of Obtrusive Light” GN01:2021 is typically used, in order to provide suitable assessment criteria against which to assess the likely effects of artificial lighting on human receptors and the night sky.
- 5.5.2. The relevant criteria of upward light, light intrusion and direct source intensity for the relevant Environmental Zone are detailed in Table 2.
- 5.5.3. Guidance published by the ILP and the Bat Conservation Trust is used to assess the effects of lighting on protected light sensitive ecology.

## **5.6. Assumptions and Limitations**

- 5.6.1. This assessment assumes that the design and installation of artificial lighting associated with the Proposed Development will be undertaken by suitably qualified and experienced designers and contractors, who are capable of carrying out such works, and that the detailed lighting design follows the Lighting Strategy provided in **Appendix 1**.
- 5.6.2. As the application has outlined, a 3-d model has been undertaken to show how the light from the dwelling windows may be perceived. At the detailed design stage, it is recommended that detailed obtrusive light calculations are conducted, and the results are clearly demonstrated to show compliance with the requirements set out in this Lighting Impact Assessment.

## 6. THE APPLICATION SITE

### 6.1. Site Description and Context

- 6.1.1. The Application Site is Cambridge Batch Garage, Weston Road, Long Ashton.
- 6.1.2. The Application Site currently consists of new residential properties surrounded on several sides by pastureland and a small residential area to the South-West.

### 6.2. Desktop Assessment

- 6.2.1. During the desktop assessment, publicly available information was used to assess the Application Site and the surrounding area to inform the identification of potentially sensitive receptors, and the Environmental Zone applicable to the Application Site and the surrounding area.
- 6.2.2. Information used during the desktop assessment includes:
  - 1. The Countryside Charity (CPRE) Skyward Radiance Mapping,
  - 2. Aerial photography and mapping; and
  - 3. Google imaging data.
- 6.2.3. As can be seen in **Figure 3** the Application Site and the surrounding area contains existing levels of skyward radiance ranging between 2-4 NanoWatts/cm<sup>2</sup>/sr, indicating the area contains low levels of skyward radiance.
- 6.2.4. The Application Site and the surrounding area is “*low district brightness*” and is typical of “*Sparsely inhabited rural area*”. An E2 Environmental Zone has been chosen to inform the Lighting Impact Assessment and Lighting Strategy (**Table 1 and 2**).
- 6.2.5. No ecology report has been carried out to determine if any sensitive ecology receptors are likely to be impacted by the change to the Proposed Development.
- 6.2.6. This assessment will therefore focus on the spill light from the proposed glazing of the new dwellings as the closest light source.
- 6.2.7. A model of the vertical illuminance bounding the ecologically sensitive receptors was undertaken, the results are presented in **Appendix 2**.

## 7. SUMMARY OF RESULTS

### 7.1. Overview

7.1.1. The 3-d model as demonstrated in **Appendix 2** shows that the spill light from the Proposed development does not exceed the requirements of the planning condition below;

*iv. measures to minimise internal and external light spill to below 0.2-0.5 lux onto nearby habitats through mitigation such as PIR sensors and timers, placement and type of fittings and physical barriers to prevent light spill such as low transmittance glazing, solid fencing and automated blackout blinds'*

7.1.2. The two vertical grids positioned to measure the spill light from Plot 8 and Plot 10 give a reading of  $E_{max} = 0.28$  for Plot 8 and 0.48 for Plot 10. These meet the requirement of the planning condition of a maximum of 0.5 lux.

7.1.3. To ensure the worst-case scenario has been modelled, the highest potential light levels have been modelled / presented in the light spill diagram, with the project maintenance factors set at  $MF = 1.0$ . This demonstrates the light levels at their highest (initial light levels at the start of luminaire life).

7.1.4. The glazing is assumed to be at least double glazing with a transmission of 80%.

## 8. CONCLUSION

### 8.1. General

- 8.1.1. Lighting associated with the Proposed Development shall be designed in accordance with the Lighting Strategy for the Application Site outlined in Appendix 2.
- 8.1.2. This lighting strategy has been written in accordance with the relevant British Standards, industry guidance and local policies to ensure it is unlikely to give rise to obtrusive light with the potential to affect human, environmental and ecological receptors.
- 8.1.3. Through the application of this lighting strategy sensitive receptors will not be adversely affect by obtrusive light, as shown in **Appendix 2**
- 8.1.4. Through careful design and mitigation, this Lighting Strategy ensures the lighting installation at the proposed development will be in accordance with British Standards, Guidance and Local Policy.
- 8.1.5. The planning condition has been discharged by the following;
- i. Information of the models and positioning of the proposed street lighting can be found in 2803-DFL-ELG-XX-RP-EO-13001-S3-P01 and **Appendix 1**. The internal lighting has been placed to ensure a lighting level of approximately 100 lux and the effect can be seen in **Appendix 2**.
  - ii. As no site survey was carried, a desktop assessment was carried out. It is unknown if the area is lit during the hours of darkness therefore it has been assumed that the existing site is dark as this is the worst case where an introduction of new light could have the greatest effect. The existing site contains a car dealership open between the hours of 07:30 and 16:00.
  - iii. Proposed Lux levels and lighting contours can be found in 2803-DFL-ELG-XX-LD-EO-13001-S3-P01 and **Appendix 2**.
  - iv. Controls for the exterior lighting has been shown in the Lighting Strategy in Appendix 1 and include PIR sensors to minimise the time that the lights are active. For the interior lighting the windows are assumed to be double glazed which will reduce the transmission of spill light from the houses. The wall shown on the plans has been added to help mitigate the spill light. Where the use of the wall mounted luminaires at entrances and exits will cause the vertical grids to exceed what is deemed acceptable, these luminaires have been removed. The vertical grids shown in **Appendix 2** meet the requirement of Emax to be between 0.2-0.5 lux.

## APPENDIX 1 – LIGHTING STRATEGY

### 9. LIGHTING STRATEGY

#### 9.1. Brief

- 9.1.1. The Proposed Development will require lighting for safety, wayfinding, security and amenity at limited times during the hours of darkness. Lighting will be fit for purpose and sensitive to nearby human and ecological receptors.
- 9.1.2. Lighting will be required for limited periods of time when movement is detected at the exterior of the dwelling.
- 9.1.3. The following criteria seeks to ensure that the lighting is not outside of the obtrusive light limits for the Environmental Zone in which the Application Site is located, is sensitive to the area, and provides an acceptable level of lighting for all areas requiring illumination (as modelled in **Appendix 2**).
- 9.1.4. Amenity lighting for the Proposed Development will be provided through the provision of wall-mounted downlights mounted at a height no greater than 2.0m FFL (finished floor level).
- 9.1.5. All exterior luminaires are to be mounted with 0-degree tilt from the horizontal to prevent any upward light spill in line with guidance outlined by the IDA (International Dark Skies Association<sup>1</sup>).
- 9.1.6. All lighting unless otherwise stated is to emit a warm white colour temperature light (3000 Kelvin or less) to reduce the potential for adverse effects onto potentially sensitive receptors.
- 9.1.7. Lighting spill from the dwelling has been shown using Dialux Evo, an industry recognised software. Some assumptions have been made as the transmission of the glass and the position and type of the exterior lighting.
- 9.1.8. Information on the types and positioning of road lighting to meet the British Standard specified lighting class can be found be 2803-DFL-ELG-XX-RP-EO-13001-S3-P01 and 2803-DFL-ELG-XX-LD-EO-13001-S3-P01.

#### 9.2. Property Frontages and Rears

- 9.2.1. The Application Site frontages and rears are to be illuminated for the sake of wayfinding, safety, security and amenity of the Proposed Development.

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<sup>1</sup> <https://www.darksky.org/our-work/lighting/lighting-for-citizens/lighting-basics/>

- 9.2.2. Luminaires will distribute light downwards only, to reduce the potential for light spill onto the boundaries surrounding the building and upwards towards the sky.
- 9.2.3. Luminaires are to be mounted no greater than 2.0 meters FFL in order to restrict the surrounding light levels.
- 9.2.4. Luminaire performance parameters for the illumination of the entrance and exit points within the Proposed residential property can be found in **Table 1.1**.
- 9.2.5. These luminaires have not been added to every exit point. Where a luminaire negatively impacted the vertical grid set to calculate the spill light, this luminaire has been removed (see Plot 10).

<u>Equipment Specification</u>	<u>Description</u>
<b>Location</b>	Property Frontages and Rears
<b>Correlated Colour Temperature (Kelvin)</b>	3000K (maximum)
<b>Luminaire Manufacturer</b>	Ligman (or similar approved)
<b>Luminaire Model</b>	Jet Downlight (or similar approved)
<b>Light Source</b>	LED (Light Emitting Diode)
<b>Height</b>	2.0 m FFL (Maximum)
<b>Mounting Arrangement</b>	Wall mounted
<b>Luminaire Tilt</b>	0%
<b>Example Luminaire Image</b>	
<b><u>Design Guidance</u></b>	
<b>Lighting Class</b>	N/A
<b>Lighting Design Criteria</b>	At entrances only
<b>Controls</b>	To be controlled via Infrared PIR detection system ON – On Movement, OFF – 30 Seconds with no movement

**Table 1.1: Performance and installation requirements**

### 9.3. Interior Lighting

- 9.3.1. The interior lighting is to use recessed downlighters on the ground and first floor and surface mounted downlighters in the second storey to allow for the pitch of the roof. These are all set to point downwards to minimise any upward light that could spill through the windows.
- 9.3.2. The lighting level for each living area must not exceed 150 lux and as a default the lighting is set to 100 lux.
- 9.3.3. To minimise sky glow the skylights should have automatic shutters that close automatically at dusk.
- 9.3.4. The interior lighting has been included to give an indication of the possible light spill from windows without blinds / curtains pulled. Double glazing has been used with a transmission of 80%.


<u>Equipment Specification</u>	<u>Description</u>
<b>Location</b>	Interior Lighting
<b>Correlated Colour Temperature (Kelvin)</b>	2700K (maximum)
<b>Luminaire Manufacturer</b>	Collingwood (or similar approved)
<b>Luminaire Model</b>	H2 Pro 7W / 1901 Baffled Rotatable Spot Narrow Beam (or similar approved)
<b>Light Source</b>	LED (Light Emitting Diode)
<b>Height</b>	Ceiling Height
<b>Mounting Arrangement</b>	Ceiling recessed / Surface mounted
<b>Example Luminaire Image</b>	
<b><u>Design Guidance</u></b>	
<b>Lighting Class</b>	N/A
<b>Lighting Design Criteria</b>	100 lux approximately
<b>Controls</b>	

Table 1.2: Performance and installation requirements



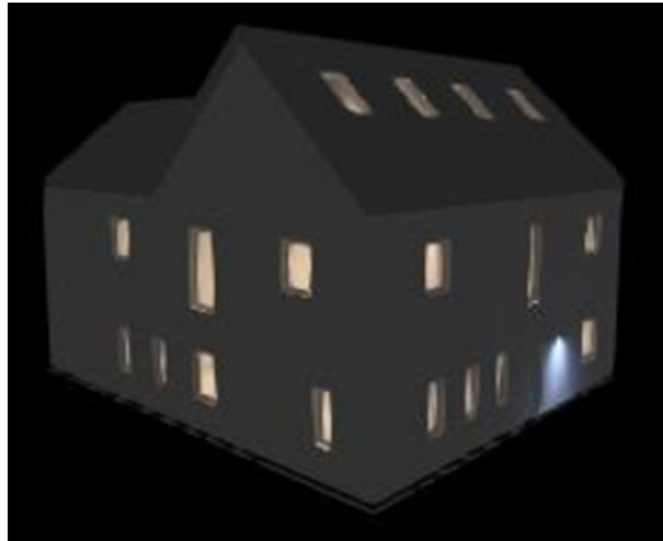
## APPENDIX 2 – 3-D MODEL

### 10. DIALUX EVO MODEL

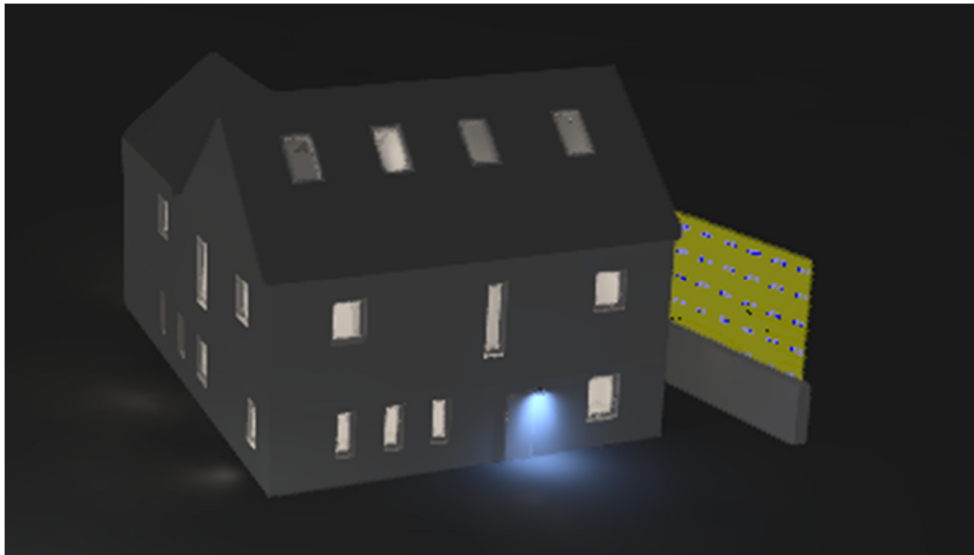
#### 10.1. Interior Lighting Example

10.1.1. The following images are taken from the 3-d model created in Dialux Evo, which is an industry standard. The luminaires chosen were 2700K and the spill light shown at a worst case scenario. This is modelled with a maintenance factor of 1.0 and no curtains or blinds shown at any windows.

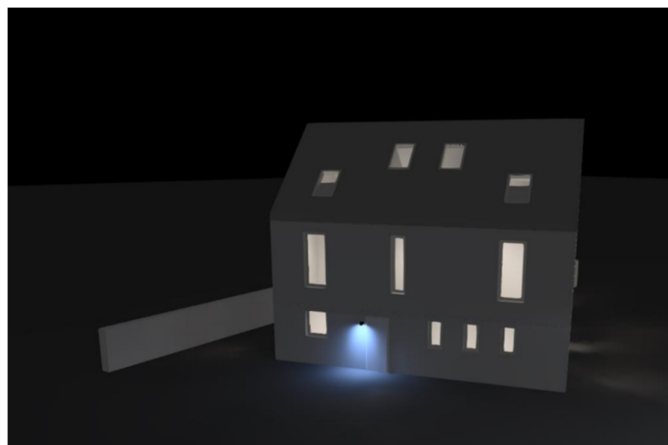
10.1.2. Plot 8 images are shown below.

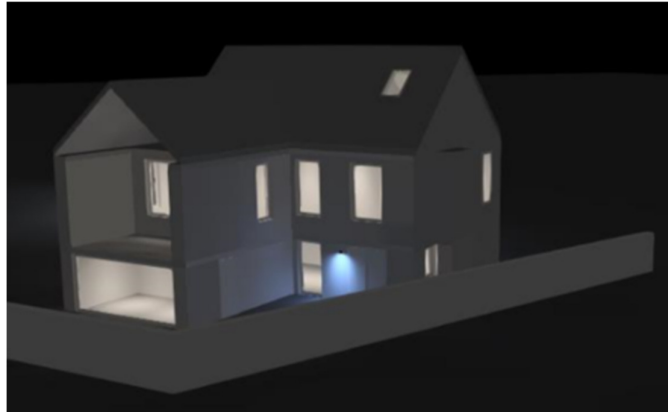


Vertical Grid East		
	0.13 lx	0.015
Calculation surface (Perpendicular illuminance)		
	Actual	Target
Average	0.13 lx	-
Min	0.002 lx	-
Max	0.26 lx	-
Min/average	0.015	-
Min/max	0.008	-



10.1.3. Plot 10 images are shown below.



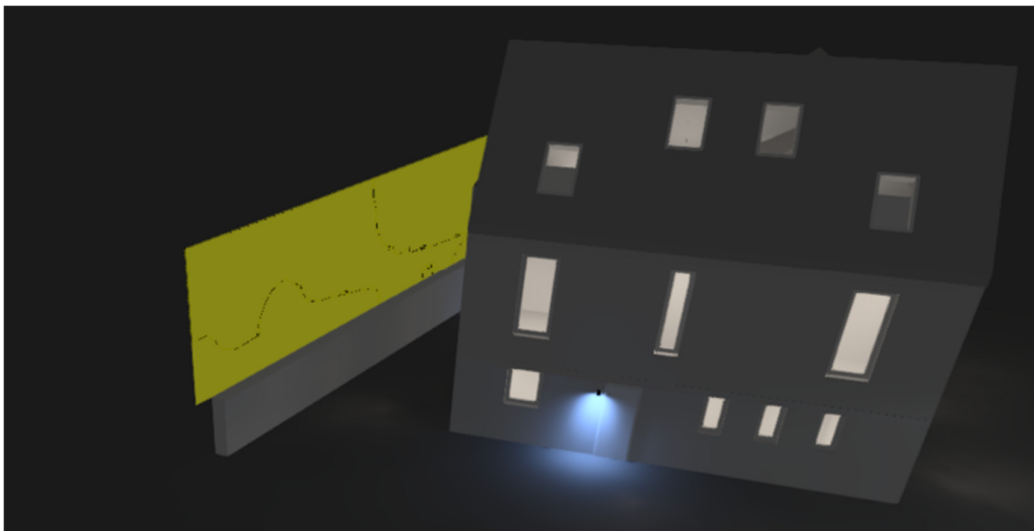


Vertical Grid West

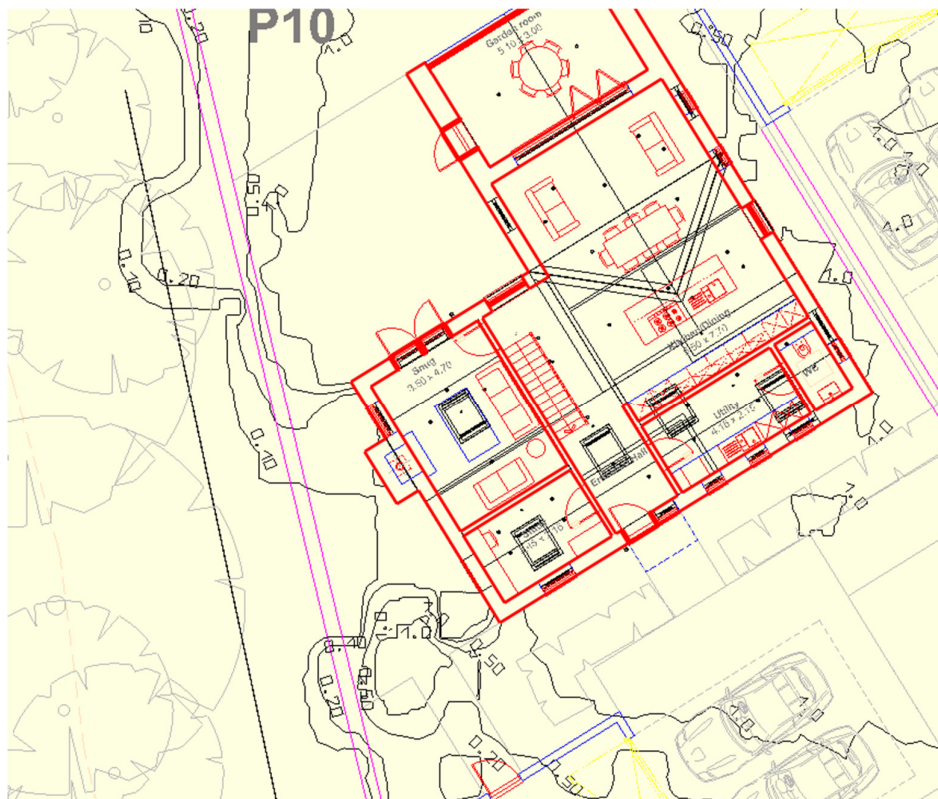
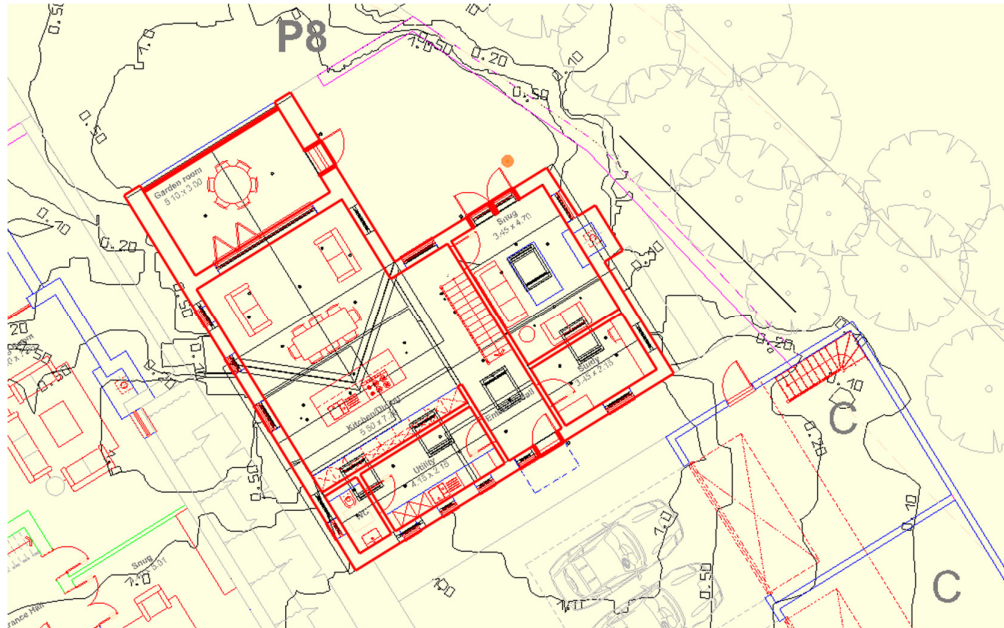
0.22 lx      0.009

Calculation surface (Perpendicular illuminance)

	Actual	Target
Average	0.22 lx	-
Min	0.002 lx	-
Max	0.48 lx	-
Min/Average	0.009	-
Min/max	0.004	-



10.1.4. The isolux lines on the ground surrounding the two plots modelled (P8 and P10) are shown below. The isolux lines shown are 0.1 lux, 0.2 lux, 0.5 lux and 1.0 lux



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