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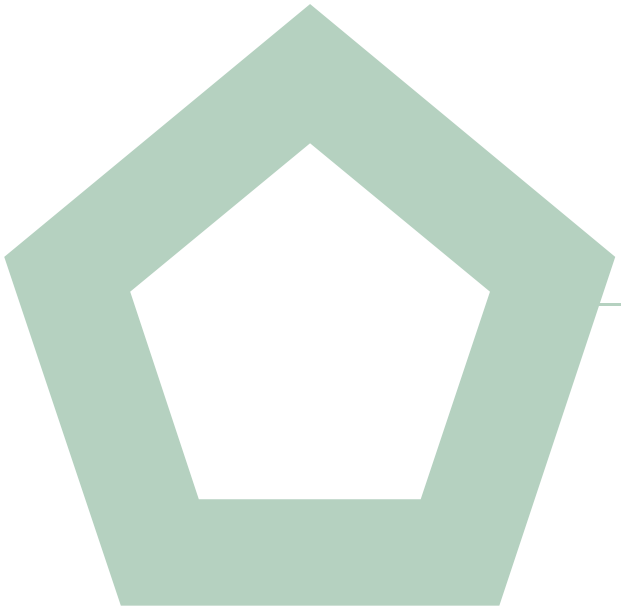
MEP ENGINEERING

STAGE 3 EXTERNAL LIGHTING REPORT

REVISION P1 – 06 JULY 2021



STAGE 3

Audit sheet.

Rev.	Date	Description of change / purpose of issue	Prepared	Reviewed	Authorised
P1	06/07/21	Stage 3 Issue (for comment)	JK	LS	MSJ

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Contents.

1. Introduction

1.1 Scope of Report

This report has been prepared to demonstrate that the external lighting scheme at the new Begbroke Science Park development will comply with Local and National Guidelines in terms of light pollution and minimum levels of illumination required addressing security and amenity.

1.2 Site Location and Description

Begbroke Science Park is situated in North Oxfordshire, accessed via the A44. The scheme will comprise two new buildings; a commercial building and an academic building, with associated car park, bicycle facilities, and walkways.

Figure 1 below shows the site location, and Figure 2 shows the proposed site extents.

Figure 1: Site Location

2. Objectives and Design Criteria

2.1 Objectives

Specific objectives of the proposed lighting scheme when fully designed include:

- Provide adequate illuminance to the roadways and car park areas of this development
- Provide adequate illuminance to walkways and entrances to improve the security of the users
- Mitigate light pollution and light trespass so far as is practicable
- Limit impacts to site ecology, and specifically impact to bats
- Minimise energy consumption through efficient luminaires and suitable lighting control strategy

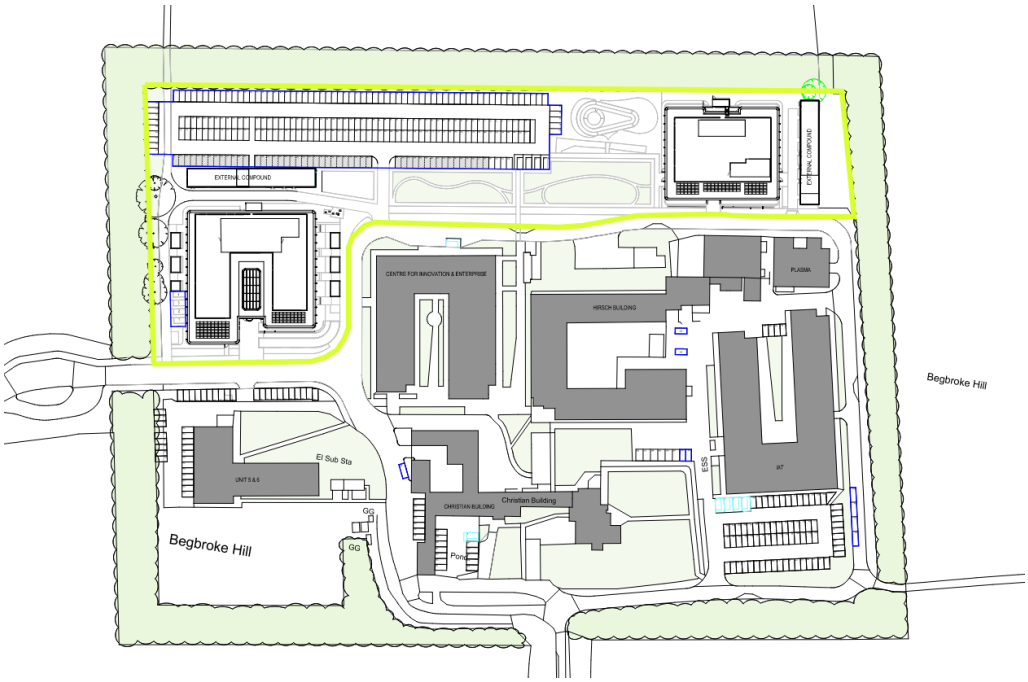

Figure 2: Site Extents

2.2 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 5489-1:2020 Design of Road Lighting. Part 1: Lighting of Roads and Public Amenity Areas - Code of Practice
- BS EN 13201-2:2015 Road Lighting. Part 2: Performance Requirements
- BS EN 12464-2 Lighting of work places. Part 2: Outdoor work places

Additional guidance on light pollution and limiting impacts on ecology:

- Guidance Notes for the Reduction of Obtrusive Light – ILP
- Guidance Note 08/18: Bats and Artificial Lighting in the UK

The above publications refer to five environmental zones E0-E4 which are based on background brightness, for which a number of limiting technical parameters are given. The Begbroke Science Park will fall within Environmental Zone 2: Rural, Low District Brightness

The legal requirements for good lighting are limited to those aspects relevant to safety and are encompassed in the following UK sets of Regulations:

- Health & Safety at Work etc. Act
- Health & Safety Commission, Approved Code of Practice Regulation 8 Lighting

2.3 Performance Criteria

2.3.1 Quality of Light

Lamps and Luminaires
Lamp types will be selected for their efficacy, colour rendition and longevity to provide an efficient lighting solution with a predictable maintenance regime. Where possible luminaires will be sourced from readily available standard product ranges. Luminaires will be selected for their construction, design, fabrication and ingress protection and will be sited in accessible locations. Particular attention will be paid to selecting luminaires with good optical control to help ensure that light pollution is kept to a minimum.

Colour Temperature
The colour temperature of a light source is conventionally stated in the unit of absolute temperature, Kelvin, having the unit symbol K. Temperatures above 4000K are cool in colour, with bluish white light, while colour temperatures around 4000K are more neutral white in tone, providing a modern feel. Colour temperatures in the 2400K-3000K range have a warmer effect, creating a traditional atmosphere.

Guidance from the ILP states that luminaires with a warm white spectrum are preferential as bats are more affected by the blue light component, therefore luminaires with a colour temperature of 2700K-3000K will be used.

Figure 3: Colour Temperature Comparison

2.3.2 Obtrusive Light

Light pollution, or obtrusive light, has the potential to cause physiological and ecological issues. It takes various forms:

- Sky glow: the brightening of the night sky above our towns and cities,
- Glare: the uncomfortable brightness of a light source in contrast to the background
- Light Trespass: the spilling of light beyond the boundary of the property on which the light source is located
- Light Ingress: the passage of light into buildings from an external source(s)

Obtrusive light is a nuisance to both humans and wildlife, it is a waste of energy and contributes to greenhouse gas emissions. The problems of unnecessary, obtrusive light can and should be reduced or eliminated at the design stage. When specifying luminaires, careful consideration is given to minimising upward light and the use of optical units with precise light intensity distribution: thus, ensuring that spill and glare are minimised.

Luminaires selected for this development will have no upward light component and will all be LED with optics designed for precise projection of light.

During the design phase of a lighting installation the following measures should be considered to reduce the occurrence of obtrusive light:

Over-lighting: This is avoided by conducting thorough calculations and carefully selecting the most appropriate lighting equipment and lamp types.

Lighting Control: To ensure luminaires are only switched on when necessary, a lighting control performance specification is produced.

Follow Guidance: For the purpose of this study it is considered that the development is an area of 'Low district brightness' (Zone E2). Therefore, the relevant maximum values highlighted from the tables below should be applied.

Table 2.1 Environmental zones

Zone	Surroundings	Lighting environment	Examples
E0	Protected	Dark	IDA Dark Sky Parks, UNESCO Starlight Reserves
E1	Natural	Intrinsically dark	Areas of Outstanding Natural Beauty, relatively uninhabited rural areas
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 and city centres, commercial areas

Source: CIE 150: 2003.

Figure 4: LG 6 - Environmental Zones

Light Technical Parameter	Application Conditions	Environmental Zones			
		E1	E2	E3	E4
Illuminance in vertical plane (E_v)	Pre-curfew:	2 lux	5 lux	10 lux	25 lux
	Post-curfew:	0* lux	1 lux	2 lux	5 lux

Figure 5: CIE 150 - Maximum Values of Vertical Illuminance on Properties

Road Illuminance

Traffic flow	Lighting class		
	Dual carriageway		Single carriageway
	Junction density: high	Junction density: low	
High to very high[A)]	M3	M4	M3
Low to moderate[B)]	M4	M5	M4
Very low[C)]	M5	M6	M5

Figure 6: BS 5489-1:2020 - Lighting classes for traffic routes (v < 40mph)

Begbroke Science Park will have a very low traffic density as the roadways on the site will be for the building users and for deliveries to the site, therefore the roadways will target lighting class M5.

Class	Luminance of the road surface of the carriageway for the dry and wet road surface condition				Disability glare	Lighting of surroundings
	Dry conditions			Wet	Dry conditions	Dry conditions
	$\overline{L}$ [minimum maintained] cd·m²	U_o [minimum]	U_l [a] [minimum]	U_{ow} [b] [minimum]	f_{TI} [c] [maximum] %	R_{EI} [d] [minimum]
M1	2,00	0,40	0,70	0,15	10	0,35
M2	1,50	0,40	0,70	0,15	10	0,35
M3	1,00	0,40	0,60	0,15	15	0,30
M4	0,75	0,40	0,60	0,15	15	0,30
M5	0,50	0,35	0,40	0,15	15	0,30
M6	0,30	0,35	0,40	0,15	20	0,30

Figure 7: BS EN 13201-2:2015 - M Lighting Classes

Car Park Illuminance

		Values in lux
Type of area and usage	$\bar{E}$	U_o
Light traffic, e.g. parking areas of shops, terraced and apartment houses; cycle parks	5	0.25
Medium traffic, e.g. parking areas of department stores, office buildings, plants, sports and multipurpose building complexes	10	0.25
Heavy traffic, e.g. parking areas of major shopping centres, major sports and multipurpose sports and building complexes	20	0.25

Figure 8: BS 5489-1:2020 - Maintained Lighting Levels for Outdoor Car Parks

As the car park will be for the sole use of the building users, it is anticipated that the car park use will be fairly light but may pick up at peak times.

Walkway Illuminance

Traffic flow	**Lighting class**		
	E1 to E4[A)]	**E1 to E2[A)]**	**E3 to E4[A)]**
	Pedestrian and cyclists only	**Speed limit $v \leq 30$ mph**	**Speed limit $v \leq 30$ mph**
Busy [B)]	P5	P4	P3
Normal [C)]	P5	P5	P4
Quiet [D)]	P6	P5	P4

Figure 9: BS 5489-1:2020 - Lighting Classes for Subsidiary Roads

Class	**Horizontal illuminance**		**Additional requirement if facial recognition is necessary**	
	$\bar{E}$ [a] **[minimum maintained]** lx	E_{min} **[maintained]** lx	$E_{v,min}$ **[maintained]** lx	$E_{sc,min}$ **[maintained]** lx
P1	15,0	3,00	5,0	5,0
P2	10,0	2,00	3,0	2,0
P3	7,50	1,50	2,5	1,5
P4	5,00	1,00	1,5	1,0
P5	3,00	0,60	1,0	0,6
P6	2,00	0,40	0,6	0,2
P7	performance not determined	performance not determined		

[a] To provide for uniformity, the actual value of the maintained average illuminance shall not exceed 1,5 times the minimum $\bar{E}$ value indicated for the class.

Figure 10: BS EN 13201-2:2015 - P Lighting Classes

Pole mounted luminaries with street optic will be utilised to illuminate the main pedestrian walkways through the site, these will allow even illumination of the walkways to improve the safety and security of the users of the site. In order to minimise impact to ecology these will have a colour temperature of 2700K and will be mounted at 4000mm. The minimum maintained illuminance will be as shown in Figure 10.

Access pathways and secondary pathways within the landscaping will be illuminated at low level with bollards.

3. Calculation Results

3.1 Model

A lighting model was prepared in Relux in order to check the compliance of the design with the aforementioned criteria, ensuring adequate illumination of the roads, car park, paths and entrances to the building, as well as examining the obtrusive light to minimise the ecological impact of the design.

The model was based on the landscape designers and architect's layouts. Relux was used to give a realistic indication of the development when constructed. The parameters considered in the model are as follows:

- All column mounted luminaires will be mounted at 4000mm.

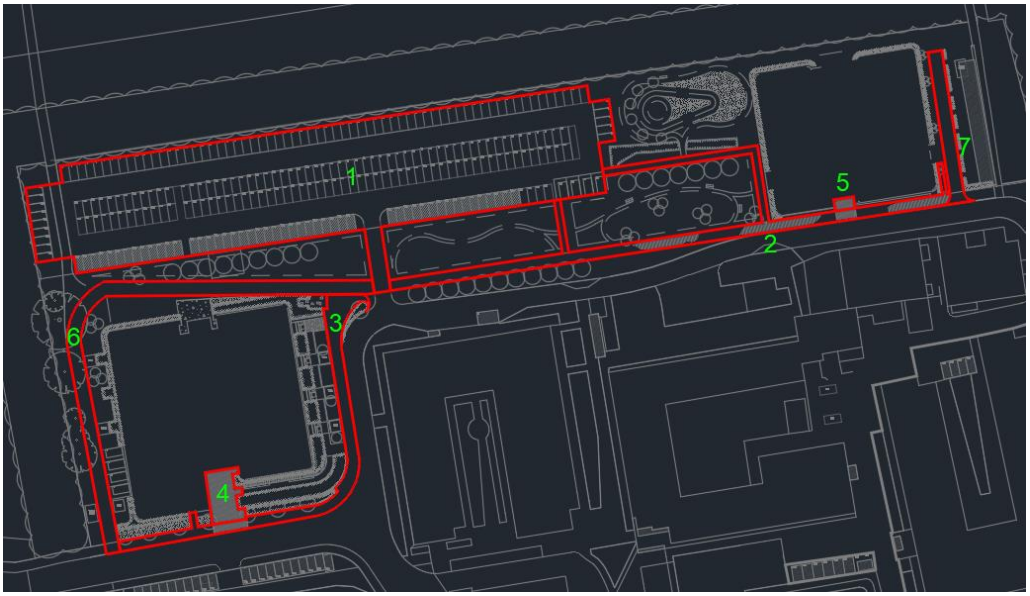

Figure 11: Calculation Surfaces

3.2 Results Overview

	Car Park (1)	Main East-West Path (2)	CB Path (3)	CB Entrance (4)	AB Entrance (5)	CB Road (6)	AB Road (6)
Average Illuminance (lx)	10	18	18	86	86	20.2	23
Minimum Illuminance (lx)	3	9	6	27	32	11.2	11
Maximum illuminance (lx)	31	74	35	126	122	22.7	43
Uniformity (Uo)	0.28	0.5	0.35	0.33	0.37	0.55	0.49
Minimum Luminance (cd/m^2)	-	-	-	-	-	0.5	0.5
Average Luminance (cd/m^2)	-	-	-	-	-	0.9	1.19

3.3 Obtrusive Light

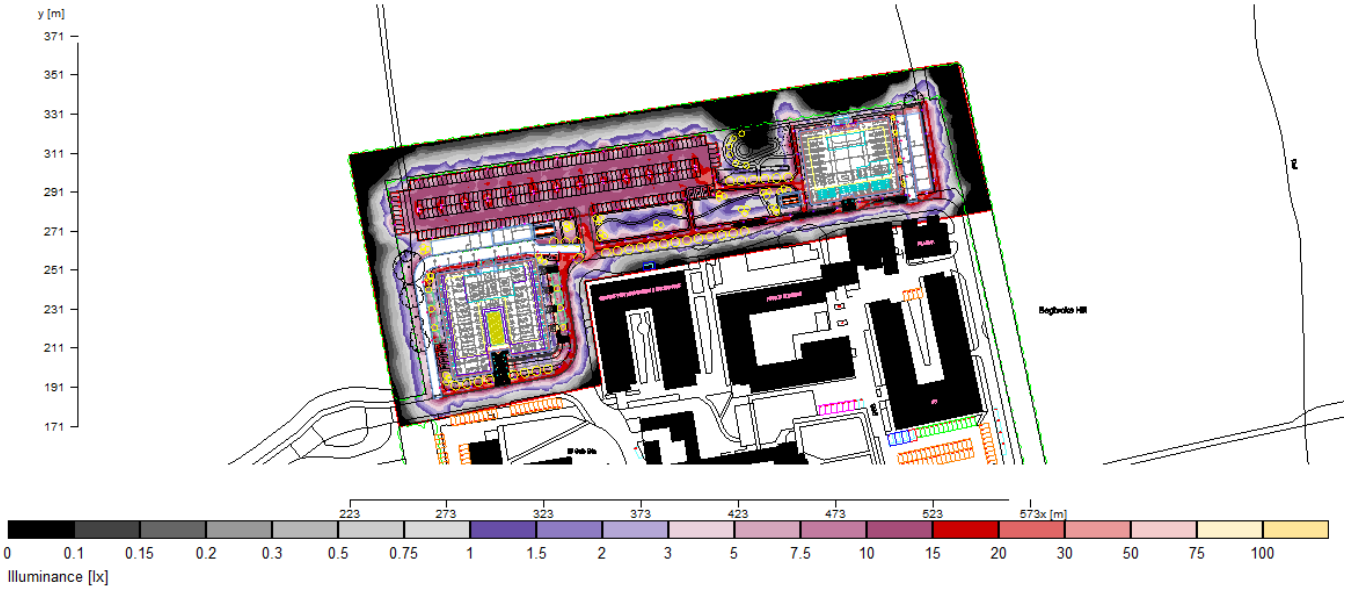

Figure 12: Site Illuminance False Colour Rendering

See associated drawing BBSP-HLEA-XX-XX-DR-E-708-001 for detailed isoline layout showing extents of light spill.

3.4 Luminaire Schedule

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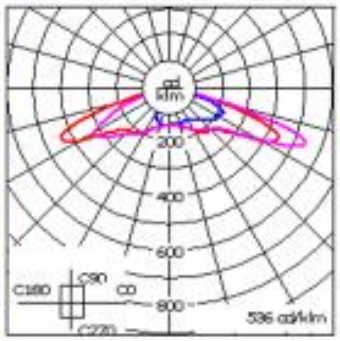
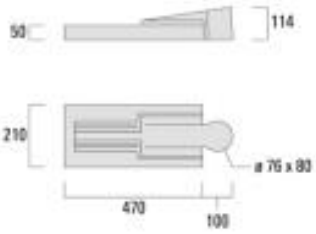
LUMINAIRE DATASHEETS

Begbroke Science Park

Luminaire reference: EX1

***E denotes 3hr Emergency integral battery to BS EN 60598-2-22:1998+A2:2008.**





Manufacturer	We-ef	Rated input power (in W) & Power Factor	24 W >0.90
Manufacturer Contact Details	Sarah Taylor Sarah.taylor@fagerhult.co.uk	Rated luminous fux (in lm)	2796 lm
Product Ref.	VFL520	LED luminaire efficacy (in lm/W)	116.5 lm/W
Control Method	Photocell	Rated life (in h) & Failure fraction & Ambient temp (ta)	90000h L90B10 at 25°C
IP Ratting & IK Impact Protection Ratings	IP66 IK08	Correlated Colour Temperature (CCT in K)	2700 K
Weight & Dimensions	4.7 kg 470 x 210 x 114 mm	Rated Colour Rendering Index (CRI)	80
RAL colour	RAL 7016	MacAdam (initial and maintained)	3
General Notes	Roadways Side throw distribution Mounted at 4000mm	Drive Current	700mA

Note: Prices quoted are manufacturers trade price (£Sterling) excluding V.A.T. Product codes, quantities and prices are for reference only and should be confirmed prior to order placement. Dimensions and technical details are for information only. Installation data should be obtained direct from manufacturer.

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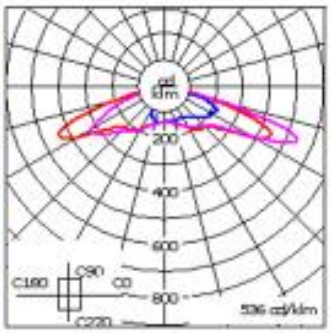
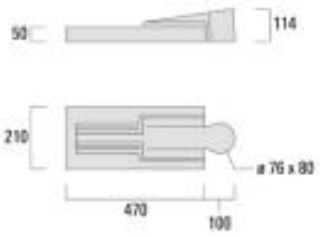
LUMINAIRE DATASHEETS

Begbroke Science Park

Luminaire reference: EX2

***E denotes 3hr Emergency integral battery to BS EN 60598-2-22:1998+A2:2008.**





Manufacturer	We-ef	Rated input power (in W) & Power Factor	12 W >0.90
Manufacturer Contact Details	Sarah Taylor Sarah.taylor@fagerhult.co.uk	Rated luminous fux (in lm)	1512 lm
Product Ref.	VFL520	LED luminaire efficacy (in lm/W)	126 lm/W
Control Method	Photocell	Rated life (in h) & Failure fraction & Ambient temp (ta)	90000h L90B10 at 25°C
IP Ratting & IK Impact Protection Ratings	IP66 IK08	Correlated Colour Temperature (CCT in K)	2700 K
Weight & Dimensions	4.7 kg 470 x 210 x 114 mm	Rated Colour Rendering Index (CRI)	80
RAL colour	RAL 7016	MacAdam (initial and maintained)	3
General Notes	Car Park Asymmetric forward throw distribution Mounted at 4000mm	Drive Current	700mA

Note: Prices quoted are manufacturers trade price (£Sterling) excluding V.A.T. Product codes, quantities and prices are for reference only and should be confirmed prior to order placement. Dimensions and technical details are for information only. Installation data should be obtained direct from manufacturer.

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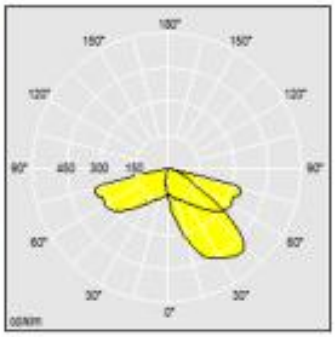
LUMINAIRE DATASHEETS

Begbroke Science Park

Luminaire reference: EX3

***E denotes 3hr Emergency integral battery to BS EN 60598-2-22:1998+A2:2008.**



Manufacturer	Thorn	Rated input power (in W) & Power Factor	15 W 0.95
Manufacturer Contact Details	Ryan Chadwick Ryan.Chadwick@zumtobelgroup.com	Rated luminous fux (in lm)	1009 lm
Product Ref.	Urba Bollard	LED luminaire efficacy (in lm/W)	67 lm/W
Control Method	Photocell	Rated life (in h) & Failure fraction & Ambient temp (ta)	100000h L85 at 25°C
IP Ratting & IK Impact Protection Ratings	IP65 IK10	Correlated Colour Temperature (CCT in K)	3000 K
Weight & Dimensions	12.9 kg Ø201 x 976 mm	Rated Colour Rendering Index (CRI)	80
RAL colour	RAL 7016	MacAdam (initial and maintained)	3
General Notes	Walkways	Drive Current	350mA

Note: Prices quoted are manufacturers trade price (£Sterling) excluding V.A.T. Product codes, quantities and prices are for reference only and should be confirmed prior to order placement. Dimensions and technical details are for information only. Installation data should be obtained direct from manufacturer.

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LUMINAIRE DATASHEETS

Begbroke Science Park

Luminaire reference: EX4

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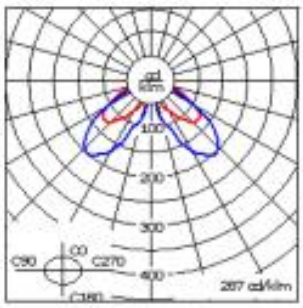

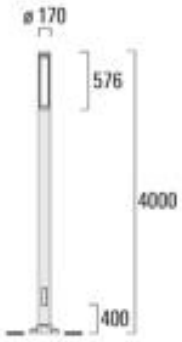

Manufacturer	We-ef	Rated input power (in W) & Power Factor	17 W >0.90
Manufacturer Contact Details	Sarah Taylor Sarah.taylor@fagerhult.co.uk	Rated luminous fux (in lm)	2935 lm
Product Ref.	LMT440	LED luminaire efficacy (in lm/W)	172 lm/W
Control Method	Photocell	Rated life (in h) & Failure fraction & Ambient temp (ta)	90000h L70B50 at 25°C
IP Ratting & IK Impact Protection Ratings	IP66 IK10	Correlated Colour Temperature (CCT in K)	2700 K
Weight & Dimensions	25.3 kg Ø170 x 4000 mm	Rated Colour Rendering Index (CRI)	80
RAL colour	RAL 7016	MacAdam (initial and maintained)	3
General Notes	Entrances Rectangular distribution	Drive Current	700mA

Note: Prices quoted are manufacturers trade price (£Sterling) excluding V.A.T. Product codes, quantities and prices are for reference only and should be confirmed prior to order placement. Dimensions and technical details are for information only. Installation data should be obtained direct from manufacturer.

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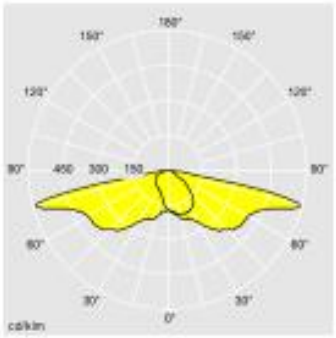
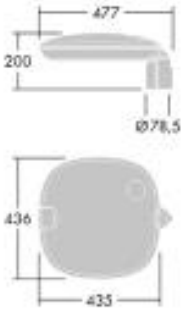
LUMINAIRE DATASHEETS

Begbroke Science Park

Luminaire reference: EX5

***E denotes 3hr Emergency integral battery to BS EN 60598-2-22:1998+A2:2008.**





Manufacturer	Thorn	Rated input power (in W) & Power Factor	15 W 0.95
Manufacturer Contact Details	Ryan Chadwick Ryan.Chadwick@zumtobelgroup.com	Rated luminous fux (in lm)	1445 lm
Product Ref.	Flow	LED luminaire efficacy (in lm/W)	96 lm/W
Control Method	Photocell	Rated life (in h) & Failure fraction & Ambient temp (ta)	100000h L85 at 25°C
IP Ratting & IK Impact Protection Ratings	IP66 IK10	Correlated Colour Temperature (CCT in K)	3000 K
Weight & Dimensions	9.6 kg 477 x 436 x 200 mm	Rated Colour Rendering Index (CRI)	80
RAL colour	RAL 7016	MacAdam (initial and maintained)	3
General Notes	Pedestrian Paths Pole Mounted @ 4000mm Wide Street Optic	Drive Current	350mA

Note: Prices quoted are manufacturers trade price (£Sterling) excluding V.A.T. Product codes, quantities and prices are for reference only and should be confirmed prior to order placement. Dimensions and technical details are for information only. Installation data should be obtained direct from manufacturer.

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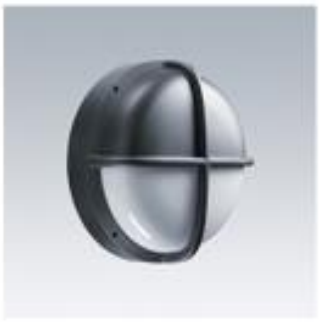
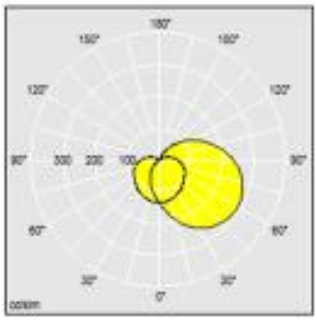
LUMINAIRE DATASHEETS

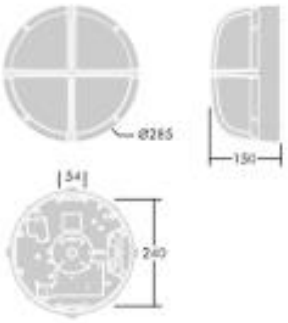
Begbroke Science Park

Luminaire reference: EX6

***E denotes 3hr Emergency integral battery to BS EN 60598-2-22:1998+A2:2008.**







Manufacturer	Thorn	Rated input power (in W) & Power Factor	7 W 0.95
Manufacturer Contact Details	Ryan Chadwick Ryan.Chadwick@zumtobelgroup.com	Rated luminous fux (in lm)	400 lm
Product Ref.	EyeKon LED	LED luminaire efficacy (in lm/W)	60 lm/W
Control Method	Photocell & Motion Detector	Rated life (in h) & Failure fraction & Ambient temp (ta)	50000h L90 at 25°C
IP Ratting & IK Impact Protection Ratings	IP65 IK10	Correlated Colour Temperature (CCT in K)	2700 K
Weight & Dimensions	2.34 kg Ø285 x 150 mm	Rated Colour Rendering Index (CRI)	80
RAL colour	RAL 7016	MacAdam (initial and maintained)	3
General Notes	Wall Mounted Stores & Bike Shelters	Drive Current	-

Note: Prices quoted are manufacturers trade price (£Sterling) excluding V.A.T. Product codes, quantities and prices are for reference only and should be confirmed prior to order placement. Dimensions and technical details are for information only. Installation data should be obtained direct from manufacturer.

3.5 Controls

The external lighting installation will be automatic with user intervention where required. Lighting will be controlled via centralised photocell and programmable time clock lighting control system, located adjacent to external lighting distribution boards. Override / isolation switches will be provided alongside the boards to allow for routine maintenance and testing.

The lighting installation will be zoned to allow different areas to be controlled independently.

- Control Zone 1 : Pedestrian pathways
- Control Zone 2 : Roadways
- Control Zone 3 : Car Park
- Control Zone 4 : Building Entrances
- Control Zone 5 : Bike Shelters

The external lighting will be switched on at dusk via the centralised photocell, and switch off as detailed below. Please note that these times could be changed within the external lighting system to meet the Client's requirements.

- Control Zone 1 : Pedestrian Pathways – Dusk to Midnight, 6.00am to daylight
- Control Zone 2 : Roadways – Dusk to Dawn
- Control Zone 3 : Car Park - Dusk to Midnight, 6.00am to daylight
- Control Zone 4 : Building Entrances - Dusk to Midnight , dimmed Dusk to Dawn
- Control Zone 5 : Bike Shelters - Dusk to Dawn presence detection externally to illuminate internal and external bike shelter lighting

The external lighting control system shall be managed by a central control system that shall allow the on/off times to be modified as the requirements of the buildings users and Begbroke site develops over time.

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