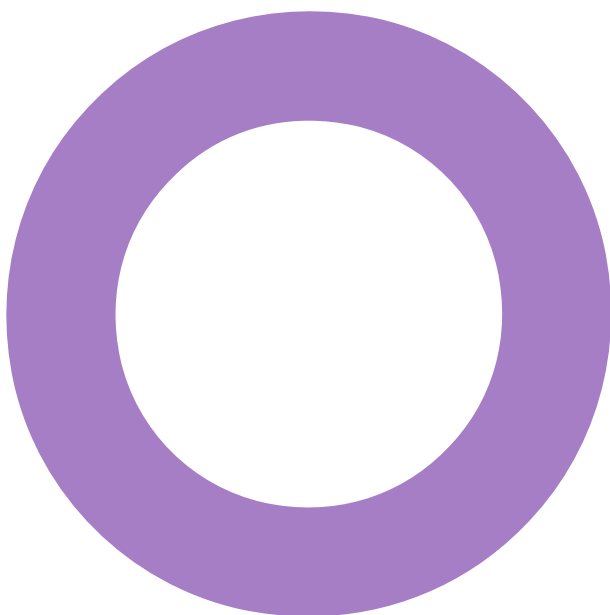


**Beehive Centre
Redevelopment.
Cambridge.**
**Railway Pension Nominees
Limited.**

MEP ENGINEERING

DN-3103570-GS-20230519 – EXTERNAL LIGHTING STRATEGY

REVISION 05 – 24 OCTOBER 2024



Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
00	19/05/2023	Draft planning issued for comments	GS/GO	JT/BA	JT
01	21/06/2023	Planning Issued incorporating comments	BA	JF/JT	JT
02	07/07/2024	Planning Issued incorporating comments	BA	JF/JT	JT
03	09/08/2024	Planning Issue	GO	BA	JT
04	22/08/2024	Bidwells comments incorporated	GO	BA	JT
05	24/10/2024	Planning comments incorporated	ACC	BA	JT

This document has been prepared for RailPen Investments only and solely for the purposes expressly defined herein. We owe no duty of care to any third parties in respect of its content. Therefore, unless expressly agreed by us in signed writing, we hereby exclude all liability to third parties, including liability for negligence, save only for liabilities that cannot be so excluded by operation of applicable law. The consequences of climate change and the effects of future changes in climatic conditions cannot be accurately predicted. This report has been based solely on the specific design assumptions and criteria stated herein.

Project number: 3104009

Document reference: DN-3103570-GS-20230519 - External Lighting Strategy - P05.docx

Contents.

Audit sheet.	2
1. Introduction	4
2. Lighting Considerations	5
2.1 Approach & Objectives	5
2.2 Safety & Orientation	5
3. Lighting Design Methodology	6
3.1 Creating a Circular Economy	6
3.2 Embodied Carbon	7
4. Relevant Standards & Guidance	7
5. Standards and Guidance Overview	8
6. Scope of External Lighting	9
6.1 Control	10
6.2 Walkways	11
6.3 Servicing Areas	11
7. BREEAM Requirements	11
8. Lighting Level Plots	11

1. Introduction

The lighting strategy contained within this report has been developed by Hoare Lea to support planning application for the redevelopment of the Beehive Centre, Cambridge. The Outline Planning Application (23/03204/OUT) includes the demolition of existing buildings and a comprehensive redevelopment of the Site. The Proposed Development consists of a new local centre, office and laboratory space, landscaping, and associated infrastructure.

The Beehive redevelopment presents a unique opportunity to support the night-time economy, enhance the environment for residents, workers, and businesses, and celebrate the community's character. Artificial lighting plays a crucial role in modern life, enabling safe activities such as driving, cycling, walking, and sports, as well as enhancing the aesthetic appeal of areas, features, and buildings. However, it's important to ensure that our use of artificial light aligns with environmental objectives, including reducing energy consumption and minimising light pollution.

The lighting strategy will contribute to the commitment to improve the well-being of residents and create an environment we can be proud to pass on to future generations. It serves as a guidance, providing a cohesive vision for the lighting across the site. The strategy aims to enhance perception, quality, vibrancy, culture, and safety during night-time, thereby supporting a sustainable and safe evening/night-time economy.

Lighting significantly impacts how people perceive and interact with the built environment, and by implementing good quality lighting, we can promote inclusion, safety, and security. Lighting also aids wayfinding, highlights architectural and landscape details, and can serve as a form of public art, contributing to effective navigation and adding to the areas visual appeal.

Well-designed and strategically placed lighting enhances safety in public spaces. Adequate illumination helps prevent accidents, deter crime, and improve visibility during night-time activities. Well-lit streets, walkways, and parks create a sense of security, encouraging people to utilise these spaces and engage in outdoor activities after dark.

Lighting contributes strongly to wayfinding, connection, and legibility. Key routes, buildings, and transportation infrastructure can be illuminated to guide and welcome visitors, residents, and business users. Street lighting serves as a foundational level of illumination across the development, while additional lighting considerations cater to different user requirements, activity levels, and safety standards. Wayfinding features encourage exploration and raise awareness of the various attractions and amenities.

The strategy will promote the adoption of sustainable and environmentally friendly lighting solutions to manage energy usage, reduce carbon footprint, and minimize light pollution. Achieving sustainable lighting involves considering the whole life costing assessment, including the specification of energy-efficient lighting and intelligent controls to minimize unnecessary lighting and energy inefficiencies.

Well-designed exterior lighting minimises light pollution, the lighting strategy aims to mitigate light trespass and restrict its effects on neighbouring areas. This will be achieved through the use of appropriate light optics, strategic positioning of fixtures, and effective lighting controls to minimize excessive illumination. By implementing these measures, the strategy seeks to create a more harmonious lighting environment that respects the well-being of humans.

Poor lighting not only affects humans but can also have a negative impact on ecology. This has detrimental effects on ecosystems and disrupts the natural behaviour of wildlife. By utilising appropriate lights and optics we can reduce light spillage and preserve the ecological balance. Additionally, adopting warm colour temperatures and controlling the intensity of lighting helps mitigate the adverse impacts on nocturnal animals and maintains the harmony of the local ecosystem.

2. Lighting Considerations

Light is a crucial ingredient in creating a dynamic and inviting environment. A fundamental understanding of light and human response to light is central to our design ethos. We believe that understanding how people see and respond to light is key to the design of a well-lit space.

Used correctly exterior lighting can boost an area's night-time use and commercial viability. For this reason it is generally accepted that effective, varied lighting of buildings and townscapes, both public and private, is a sound investment, that well justifies the relatively small capital and energy costs involved.

A badly-designed lighting scheme distributes light where it is not wanted, causing light pollution, while wasting energy unnecessarily and creating poor visual environments. Designed lighting solutions create better exterior schemes and give a new dimension to the urban environment at night rather than, the all too often, so called 'functional' lighting approach which adds little to the night scene.

2.1 Approach & Objectives

The purpose of landscape lighting is to create external realm spaces which are inviting, safe and can be enjoyed at all hours. For spaces such as this, it is also important to make an environment which is visually interesting as it forms a vital interaction point for visitors to the development.

A textured approach to the lighting is proposed with a background illuminance, for safety and interaction, balanced with illumination to key landscape features. The texture of light pattern creates visual interest and excitement through incorporating a number of lighting events to be interacted with on both a macro and micro level.

The creation of exciting lighting environments can enhance the specification and commercial success of a space by creating a vibrant visual identity for the development within the nightscape.

The above approach will develop a scheme that is safe, secure, and accessible via a sustainable approach while minimising light pollution to residents and on an ecology basis.

2.2 Safety & Orientation

The amount of lighting required for obstacle avoidance and visual orientation is minimal. For example, emergency lighting standards suggest a value of between 0.5 and 1 lux for a person, in a high stress situation, to safely negotiate a safe passage. Often these low levels of illumination are provided by existing light spill and moonlight alone.

In reality the purpose of urban realm pedestrian lighting is not one of obstacle avoidance, but of human subjectivity. Research has shown that the ability to read a person's facial features in external realm environments is a key function in reducing "fear of crime".

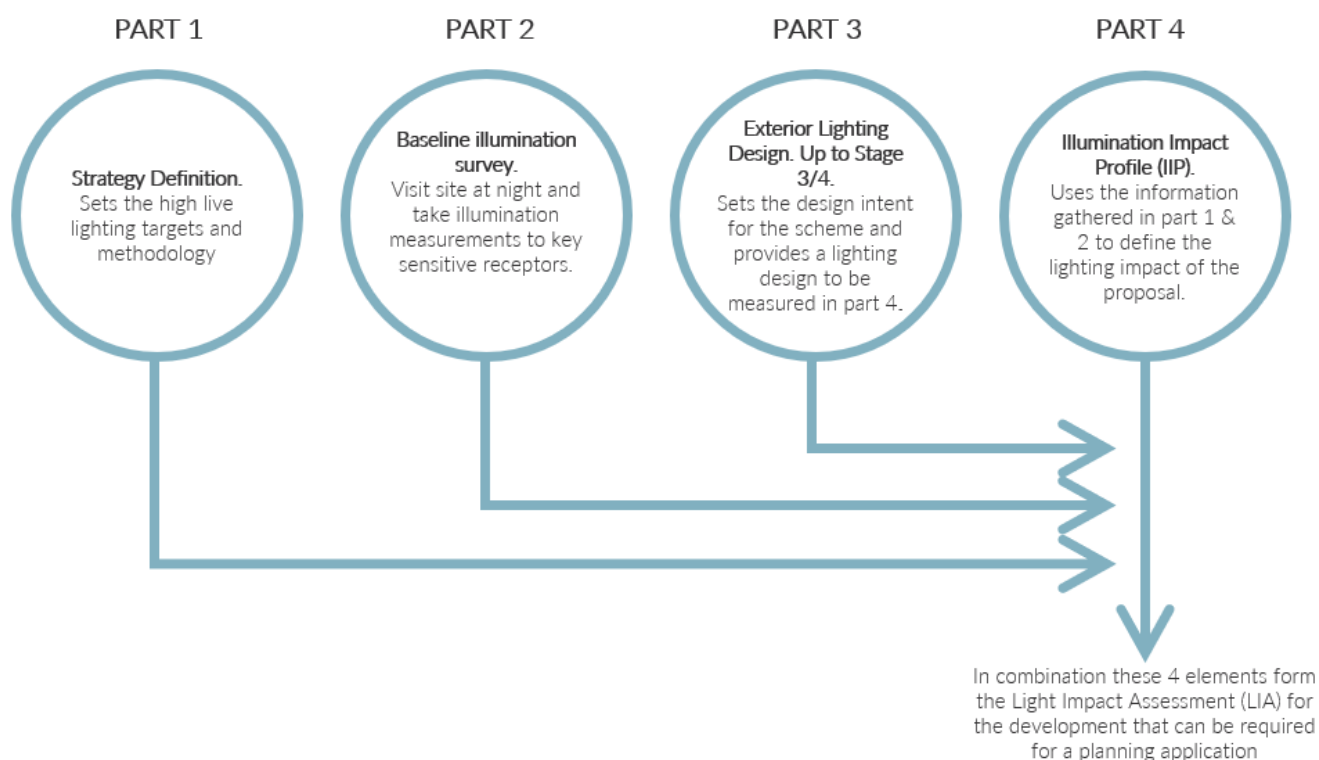
Appropriately illuminated pedestrian areas can reduce fear of crime, which is known to encourage footfall – this in turn can increase natural and community surveillance and further deter criminal acts.

A pleasing and visually interesting exterior environment can be further enhanced by creating spaces and zones of interaction which encourage residence to utilise spaces in the evening.

3. Lighting Design Methodology

The formulation of the lighting strategy involves multiple stages, aiming to comprehensively address the design's performance and aesthetic aspects while prioritising the needs of the space's users. Additionally, it takes into account the potential environmental impact of the lighting system on the surrounding ecosystem.

The lighting impact assessment follows the steps below to set a baseline of existing illuminance and provide lighting information which can then be measured to provide an Illumination Impact Profile (IIP). The IIP follows national planning frameworks to provide a documented estimate of lighting impacts.



3.1 Creating a Circular Economy

The CIBSE TM66 guide focuses on the circular economy of luminaire fittings, in particular focusing on how certain elements of the luminaires such as the LEDs/lamps and control gear can be easily recyclable to aid with both maintenance and repair, enhancing the longevity of the products.

The assessment looks at the following four areas:

Product Design: e.g. design for long life and repair

Materials: e.g. use of recyclable materials

Manufacturing: e.g. use of manufacturing techniques and localisation

Ecosystem: e.g. repairing or upgrading services complementing circular economy design and manufacturing

Every luminaire included in the scheme will undergo an evaluation based on the aforementioned metric to ensure that the principles of the circular economy have been taken into account.

3.2 Embodied Carbon

CIBSE TM65 provides a method of calculating the embodied carbon for not only just luminaires, but also MEP (Mechanical, Electrical and Public Health) systems. Lighting designers can use this to compare lighting products with each other.

The TM65/embodied carbon calculations will start forming part of the normal specification process, alongside the luminaire aesthetics, technical considerations and price of the luminaires. Lighting designers are driving this aspect alongside manufacturers to allow it to become integrated within daily calculations.

4. Relevant Standards & Guidance

Light and people's perception of it, are a complex interaction and vary from person to person. There are therefore recognised standards that are based on current good practice.

The proposed developments external lighting shall be designed in accordance with the following regulations, standards and guidance:

- SLL Code of Lighting
- Society of Light & Lighting Handbook
- CIE Technical Report, CIE 150 – Guide to the Limitation of the Effects of Obtrusive Light from Outdoor Installations
- CIBSE Lighting Guide 6 – The Outdoor Environment
- BS EN 12464-2 Lighting of work places. Part 2: Outdoor work places

Light pollution criteria can be found in the following publications:

- Institute of Lighting Professionals (ILP): Guidance Notes for the Reduction of Obtrusive Light – GN01/21
- Obtrusive light from proposed developments (BRE Digest – DG 529)

The above publications refer to four environmental zones E1-E4 which are based on background brightness, for which several limiting technical parameters are given.

5. Standards and Guidance Overview

All standards consulted are nationally recognised documents, which deal with all design issues associated with external lighting. Following these standards will ensure the lighting scheme puts people and the environment first.

CIE Standards, the CIBSE and the Society of Light & Lighting guidance documents all apply a common Environmental Zoning system, which is summarised in the following Table 1.

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

Table 1: Environmental Lighting Zones

The development site has been assessed as a Class 6 or using the table above Urban Environmental Zone E3 with “Medium district brightness” as this is in the city centre with high activity levels during operating hours but limited at night due to most activities on site closing late evening prior to the 23:00hrs night curfew time.

There are other factors which influence the appropriate design of a lighting scheme, other than illumination levels on the ground as determined by the environmental class. These factors explained in more details below.

Sky glow which is defined as the brightening of the night sky caused by outdoor lighting and natural atmospheric factors must be minimised, by restricting the upward light ratio of all light fittings. Table 3, from CIE guidance states the requirements that must be met.

Light technical parameter	Environmental zones				
	E0	E1	E2	E3	E4
Upward light ratio (ULR) / %	0	0	2.5	5	15

Table 2: CIE Maximum values of upward light ratio (ULR) of luminaires

Any luminaire proposed for this scheme will emit less than 5% upward light and will therefore meet the objective.

The limiting illuminances directly relating to light intrusion into neighbouring buildings for this development are 10 lux (pre-curfew) and 2 lux (post curfew), as defined in Table 3.

Light technical parameter	Application conditions	Environmental zone				
		E0	E1	E2	E3	E4
Illuminance in the vertical plane (E _v)	Pre-curfew	n/a	2 lx	5 lx	10 lx	25 lx
	Post-curfew	n/a	<0.1 lx*	1 lx	2 lx	5 lx

Table 3: CIE Maximum values of vertical illuminance

The values which are also in Table 3, are the suggested maximum and need to also take into account the existing light trespass at the point of measurement.

The intensity of all light sources must also be controlled such that there is limited lamp visible from the site boundary exceeding the values above.

Signage Illumination and brightness of the building façade where required is also restricted by the standards. Both Institution of Lighting Engineers and the CIE publish guidance on brightness limits for signage.

6. Scope of External Lighting

The external lighting scheme will cover the following areas of the new development:

- Principal entrances to the buildings
- Walkways
- Service areas
- Cycle Paths and stores
- Main road through site and entrance area

The guidance requirements from the Institute of Lighting Professionals (ILP) is followed in respect to the reduction of obtrusive light. The main road running through the site is to be lit using column mounted luminaires mounted on poles. At this height, it is possible to achieve a more even illumination across the area to be lit. High efficiency luminaires with specialist optics are to be provided that ensure the direct upward light and split light components are kept to an absolute minimum. As a rule, beam angles are kept below 75 degrees to the vertical.

All lamp types used within the scheme shall consist of high efficiency LED type lamps, this in turn will contribute towards achieving a good level of efficacy (luminaire lumens/circuit watt). This will provide a good colour rendering of greater than 60 Ra, to improve visibility and provide a safer environment in line with a 'secured by design' approach (colour rendering values from CIBSE SLL Code for Lighting). Utilising these lamp types will also provide an energy efficient solution and will be Building Regulation Part L compliant.

Final choice and positioning of luminaires will be subject to detail design, the specification of which will meet or exceed the technical requirements outlined in this report.

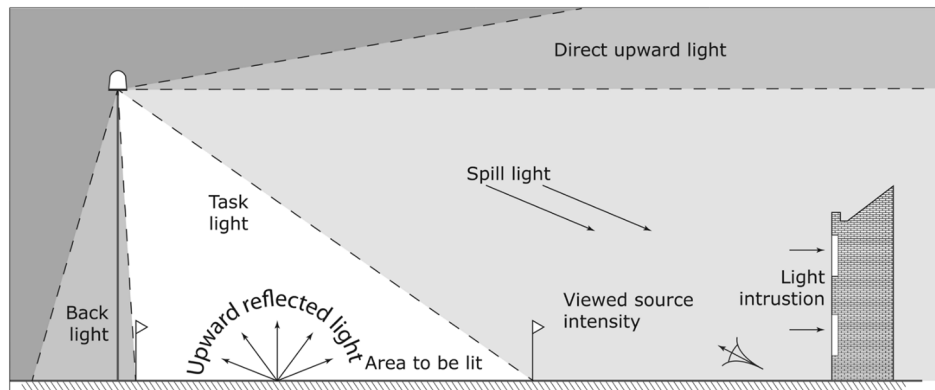


Figure 1: Types of obtrusive light

Illumination levels shall follow the requirements of BS EN12464-2 and CIBSE Lighting Guide 6 whilst maintaining a minimal impact on the site surroundings, environment and neighbours properties. The scheme shall ensure that a uniform, safe level of light is provided across all roadway and parking areas. This scheme will be based on LED luminaires mounted on poles and wall mounted luminaires. Illumination levels have been based on the following:

Areas	Maintained Illuminance E_m lux	Uniformity U_0 -	Glare Rating R_{GL} -	Colour Rendering R_a -
Table 5.1.1 <u>General Outdoor</u> Walkways exclusively for pedestrians	5	0.25	50	20
Table 5.1.2 <u>General Outdoor</u> Traffic areas for slowly moving vehicles (max. 10 km/h), e.g. bicycles, trucks	10	0.4	50	20
Table 5.1.4 <u>General Outdoor</u> Pedestrian passages, vehicle turning, loading and unloading points	50	0,40	50	20
Table 5.9.2 <u>Parking Areas</u> Medium traffic, e.g. parking areas of department stores, office buildings, plants, sports and multipurpose building complexes	10	0,25	50	20

Table 4: Recommended Illuminance levels

6.1 Control

A smart lighting control systems applied to the lighting equipment installed throughout the project will help to reduce the energy consumption and operate the lighting schemes in a more efficient way.

The external lighting installation will be automatic with user intervention where required. Lighting will be controlled via photocells, motion sensors, and programmable time clocks located adjacent to external lighting distribution board(s) and will all come off a DALI (Digital Addressable Lighting Interface) control system which will enable an efficient communication between the lighting system. Override switches are to be provided alongside the boards to allow for routine maintenance and testing.

Building mounted luminaires will all be controlled separately from other lighting installations. Digital time clocks are to be provided to switch off the lighting when it is not required out of hours.

6.2 Walkways

The site will see pedestrian walkways leading from the main road running throughout the site, allowing for full access around the buildings. To allow safe access and egress along these walkways and around the perimeter of the buildings, bollards and wall mounted luminaires will be provided along the entirety of each walkway and the buildings. The wall mounted luminaires will only be operational under normal conditions, additional non-maintained emergency luminaires will be provided above every external door to allow safe egress from each building.

6.3 Cycle Paths

Lighting will be designed to aid intuitive movement through the site by appropriately illuminating and accenting the cycle paths. The direction of the cycle route will be highlighted to help cyclists and pedestrians identify potential hazards. The Cycle paths will have good uniformity of light to allow the safe movement over the surfaces. The cycle path area lighting will comprise vandal resistant and decorative luminaires, designed to limit light pollution from a selection of appropriate lighting class from BS EN 13201-2: Road lighting.

6.4 Servicing Areas

The site will be subject to unloading areas from large vehicles to the rear of the site. These areas have been categorised into table 5 of the general requirements for the lighting of areas outlined within BS EN 12464-2 therefore safe illumination levels will see a minimum average of 50 Lux. This level of illuminance will be achieved using a combination of column mounted, wall mounted, and bollard luminaires.

7. BREEAM Requirements

The following BREEAM credits will be considered as part of this project, to achieve Excellent rating.

Hea 01 Visual Comfort – (Internal and) External Lighting

All external lighting located within the construction zone is designed to provide illuminance levels that enable users to perform outdoor visual tasks efficiently and accurately, especially during the night. To demonstrate this, external lighting provided is specified in accordance with BS 5489-1:2013 Lighting of roads and public amenity areas and BS EN 12464-2:2014 Lighting and lighting – Lighting of workplaces – Part 2: Outdoor workplaces.

The design will take measures to reduce light pollution as shown in the figures above.

A lighting impact assessment shall be undertaken in regard to and accordance with the Institute of Lighting Professionals 'PLG04 – Guidance on Undertaking Environmental Lighting Impact Assessments.

8. Lighting Level Plots

The following is a summary of the different functional spaces for the lighting level plots. The external lighting will be provided to areas denoted in blue below, for the associated walkways, main road, cycle stores, servicing areas, and perimeter landscape. The lighting levels and parameters necessary in these areas have been outlined in the table below.

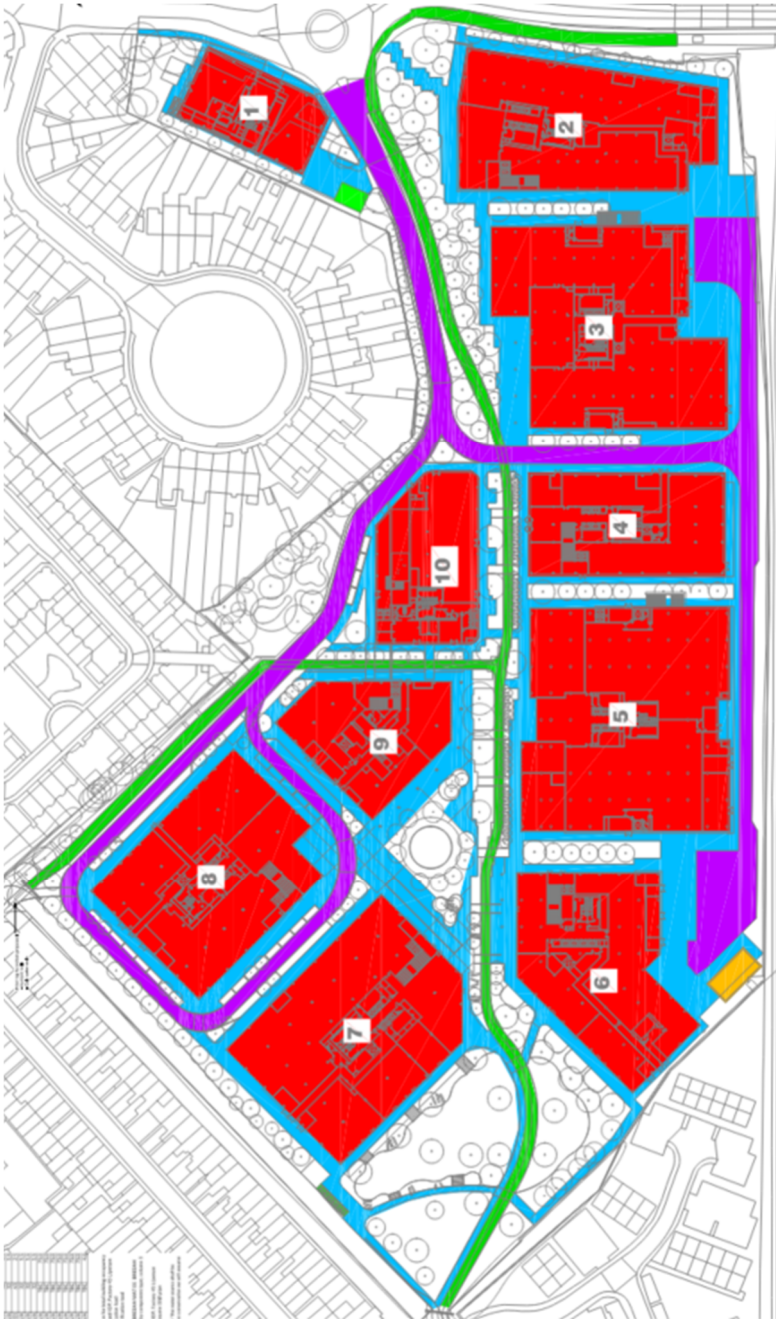


Figure 2: Functional spaces for lighting level plots

Key	Functional spaces	Lighting Plot Lux Level
-----	-------------------	-------------------------

	Building Plots	n/a
	Pedestrian Walkways	5 lux
	Cycle Paths	10 lux
	Regular Vehicle Traffic	10 lux
	Servicing areas	50 lux
	Cycle Stores	50 lux

Table 5: Colour key for functional spaces



ALEX COLEMANCOLE

PRINCIPAL ENGINEER

+44 1865 670 305

alexcolemancole@hoarelea.com

HOARELEA.COM

Old Iron Works
35a Great Clarendon Street
Oxford
OX2 6AT
England

