Former Sipson Garden Centre

External Lighting Planning Report

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Quality information

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1. Introduction

AECOM has been commissioned by VIRTUS Data Centres Limited to undertake an External Lighting Assessment in support of an outline planning application submitted to the London Borough of Hillingdon for the redevelopment of the Former Sipson Garden Centre and associated land, West Drayton, to provide a data centre facility, together with associated energy infrastructure, security measures, landscaping and access arrangements (hereafter referred to as the Proposed Development). The outline application seeks approval for access, with all other matters reserved.

The Proposed Development will require external lighting to support operational, maintenance and security requirements across the site. Lighting is anticipated to be provided at key locations including vehicular and pedestrian access points, internal circulation routes, parking and servicing areas, building entrances, plant and utility infrastructure, and site security features.

This assessment has been prepared to inform the outline planning application and considers the potential lighting requirements of the Proposed Development in the context of the surrounding environment, including nearby residential properties, transport infrastructure and ecological features. The assessment seeks to demonstrate that an appropriate lighting strategy can be developed which supports safe and secure operation of the site whilst minimising potential impacts associated with obtrusive light and maintaining compliance with relevant planning policy and guidance.

1.1 Purpose of the report

The purpose of this report is to outline the design principles, assessment methodology and environmental considerations associated with the proposed external lighting scheme for the Proposed Development.

The assessment considers the potential effects of artificial light at night and demonstrates how the lighting strategy has been developed to minimise obtrusive light, including light spill, glare and sky glow, whilst maintaining the operational, safety and security requirements of the facility. The lighting design follows a mitigation hierarchy, prioritising appropriate luminaire selection, careful positioning, optical control, lighting controls and management measures to reduce unnecessary illumination.

The report has been prepared with reference to current industry guidance and relevant planning policy and seeks to demonstrate that the proposed lighting installation can operate without causing unacceptable effects on neighbouring receptors, ecological interests or the wider night-time environment.

This report includes:

- A review of relevant lighting standards, guidance documents and planning policy.
- Identification of sensitive receptors within and surrounding the site.
- Classification of the site and surrounding area in accordance with the Environmental Zone framework defined within the Institution of Lighting Professionals' *Guidance Note 01/26: The Avoidance of Obtrusive Light*.
- Definition of the applicable obtrusive light criteria and assessment requirements for the proposed development.
- An overview of the indicative lighting strategy, including luminaire characteristics, mounting arrangements, operating scenarios and lighting controls.
- An assessment of potential lighting effects on nearby receptors.
- Recommendations for mitigation measures and design controls to ensure compliance with relevant obtrusive lighting criteria and planning policy objectives.

This assessment demonstrates how the proposed lighting scheme can achieve the operational requirements of the proposed facility while minimising impacts on the surrounding environment and maintaining the quality of the night-time landscape.

2. Standards and Guidance

2.1 Design Standards and Guidelines

The external lighting strategy has been developed with reference to relevant national planning policy, industry guidance and recognised lighting design standards applicable to the Proposed Development. The detailed lighting design will be undertaken in accordance with the following documents, as appropriate:

1. National Planning Policy Framework (NPPF, 2026), with particular regard to the requirement to limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation;
2. London Borough of Hillingdon Local Plan (2021) – policies relating to external lighting, environmental protection and biodiversity;
3. BS 5489-1:2020 *Design of road lighting - Lighting of roads and public amenity areas – Code of practice*
4. BS EN 13201 (*Road Lighting* Series), as applicable to vehicular circulation routes and external access roads.
5. BS EN 12464-2:2024, *Light and Lighting - Lighting of Workplaces - Part 2: Outdoor Workplaces*;
6. Institution of Lighting Professionals (ILP) *Guidance Note GN01/26, The Avoidance of Obtrusive Light*, which supersedes GN01/21 and provides guidance on the assessment and control of light spill, glare, sky glow and other forms of obtrusive light;
7. ILP *Guidance Note GN08/23, Bats and Artificial Lighting at Night*, where relevant to ecological considerations;
8. CIE 126:1997, *Guidelines for Minimising Sky Glow*, where applicable;
9. CIE 150:2017, *Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations*, which forms the technical basis of many obtrusive light assessments and is referenced by GN01/26;
10. Relevant guidance published by the Society of Light and Lighting (SLL) and the Chartered Institution of Building Services Engineers (CIBSE) applicable to exterior lighting design; and current best practice guidance relating to biodiversity-sensitive lighting design and the protection of nocturnal wildlife.

2.2 Local Planning Policy

London Borough of Hillingdon Local Plan

The principal local planning policies relevant to external lighting are:

Policy BE1: Built Environment (Hillingdon Local Plan Part 1: Strategic Policies (LPP1)) which requires development to improve and protect the quality of the built environment and safeguard residential amenity.

Policy DMHB 11: Design of New Development (Hillingdon Local Plan Part 2: Development Management Policies (LPP2)) requires development proposals to be designed to protect the amenity of adjoining occupiers and the character of the surrounding area. This policy is regularly cited by the Council in relation to lighting proposals where light spill, glare or visual intrusion may affect neighbouring receptors.

Policy DMEI 7: Biodiversity Protection and Enhancement requires development proposals to protect biodiversity interests and avoid adverse effects on ecological features and species. Lighting design therefore requires careful consideration where artificial light has the potential to affect nocturnal wildlife or ecological connectivity.

Where relevant, regard has also been given to:

- **Policy DMHB 13A: Trees and Landscaping**, in relation to lighting adjacent to landscape features.
- **Policy DMHB 14: Planning for Safer Places**, recognising the need for lighting to support security and public safety objectives.

London Plan

The Proposed Development has been developed with regard to the relevant policies of the London Plan (2021), including:

- **Policy D3 (Optimising Site Capacity Through the Design-Led Approach)**, which requires high-quality design that protects the amenity of surrounding occupiers.
- **Policy D8 (Public Realm)**, which promotes inclusive, safe and well-designed external environments.
- **Policy G6 (Biodiversity and Access to Nature)**, which seeks to protect and enhance biodiversity and ecological networks.

National Planning Policy Framework

The National Planning Policy Framework (NPPF) requires planning decisions to limit the impact of light pollution arising from artificial light on local amenity, intrinsically dark landscapes and nature conservation interests. External lighting proposals should therefore be designed to avoid unnecessary illumination and minimise obtrusive light effects.

2.3 Ecological Guidelines

The ILP have produced the following guidance documents, which are considered when developing new outdoor lighting installations:

- **Guidance Note GN:01/26**: The avoidance of obtrusive light – Guidance which is used throughout the industry that presents limiting criteria for direct obtrusive lighting effects (such as light spill, sky glow and glare) suitable to a given area brightness condition as well as good practice design approaches; and
- **Guidance Note GN:08/23**: Bats and artificial lighting at night – Guidance created in collaboration with the Bat Conservation Trust (BCT) which advises on light levels and colour temperature impacts on different bat species. It also looks at potential solutions to avoid and reduce this harm.

These documents will serve as a benchmark for evaluating the proposed lighting solutions and their potential obtrusive effects.

The ILP states that good lighting practice is the provision of the right light, at the right time, in the right place and controlled by the right system. Where not appropriately designed and controlled, artificial lighting can result in obtrusive light effects, which may adversely affect visual amenity, ecological features and the character of the night-time environment. Obtrusive light principally comprises:

- **Upward Light**: light emitted above the horizontal from individual luminaires or lighting installations, contributing to sky glow and the brightening of the night sky;
- **Light Spill**: light falling outside the area intended to be illuminated;
- **Glare**: the uncomfortable brightness of a light source when viewed against a darker background; and
- **Light Intrusion (Nuisance)**: unwanted light that may cause nuisance to people, adversely affect fauna and flora, or result in unnecessary energy consumption.

These types of obtrusive light are illustrated in Figure 1.

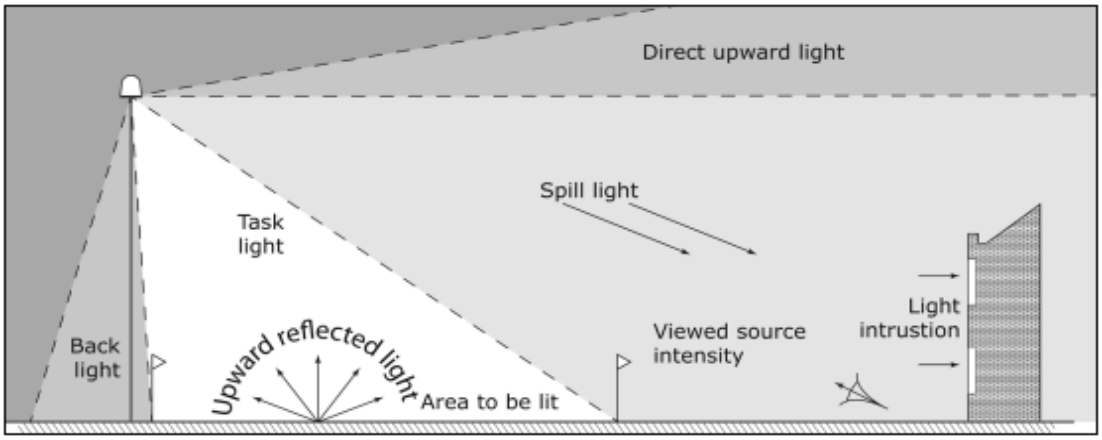


Figure 1 - Types of Obtrusive Light
Source: ILP GN01 (2026)

GN01 recommends the classification of locations into Environmental Zones E0 to E4, ranging from intrinsically dark protected environments to urban areas with high levels of night-time activity. Obtrusive light assessment criteria are then applied according to the relevant environmental zone, taking account of the sensitivity of the surrounding environment and any adjacent zone considerations.

The guidance provides recommended limits and assessment criteria relating to:

- Vertical illuminance at nearby premises, including windows of surrounding properties;
- Luminous intensity of visible luminaires in the direction of sensitive receptors;
- Upward Light Ratio (ULR) and, where applicable, Upward Flux Ratio (UFR) to control sky glow;
- The effects of lighting on transport systems through the control of glare; and
- Luminance limits for illuminated building façades and signs.

These criteria are intended to inform the design and assessment of new lighting installations, helping to ensure that operational lighting requirements are achieved whilst minimising obtrusive light effects on surrounding receptors and the wider night-time environment.

3. Baseline Conditions

3.1 Site Location

The Site is located on the eastern side of Sipson Road, to the north-east of Sipson village within the London Borough of Hillingdon. The Site lies approximately 1 km north of Heathrow Airport and immediately adjacent to the M4 Spur Road, which provides a direct connection between Junction 4 of the M4 and the airport.

The Site occupies approximately 6.9 hectares and comprises a combination of previously developed land associated with the former Sipson Garden Centre and adjacent open land. The former garden centre ceased operation in 2011, and the Site is currently occupied by an Airside Support Vehicle servicing and repair facility.

The Site is bounded by the Holiday Inn to the north, the M4 Spur Road to the east, Sipson Lane and Lady Nafisa Secondary School for Girls to the south, and residential properties to the west. Existing vegetation, including mature trees and shrubs, is present along much of the site perimeter, particularly along the western and southern boundaries. There are no Public Rights of Way within the Site boundary.

Figure *2* provides an overview of the site location.

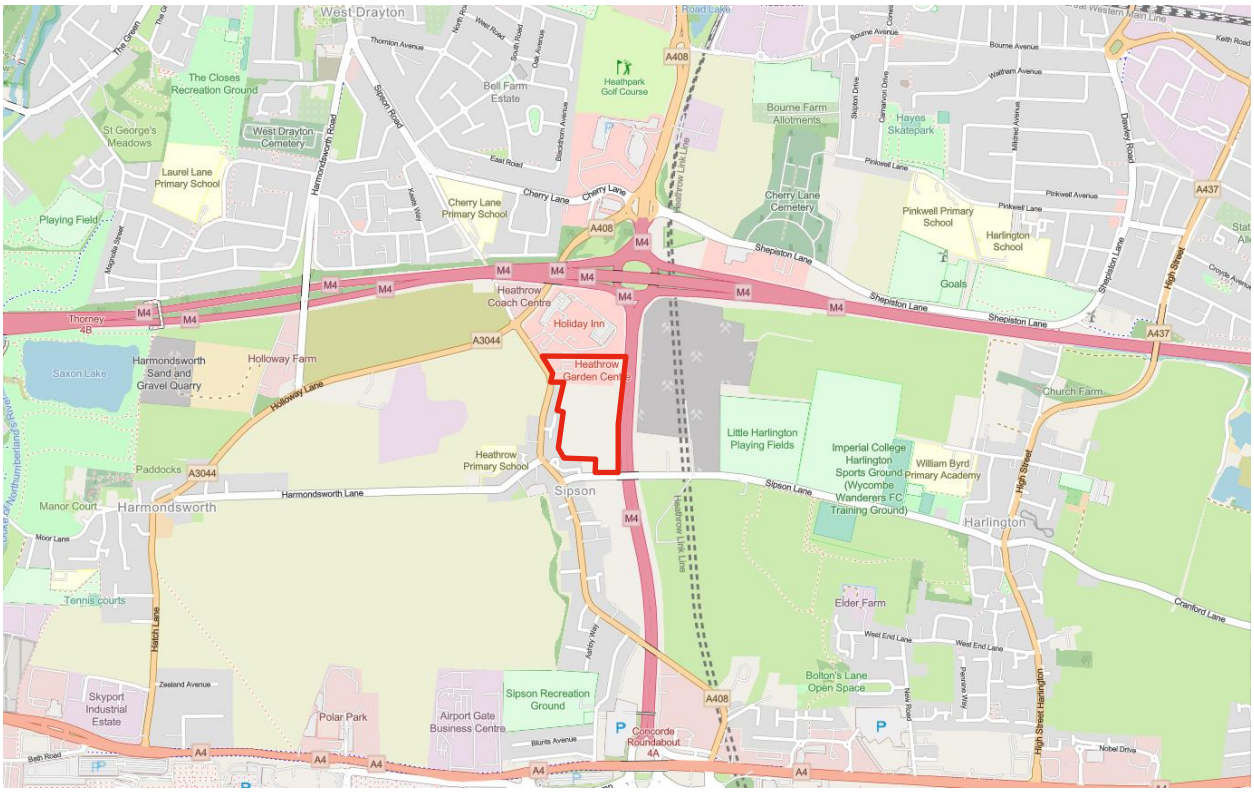


Figure 2 - Site Location

Source: AECOM GIS mapping

3.2 Existing Lighting Context

3.2.1 Sky Brightness

Mapping of night-time sky brightness, derived from satellite observations, provides a useful indication of regional patterns of artificial illumination and ambient night-time brightness. Whilst the data is intended to be interpreted alongside site-specific observations and local context, it offers a valuable representation of the prevailing lighting environment. The mapping indicates that the Site is located within an established urban environment characterised by relatively high levels of existing artificial illumination and elevated ambient brightness during the hours of darkness. The principal contributors to the baseline night-time lighting environment include Heathrow Airport, the M4 Spur Road, the wider motorway network, commercial developments and associated transport infrastructure in the surrounding area.

Areas of elevated sky brightness are evident across much of the western Greater London area and are typical of major urban and airport-related locations. Consequently, the Site does not form part of an intrinsically dark landscape and is considered to be influenced by a moderate to high level of existing ambient lighting. This baseline lighting environment is consistent with the higher environmental zone classifications defined within ILP GN01/26 The Avoidance of Obtrusive Light.

Figure 3 provides an overview of the intensity of light local to the Site where the colours depict the level of radiance that shines up into the night sky. This is a combined result of light shining directly upward and light reflecting upward from the ground or other surfaces.

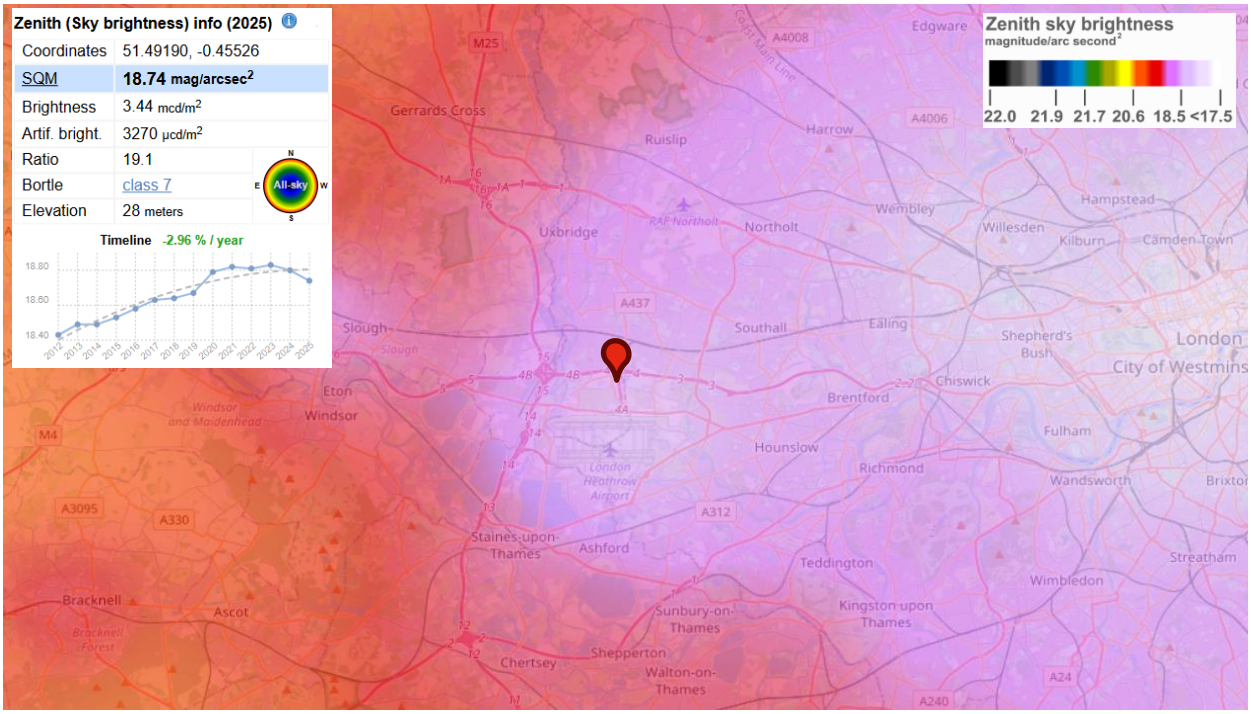


Figure 3 - Site Location on Light Pollution Plan

Source: Jurij Stare, www.lightpollutionmap.info (v3.0.25)

3.2.2 Light Fixtures

The Site is located within a highly urbanised environment influenced by the presence of Heathrow Airport, the M4 Spur Road and surrounding commercial development, as well as residential in the more local context. Existing sources of artificial light in the area include highway lighting on the strategic road network, local residential road

lighting, lighting associated with airport operations, hotel and commercial premises, illuminated signage and vehicle movements.

Street lighting within the local area is typical, comprising contemporary LED highway lighting installed on 6-10m height lighting columns along principal roads, junctions and access routes and 4-6m height lighting columns on minor residential roads. In addition, area lighting associated with hotel car parks, service yards, pedestrian routes and airport-related infrastructure contributes to the prevailing night-time brightness. The M4 Spur Road corridor and Heathrow Airport form dominant sources of illumination within the wider landscape, resulting in a night-time environment characterised by moderate to high ambient light levels.

Context street lighting is shown Figure 4, Figure 5 and Figure 6.



Figure 4 - Street view – M4

Source: Google StreetView



Figure 5 - Street view – Sipson Lane

Source: Google StreetView



Figure 6 - Street view – Sipson Road (A408)

Source: Google StreetView

3.3 Existing Visual Barriers

The surrounding area is generally characterised by relatively flat topography. Existing visual screening between the Proposed Development and the wider area is therefore primarily provided by vegetation and roadside planting.

Established trees located between the Site and nearby residential properties provide a degree of visual screening. Whilst vegetation assists in filtering views towards the Site and any associated lighting, the effectiveness of this screening varies according to viewing location and season, particularly where deciduous species experience leaf loss during the winter months.

Figure 4, Figure 5, and Figure 6 above illustrate the existing vegetation screening along the eastern, southern and western boundaries of the Site. The northern boundary benefits from more extensive screening provided by established trees and shrubs; however, the level of screening is expected to vary throughout the year, particularly where deciduous planting is present.



Figure 7 - Street view – Existing visual barriers to the North

Source: Google StreetView

3.4 Residential Receptors

Based on the requirements for the proposed lighting scheme, residential properties which have the potential to be impacted by obtrusive light from the new lighting installation will be limited to housing located within approximately 100 metres of the Site, though it should be noted that sky glow effects can potentially extend up to several kilometres from the Site if not carefully controlled. Figure 8 shows the location of residential receptors within this range, these are as follows:

North: The land to the north of the Site is occupied by the Holiday Inn London Heathrow M4 Junction 4, with the main hotel building located approximately 50 m from the Site boundary. Beyond this lies the M4 motorway corridor. As they are transient spaces, hotel rooms will be treated as residential for this assessment but are considered as medium sensitivity (as opposed to high sensitivity of a standard residential space).

South: Residential properties along Vineries Close, Sipson Lane, are located immediately south of the Site and form the closest residential frontage. Dwellings situated further within the residential area are afforded an increasing degree of screening by intervening properties and vegetation and are therefore expected to have a lower level of interaction with the Proposed Development.

East: The nearest residence is greater than 1 km away and therefore not likely to experience impacts from lighting.

West: Along the western boundary of the Site, residential properties fronting Sipson Road and Russell Gardens are located in close proximity to the Proposed Development. These dwellings represent the nearest residential receptors to the west and generally benefit from varying degrees of screening provided by existing boundary vegetation and intervening landscape features.

Indicative assessment locations have been selected to represent the principal residential receptor groups surrounding the Site (Figure 8). Representative properties in each key direction and have been used to evaluate potential lighting effects arising from the Proposed Development.

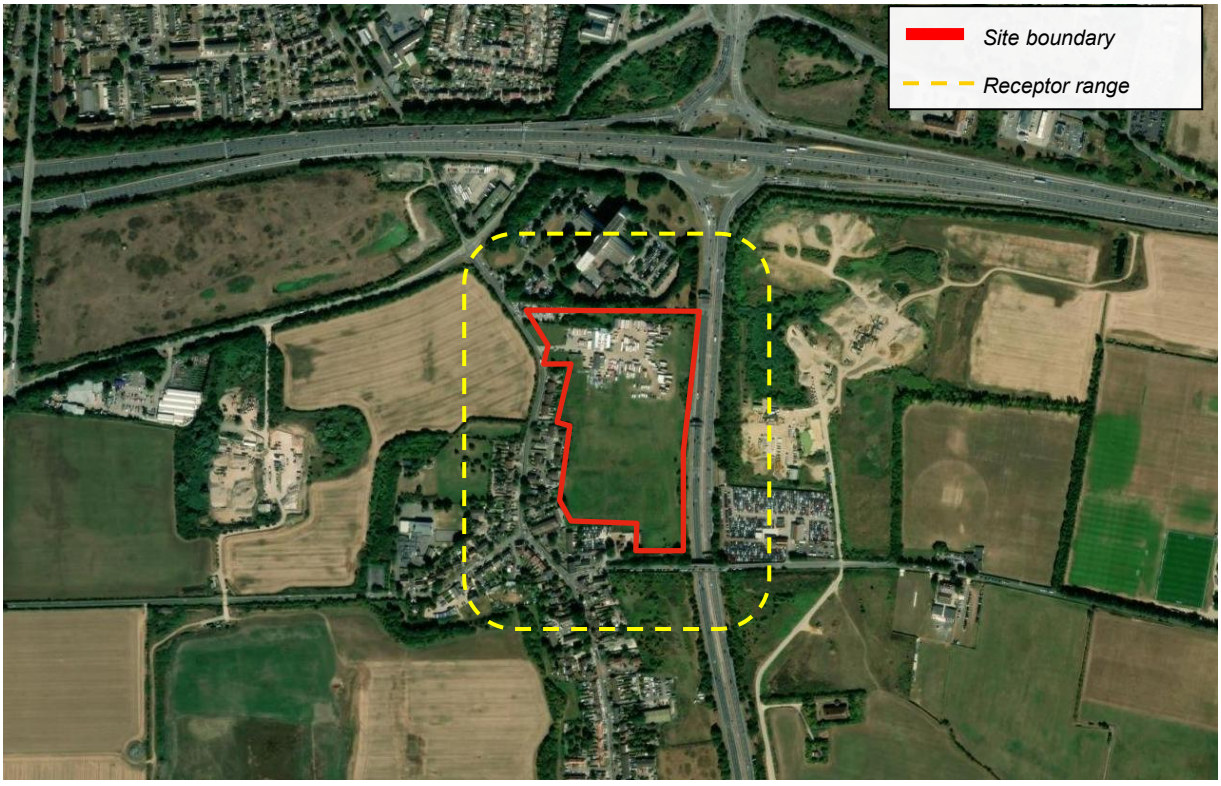


Figure 8 - Receptor range

Source: AECOM GIS mapping

3.5 Traffic Receptors

Traffic receptors may be susceptible to the effects of obtrusive light where visible luminaires create glare that could adversely affect visual comfort or, in more extreme cases, road safety. For road users, glare effects are generally most relevant where a light source is located within the primary forward field of view. Accordingly, a 25-degree forward field of view has been adopted when considering the potential for glare effects on drivers and other vehicle occupants.

Given the scale and nature of the proposed lighting installation, a study area of 100 m is considered appropriate for the assessment of potential glare effects on traffic receptors. Beyond this distance, the apparent brightness of a luminaire is reduced due to increasing separation distance and the smaller proportion of an observer's field of view occupied by the light source. Furthermore, existing buildings, vegetation and other local features become increasingly likely to provide visual screening, reducing the potential for significant glare effects.

Representative traffic receptor locations have been identified along the M4 motorway to the east of the Site and the A408 to the west, as shown in Figure 9. Road users on Sipson Lane to the south have not been included as assessment receptors due to the substantial visual screening provided by the established vegetation and dense hedgerows adjacent to the carriageway, which are expected to prevent direct views of the proposed lighting installation.

Given the Site's proximity to Heathrow Airport, the external lighting strategy has been developed with consideration of the sensitivity of the surrounding aviation environment to glare, excessive luminance and upward light emissions. The design principles adopted seek to minimise obtrusive light and maintain compatibility with nearby aviation activities. Consequently, the potential for visual distraction or interference with aircraft operations is considered negligible. As such, aviation receptors are not anticipated to experience significant effects and are scoped out of the detailed assessment.

3.6 Ecological Receptors

There are no statutory designated ecological sites within 2 km of the Site. The nearest designated ecological features are the non-statutory Stockley Road Rough SBINC, located approximately 800 m north of the Site, and Field Close Open Space Roughs SBINC, located approximately 980 m southeast. Both sites comprise grassland and scrub habitats of local biodiversity value. Given the separation distances, intervening urban development and the contained nature of the proposed lighting scheme, significant lighting effects on these designated sites are not anticipated.

The Preliminary Ecological Appraisal (AECOM, 2026) identifies bats as the principal light-sensitive ecological receptors associated with the Site. Retained boundary tree belts, woodland planting and landscape buffers may provide commuting and foraging habitat for bats, despite the Site being located within an existing urban environment influenced by surrounding road and commercial lighting. Particular consideration should therefore be given to limiting light spill onto retained vegetation corridors. However, vegetation along the eastern Site boundary is considered to have low suitability for bat commuting and foraging, owing to existing artificial lighting and spill light associated with the adjacent M4 corridor.

Other ecological receptors include nesting and roosting birds associated with retained trees and shrub planting, together with hedgehogs and other small nocturnal mammals that may utilise landscaped and grassed areas around the Site. While no habitats of high ecological value are present within the Site, retained perimeter vegetation represents the primary ecological feature requiring consideration within the lighting design to minimise disturbance from artificial light at night.

The ecological appraisal recommends that lighting is designed to minimise illumination of potential bat roosting, commuting and foraging habitats through careful control of light spill. In accordance with BCT / ILP guidance, luminaires should comprise warm-white LEDs with a correlated colour temperature (CCT) of 2700 K or lower,

incorporate peak wavelengths above 550 nm to minimise disturbance to bats, have a negligible or zero upward light ratio (ULR), and be mounted horizontally with no upward tilt. Column heights should be appropriately selected to reduce light spill, and any security lighting should be motion-activated and operated for the shortest practicable duration. Metal halide and fluorescent light sources should not be used.

3.7 Receptor Map

Key residential, road and treeline locations have been selected to evaluate potential obtrusive lighting effects. Figure 9 provides an overview of the indicative receptor points in relation to the site. R1 represents the Holiday Inn hotel building; R2 – R8 are residential receptors; R9 – R12 are traffic receptors; R13 – R15 are ecological (treeline) receptors.

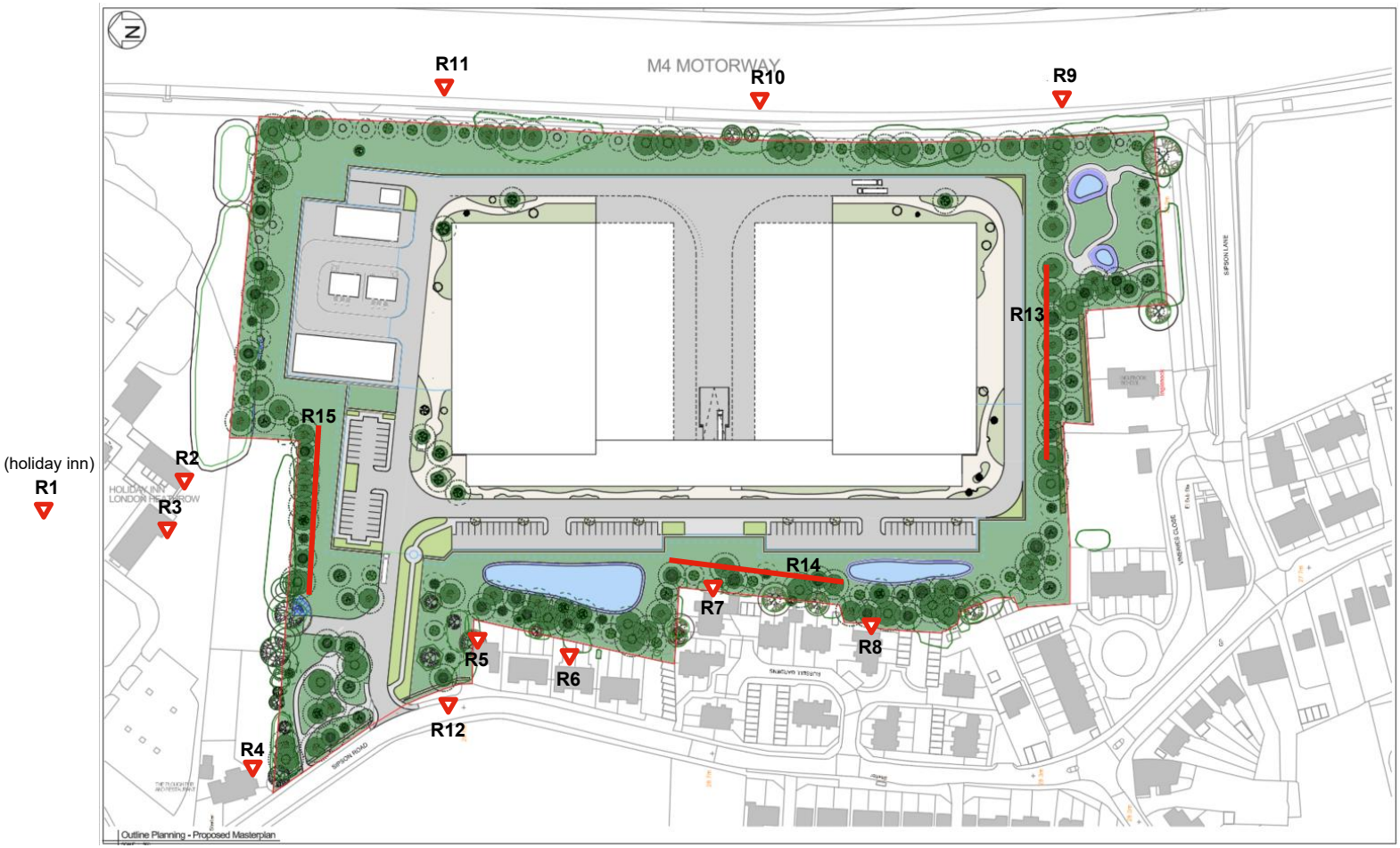


Figure 9 - Receptor Map

4. Methodology

The methodology for the obtrusive lighting assessment comprises the digital modelling and evaluation of the proposed exterior lighting scheme to quantify its potential impact on surrounding receptors. A three-dimensional representation of the site and its context is developed within DIALux Evo, incorporating luminaire photometric data, geometry, and measurement points representing sensitive receptor locations. The resulting calculations are assessed against established criteria for obtrusive light, including limits on light spill, glare, and sky glow, in accordance with relevant guidance. This approach ensures that the scheme is designed and verified to minimise light pollution and protect the amenity of the surrounding environment.

4.1 Assessment Criteria

The criteria for the residential receptors are set out in the ILP GN01, as reproduced below in Table 1, below.

Table 1 - Environmental Zone Classification

Environmental Zone	Surrounding	Lighting Environment	Examples
E0	Dark	Dark	UNESCO Starlight Reserves
E1	Natural	Intrinsically Dark	National Parks, Areas of Outstanding Natural Beauty
E2	Rural	Low district brightness	Village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Small town centres or suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

ILP Environmental Zone E3 is considered the relevant zone of the surrounding area in which the Site is located. Accordingly, the obtrusive lighting criteria associated with Environmental Zone E3 have been applied for this assessment.

Obtrusive light limits for exterior lighting installations are shown below in Table 2 for Zone E3.

Table 2 - ILP Environmental Zone E3 Criteria

Environmental Zone	Sky Glow	Light Spill (into windows)		Glare	
	Upward Light Ratio (ULR[a])	Vertical Illuminance[b]		Luminous Intensity[c]	
		Pre-curfew[d]	Post-curfew[d]	Pre-curfew[d]	Post-curfew[d]
E3	5 %	10 lux	2 lux	10,000 cd	1,000 cd

(a) Upward light ratio (ULR) of the installation is the maximum permitted percentage of luminaire flux for the total installation that goes directly into the sky.

(b) Vertical illuminance measured flat at the glazing at the centre of a residence window.

(c) Luminous intensity of bright luminaires in the field of view between an observer (at a residence location) and a light source.

(d) Note - Curfew hours refer to the period of the night, typically defined by the Local Planning Authority, during which more stringent limits for obtrusive light apply in accordance with Institution of Lighting Professionals Guidance Note 01 (GN01). These hours generally commence between 21:00 and 23:00 and extend through to early morning, reflecting increased sensitivity to artificial lighting at night. Within this period, reduced threshold values are applied to parameters such as vertical illuminance at sensitive receptors, luminaire intensity, and sky glow, typically requiring lighting schemes to incorporate appropriate control measures (e.g. dimming or switch-off) to minimise environmental impact.

In summary, the permitted light spill limit at a residential receptor for Zone E3 before curfew is 10 lux, and post-curfew it is 2 lux. The permitted source intensity limit when viewed from a residential receptor before curfew is 10 kilocandelas (kcd) and post-curfew is 1 kcd. The permitted Upward Lighting Ratio (ULR) (i.e. 'sky glow' limit) for lighting installations is 5% and this applies across pre- and post-curfew hours and the reflected light criteria for amenity lighting is 12%.

As the site lighting requirements will not change during the hours of darkness, only the ILP post-curfew obtrusive lighting criteria have been applied for comparison with the model results.

There are no definitive criteria to quantify the potential effects on ecological and landscape receptors, however many creatures such as owls and bats are active at night and sleep during the day, while others such as birds or moths may be attracted to light. Impacts will potentially limit feeding opportunities, may cause creatures to become confused or collide with floodlit structures, alternatively they may prompt desertion of the area altogether. It was recommended in the ecological report that for some bats, a maximum limit of 1 lux (or less) be applied (GN08/23), this is what is adopted for this lighting assessment.

An additional metric, Upward flux ratio (UFR), provides the effect of both direct and reflected upward components of the whole installation, including ground and building surface reflections. Although the UFR is not a prescribed assessment criterion for this development, it provides a valuable measure of the overall sustainability of a lighting installation by accounting for both direct and reflected upward light emissions. A low UFR indicates that the lighting design has successfully limited contributions to sky glow and unnecessary light pollution, demonstrating a high standard of environmental stewardship. Such an approach is beneficial not only in reducing wider night-sky impacts but also in supporting the protection of light-sensitive habitats and species by minimising artificial light within the nocturnal environment. A UFR value has been calculated along with the other metrics noted in Table 2.

4.2 Lighting Calculations

An external lighting strategy has been developed to provide appropriate illumination for the safety, security and operational requirements of the Proposed Development, whilst also supporting the safe movement and use of any publicly accessible areas by visitors and other site users. The strategy seeks to remain sympathetic to the moderately lit urban context of the surrounding area and to minimise unnecessary light spill beyond the Site boundary.

Luminaires were chosen not only to achieve the required lux level and uniformities for each area but also because they are dark sky compliant and approved by DarkSky International (DSI[1]), if installed responsibly.

Refer to Appendix A.2 for calculation results.

4.3 Assumptions and Limitations

- While the effects of a lighting installation may be commented on in terms of technical performance, aesthetic visual impact does not form part of the analysis.
- A worst-case condition is used for the assessment that assumes lighting will be needed to cover all areas of the site rather than be zoned to accommodate site use patterns throughout the year.
- Due to the 24/365 operation highlighted, it is unlikely that lighting will be turned off under normal conditions. It is, however, expected that during the post-curfew period (23:00 – 06:00) lighting will be dimmed or turned off where it is not required for safe site use or security purposes.
- The report gives recommendations about maximum permissible values of obtrusive effects based on good practice guidance for exterior lighting installations. These values are regarded as limiting values, and the

[1] DSI is a global non-profit organisation that promotes responsible outdoor lighting to reduce light pollution and protect the night-time environment. Products approved under the DarkSky Approved programme are independently verified to meet criteria relating to the control of upward light, glare and light spill; however, environmental performance remains dependent on appropriate specification, installation and operation of the lighting system.

lighting schemes for each aspect of the development should strive to meet the lowest criteria possible for the design.

5. Proposed Design

5.1 Lighting Requirements

5.1.1 Lighting strategy

The Proposed Development comprises the redevelopment of the Site to deliver a new data centre campus and associated infrastructure. The majority of existing boundary vegetation is intended to be retained as part of the development proposals.

The external lighting strategy seeks to achieve an appropriate balance between providing sufficient illumination for operational, safety and security requirements whilst maintaining stringent control of obtrusive light. To ensure the final design satisfies both technical and environmental objectives, the key principles underpinning the scheme are outlined below:

- Lighting will be provided to key operational areas including building entrances, internal access roads, car parking areas, external plant compounds, and a publicly accessible amenity space.
- The scheme has been developed to minimise the potential for light pollution, with no upward-directed lighting proposed and all column-mounted luminaires installed with zero tilt.

Predictive lighting modelling has been undertaken to assess and quantify potential obtrusive light effects, including light spill, glare and sky glow resulting from upward light emission. Modelling has also informed the optimum spacing and arrangement of luminaires, reducing the number of lighting columns required and minimising visual clutter across the Site. Potential glare and over-illumination have been addressed through the use of high-performance optical distributions, together with careful luminaire aiming and commissioning. Lighting levels have been optimised to meet operational requirements while minimising light spill beyond the Site boundary and reducing contributions to sky glow.

Key design approaches include:

- Central roads, parking, operational areas: Illuminated by 6m streetlight columns equipped with area floodlight optics with tight beam angle control to minimise light spillage.
- Pedestrian access pathways: Lit by 4m urban light columns to provide sufficient, safe and comfortable light levels and distribution.
- Building perimeter: Wall mounted fixtures at key entry/egress points
- Loading bay: Floodlights with asymmetrical lighting distribution which allows for horizontal aiming (straight downward, dark sky friendly).
- Colour temperature: 2700K is proposed in line with recommendations outlined in GN08/23.
- Colour rendering: CRI 70+

5.1.2 Lighting levels

Table 3 below sets out the light levels and uniformities required for external areas of the Proposed Development.

Table 3 - Target Lighting Levels

Area	Eav	Uniformity
Entrance / Access control area	30 lux	0.4
Internal access roads	10 lux	0.4
Service yard (circulation)	20 lux	0.4
Loading bay	50 lux	0.4
Loading bay door	100-150 lux	0.4

Area	Eav	Uniformity
Car park	10 lux	0.4
Pedestrian walkway	5 lux	0.25

Source: BS EN 12464-2:2024 Lighting of work places - Outdoor work places.

5.1.3 Hours of operation

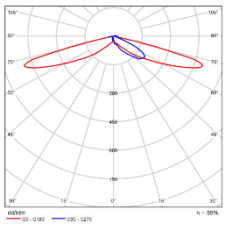
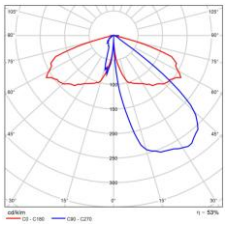
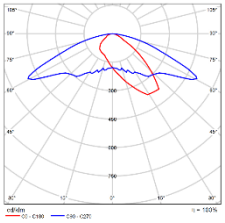
The Data Centre exterior site lighting will operate during hours of darkness, seven days a week and 365 days a year.

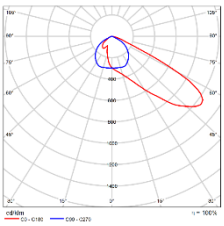
This lighting strategy provides lighting for night-time operation, for when daytime ambient light levels are low, for emergency purposes, and for the operational period during winter months.

For the purposes of this assessment, it has been assumed that the external lighting installation will operate at full output throughout the hours of darkness, including the curfew period between 23:00 and 06:00. This represents a robust worst-case scenario when assessing potential obtrusive lighting effects. However, subject to operational and security requirements, it is recommended that the lighting control strategy incorporates dimming and presence-detection measures. Such controls would enable luminaires to operate at a reduced output during periods of low activity, with rapid transition to 100% output when occupancy or movement is detected. This approach would further reduce light spill, glare and sky glow during sensitive night-time hours, whilst also delivering energy and carbon savings.

5.2 Lighting typologies

Table 4 - Indicative Lighting Equipment

Symbol	Photograph	Optic	Luminaire Information	Luminaire Specification*	Mounting height (m) / orientation (º)
EX1			Signify CitySoul BPP532 LED120-4S/727 PSD-SR II DW50 FG A	77 W 6550 lm 2700 K CRI 70+	6 m / 0º tilt
EX2			Kingfisher / Illuminazione Eco Rays TP 5P5 STU-M 7027.050-1M	10 W 1280 lm 2700 K CRI 70+	4 m / 0º tilt
EX3			Kingfisher Semita Urban bulkhead with flood optic + Comfort Glass	6 W 740 lm 2700 K CRI 80+	2.5 m / 0º tilt

EX4			Kingfisher Vasta Floodlight AL50 flood optic	60 W 10300 lm 2700 K CRI 80+	4 m / 0º tilt

* Luminaire specification notes: Watts (**W**) is the unit for electric power consumption; luminous flux (**lm**) is the total light output emitted from the luminaire; Kelvin (**K**) is the unit used to describe the colour temperature of a light source, indicating how warm (orange/yellow-ish) or cool (bluish) it appears visually.

5.3 Lighting layouts

Refer to Site Lighting Layout drawing in Appendix A.1.

5.4 Lighting control

Exterior lighting will be managed by a centrally located dusk-to-dawn photocell and a lighting contactor, sized appropriately for the number of fixtures. The lighting contactor should be installed in the electrical room that services the fixtures. Additionally, an override key switch should be placed next to the contactor for easy access.

6. Lighting Assessment

The following section presents the findings of the lighting assessment and evaluates the proposed external lighting against the relevant design criteria, standards and guidance.

Maintenance considers guidance provided by BS 5489-1:2020; a maintenance factor of 0.8 was used.

Residential receptors were assessed at mid-window height of 1.5 m above ground level and traffic receptors were assessed at an approximate driver eye height of 1.2 m above road level, representing the typical viewing position of a person operating a vehicle. Existing screening effects afforded by mature, dense landscape are not included within the simulation due to the variable amount of leaf / canopy density available throughout the year.

6.1 Technical Lighting Assessment

6.1.1 Lighting calculation results summary

A review of the technical calculation results indicates that the Proposed Lighting scheme meets the targeted lighting requirements (Appendix A.2).

6.2 Environmental Lighting Assessment

6.2.1 Light Spill

The nearest is situated approximately 1 m from the project boundary. Lighting studies were carried out to ensure that the current light spill complies with the relevant guidance criteria for both pre- and post-curfew for maximum vertical illuminance.

Horizontal lighting levels at the boundary are presented on the attached Appendix A.3.

6.2.2 Sky Glow

Sky glow associated with the proposed site lighting, in the form of both Upward Light Ratio (ULR) and Upward Flux Ratio (UFR) (as defined in Table 2), was assessed across the development area. Results are shown in Figure 10.

The assessment results demonstrated an Upward Light Ratio of 0.0 % which is substantially below the recommended 5% ULR limit for Environmental Zone E3 as defined within ILP GN01. The Upward Flux Ratio was calculated to be 0.1 %, which illustrates a significantly low proportion of reflected light being directed skyward.

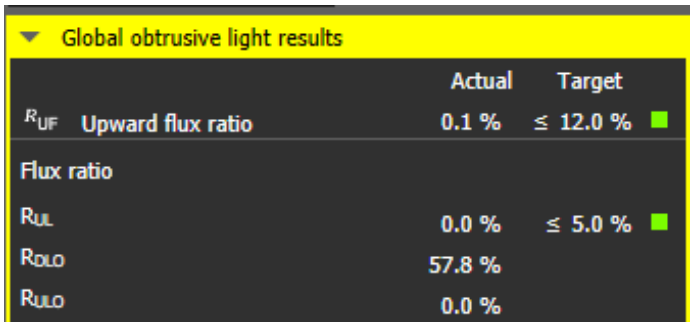


Figure 10 - Calculation results for ULR and UFR
Source: DIALux Evo lighting calculation

6.2.3 Lighting intensity (glare)

Obtrusive light intensity was checked in eight key residential locations (R1 – R8) and four key road traffic locations (R9 – R12) indicated on the receptor map Figure 9 in Section 3.7.

Table 5 provides the target intensity limits for zone E3, which is dependent on distance from the observer to the light source but also on the apparent surface area of the light source (A_P) as seen from the observer's position. For post-curfew hours for a large apparent surface the intensity limit is 1,000 cd, but for a smaller visible proportion of the source area the maximum luminous intensity limit is much lower, as demonstrated in the table.

DIALux Evo automatically calculates the apparent visible surface area of each luminaire from every assessment position and applies the corresponding luminous intensity limit. This ensures that the assessment reflects the perceived size of the light source from each receptor location and enables direct comparison against the relevant ILP GN01 obtrusive light criteria.

Table 5 - Limits for Luminous Intensity of Bright Luminaires

Light technical parameter	Application conditions	Luminaire group (projected area A_p in m²)					
		$0<A_p \leq 0.002$	$0.002<A_p \leq 0.01$	$0.01<A_p \leq 0.03$	$0.03<A_p \leq 0.13$	$0.13<A_p \leq 0.50$	$A_p > 0.5$
Maximum luminous intensity emitted by luminaire (I in cd)[5]	E0 Pre-curfew Post-curfew	 0 0	 0 0	 0 0	 0 0	 0 0	 0 0
	E1 Pre-curfew Post-curfew	 0.29 *d* 0	 0.63 *d* 0	 1.3 *d* 0	 2.5 *d* 0	 5.1 *d* 0	 2,500 0
	E2 Pre-curfew Post-curfew	 0.57 *d* 0.29 *d*	 1.3 *d* 0.63 *d*	 2.5 *d* 1.3 *d*	 5.0 *d* 2.5 *d*	 10 *d* 5.1 *d*	 7,500 500
	E3 Pre-curfew Post-curfew	 0.86 *d* 0.29 *d*	 1.9 *d* 0.63 *d*	 3.8 *d* 1.3 *d*	 7.5 *d* 2.5 *d*	 15 *d* 5.1 *d*	 10.000 1,000
	E4 Pre-curfew Post-curfew	 1.4 *d* 0.29 *d*	 3.1 *d* 0.63 *d*	 6.3 *d* 1.3 *d*	 13 *d* 2.5 *d*	 26 *d* 5.1 *d*	 25,000 2,500

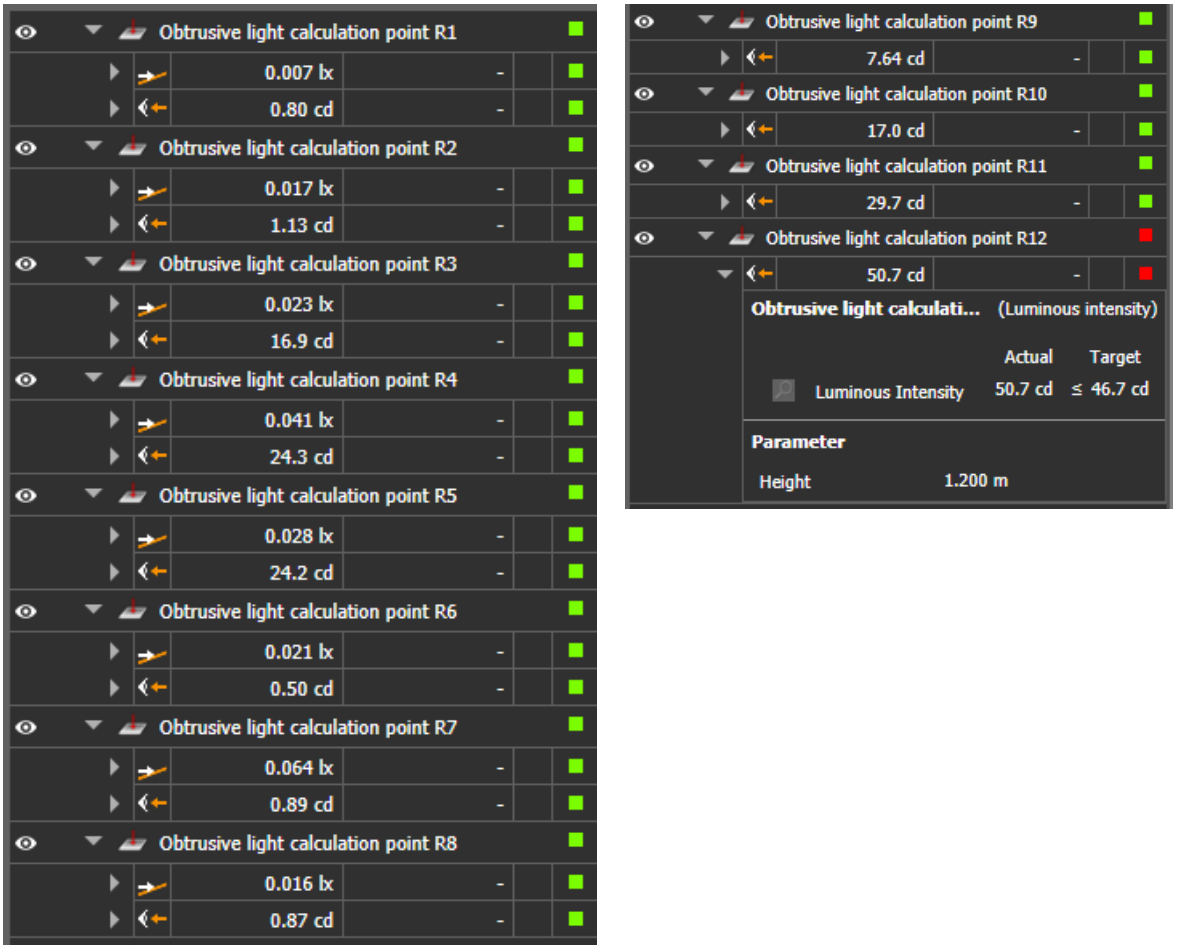


Figure 11 - Lighting Intensity Calculation Results

Source: DIALux Evo lighting calculation

Results in Figure 11 show that for all eight residential receptor locations, and results show the requirements for glare and vertical lux levels as outlined in ILP GN01 are met.

Of the four assessed traffic receptor locations, those on the M4 (R9 - R11) were calculated to comply with the recommended post-curfew glare criterion, while the one receptor on the A408 / Sipson Road (R12) was identified as exceeding the recommended maximum light intensity threshold, but to a very minimal degree. This exceedance is localised and associated with direct visibility of luminaires from the assessed vehicle approaching the site entry driving north. Due to approach angles on this road, the effect would be quite momentary.

The position of the luminaire calculated to create a potential source of glare for drivers at R12 is indicated in Figure 12.

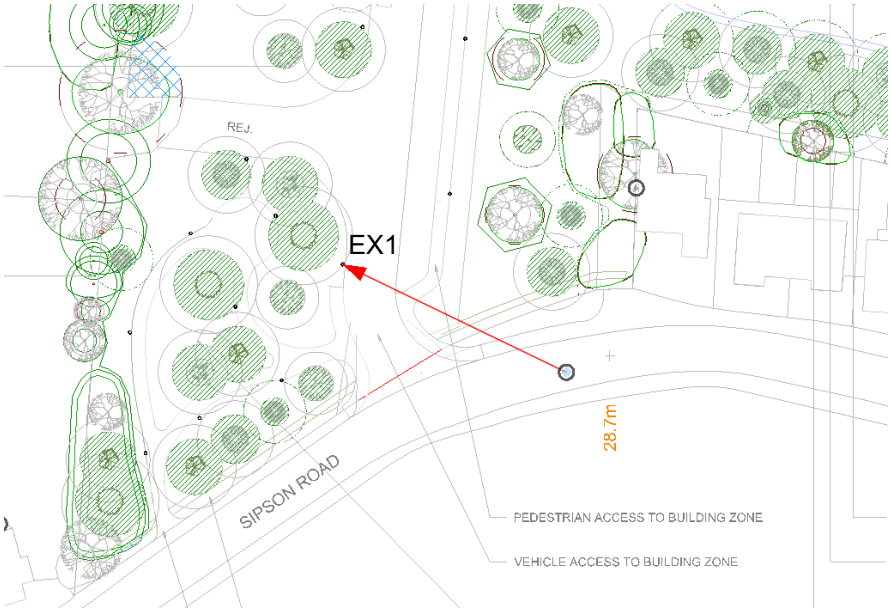


Figure 12 - Light source that may introduce glare for traffic receptors
Source: DIALux Evo lighting calculation

Further refinement of luminaire shielding arrangements may be considered to further reduce potential obtrusive lighting effects at this receptor location.

A summary of mitigation strategies Is provided in Section 0.

6.2.4 Ecological receptors

ILP GN01 and GN08 guidance does not prescribe quantitative obtrusive light limits for specific ecological receptors, recognising that the sensitivity of fauna and habitats to artificial light can vary considerably between species and locations. Nevertheless, it is widely accepted that artificial lighting can adversely affect habitat use, commuting routes, foraging behaviour, and ecological connectivity. Consequently, light spill beyond operational areas should be avoided wherever practicable and otherwise minimised through the use of appropriate mitigation measures, such as luminaire shielding, back-light control, and careful aiming of luminaires.

To assess the potential effects of lighting on future ecological features, vertical illuminance calculations were undertaken along the proposed tree lines located along the northern, western, and southern boundaries of the Site, as identified within the masterplan. These landscaped corridors are intended to contribute to biodiversity net gain and may provide habitat linkages and potential flight routes for nocturnal species. The calculated vertical illuminance levels across these areas are presented in Figure 13 and have been reviewed to identify opportunities to minimise light spill and maintain darker habitat corridors where practicable.

At the proposed tree line along the western boundary of the Site, calculated vertical illuminance levels are predicted to reach approximately 3 lux at certain locations. To further minimise ecological effects, the introduction of back shielding to the adjacent car park lighting columns should be considered. Such measures would reduce back spill towards the western boundary, helping to maintain darker conditions within the planted corridor whilst maintaining the operational lighting requirements of the development.

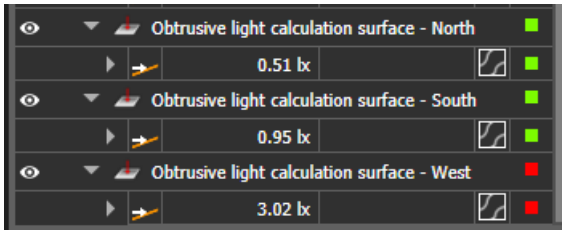


Figure 13 - Calculated vertical illuminance along tree lines within the Site

Source: DIALux Evo lighting calculation

7. Proposed and adaptive mitigation strategies

7.1 Mitigation strategies of Obtrusive Light effects

The lighting design assessed is considered to have a low environmental impact and complies with relevant good practice guidance for the control of obtrusive lighting. Predicted light spill, glare and sky glow effects are generally low and remain within the applicable assessment criteria.

One traffic receptor location on the A408/Sipson Road (R12) was identified as marginally exceeding the recommended maximum luminous intensity criterion. The exceedance is minor, localised and associated with direct visibility of luminaires from vehicles approaching the site entrance in a northbound direction. Given the geometry of the roadway, any resulting effect would be transient in nature and experienced only for a short duration.

To further minimise potential glare effects at this location, it is recommended that front shielding, glare shields or equivalent optical control measures are incorporated into the relevant luminaires. Implementation of such mitigation is anticipated to bring the assessment result within the recommended criterion.

Subject to the incorporation of this mitigation and the application of the lighting design principles outlined within this report, the proposed development is considered capable of achieving an appropriate balance between operational, safety and security requirements and the need to minimise impacts on residential amenity, ecological receptors and the wider night-time environment.

Should any changes to the lighting scheme be required, it is recommended that these are subject to review against the guidance and assessment principles presented in this report to ensure that obtrusive lighting effects remain appropriately controlled.

The following mitigation measures are proposed as part of good lighting design practice:

- All proposed luminaires in the lighting design strategy are approved International Dark Sky International (DSI) luminaires; any other exterior lighting should follow this principle.
- Utilise back shields, glare cowls, louvres and similar, to minimize/obscure source intensity towards the adjacent hedges and nearby residences (Figure 14); use reflector types that redirect light back downward to desired work areas.
- Confine lighting to the task area (use horizontal cut-off optics and zero floodlight tilt angles).
- Ensure low colour temperature lamps (CCT) ≤ 2700 K are used.



Figure 14 - Examples of Luminaries with Back shields, Glare cowl, Hood, Shield and Louvres

8. Summary and Conclusions

An indicative external lighting scheme has been developed for the proposed development to provide safe and secure access for staff, visitors, and operational activities. The proposed lighting arrangement has been modelled using DIALux Evo software to assess the nighttime visual environment and evaluate compliance with relevant standards and good practice guidance relating to obtrusive lighting. The assessment includes all luminaires identified within the indicative lighting drawings contained in Appendix A.3.

The lighting scheme has been designed to contain illumination within the Site boundary. Lighting is primarily provided by carefully selected column-mounted luminaires and dark-sky-friendly building-mounted lighting, incorporating appropriate optical control to direct light only where required. This approach limits unnecessary upward light and light spill beyond operational areas, thereby reducing the potential for obtrusive lighting effects.

The assessment demonstrates that the proposed development is capable of achieving compliance with the relevant ILP GN01 obtrusive lighting criteria for neighbouring residential receptors during both pre-curfew and post-curfew periods. Light spill, sky glow, and glare effects are predicted to be low, notwithstanding the close proximity of certain residential properties to the Site boundary.

The surrounding road network, including the M4 motorway and A408 corridor, has been considered sensitive to obtrusive light due to the potential for glare and visual distraction to road users. The assessment indicates that luminous intensity levels remain well within the applicable limits for environmental zone E3; with a minor and localised exception that may occur in the vicinity of the Site entrance; however, this is limited in extent and can be sufficiently reduced through detailed design measures such as luminaire shielding.

With regard to ecology, the proposed development is located within an established urban environment characterised by moderate to high levels of existing artificial lighting and ambient brightness consistent with an E3 environmental zone. Significant ecological effects arising from the proposed lighting are therefore not anticipated. The proposed tree belts along the northern, western and southern boundaries provide habitat connectivity and potential commuting routes for light-sensitive species, including bats. Vertical illuminance modelling indicates generally low light levels within these corridors, with only localised areas reaching approximately 3 lux along sections of the western boundary. Overall, the lighting scheme is considered compatible with the ecological context of the Site and with the extension of these vegetated corridors.

Overall, the assessment demonstrates that an appropriately designed lighting scheme can be delivered for the Site that satisfies operational requirements whilst maintaining compliance with recognised obtrusive lighting criteria and minimising effects on neighbouring residential, traffic, and ecological receptors.

Appendix A

A.1 Site Lighting & Electrical Services Layout

- DRAWING NO. PGF-ACM-DC-XX-DR-EL-590001

A.2 Lighting Calculation Report

- DIALux report – lighting performance and obtrusive lighting calculation

A.3 Site Lighting Isolux Plot

- DRAWING NO. PGF-ACM-DC-XX-DR-LI-590002