

Lower Thames Crossing – Marling Cross Compound

Lighting Strategy Assessment

Highways England

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Quality information

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GLOSSARY

Abbreviation	Description
Abbreviation	Description
AGI	Above Ground Installation
BS	British Standard
CCGT	Combined Cycle Gas Turbine – a highly efficient form of energy generation technology. An assembly of heat engines work in tandem using the same source of heat to convert it into mechanical energy which drives electrical generators and consequently generates electricity.
CEMP	Construction Environmental Management Plan – a plan to outline how a construction project will avoid, minimise or mitigate effects on the environment and surrounding area.
CIBSE	The Chartered Institute of Building Services Engineers
CIE	Commission Internationale de L'Eclairage
curfew	The time after which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied by a government controlling authority, usually the local government. If not otherwise stated – 23:00hrs is suggested.
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
E	Illuminance – The quantity of light, or luminous flux falling on a unit area of a surface in Lux (lx). One Lux is equivalent to one lumen per square meter
E _h	Horizontal Illuminance in Lux (lx)
EIA	Environmental Impact Assessment. The assessment of the likely significant environmental effects of a development undertaken in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulation 2009.
EN	European

Abbreviation	Description
EPA	Environmental Protection Act
ES	Environmental Statement – A report in which the process and results of an Environment Impact Assessment are documented.
Ev	Ev = Vertical Illuminance in Lux (lx)
Glare	A sensation that is produced by bright areas within the field of vision and may be experienced either as discomfort glare or disability glare. Glare caused by reflections in specular surfaces is usually known as veiling reflections or reflected glare
I	Light Intensity in Candelas (cd)
ilp	The Institute of Lighting Professionals
L	Luminance in Candelas per square meter (cdm-2)
LG	Lighting Guide
Lv	Veiling Luminance – A measure of the loss of visibility caused by the disability glare from the obtrusive light installation
NPPF	National Planning Policy Framework
NSIP	Nationally Significant Infrastructure Project – defined by the Planning Act 2008 and cover projects relating to energy (including generating stations, electric lines and pipelines); transport (including trunk roads and motorways, airports, harbor facilities, railways and rail freight interchanges); water (dams and reservoirs, and the transfer of water resources); wastewater treatment plants and hazardous waste facilities. These projects are only defined as nationally significant if they satisfy a statutory threshold in terms of their scale or effect.
Photocell	A light sensing device used for switching/controlling luminaires
PINS	Planning Inspectorate
PA	Planning Act
RGL	Glare Rating Limit – A metric used for the assessment of glare
SLL	Society of Light and Lighting
TI	Threshold Increment
ULR	Upward Lighting Ratio of the installation – the maximum permitted percentage of luminaire flux that goes directly into the sky. This metric is often used as a measure of 'sky-glow'

EXECUTIVE SUMMARY

This Indicative Lighting Strategy document discusses the type and level of lighting requirements of a proposed site at Marling Cross, Kent. An overview of the Proposed Development and site location is included in Section 1.

Section 2 provides a review of the relevant light standards and guidance. It discusses the legislative background on light pollution, the planning policy context in national policy statements and the National Planning Policy Framework, before discussing international and national guidance available on limiting light pollution, with reference to the Institute of Lighting Professionals lighting limits.

Section 3 discusses the lighting standards and guidance on limiting light levels, with reference to the lighting requirements outlined in British Standards Institute BS EN 12464-2:2014. A summary of other guidance and reference documents is also discussed.

Section 4 outlines the sensitive receptors to light at the site and surrounding area, including residential, road, and ecological – these are mapped on Figure 1 for ease of reference.

Section 5 provides an overview of the obtrusive light level limits that will be followed to minimise light spill to each of the receptor categories outlined in Section 4. Sections 6 and 7 then discuss the site lighting requirements for the construction and operational phase of the generating station site, respectively. A number of indicative impact avoidance measures are outlined in Section 8, which are to be adopted as good lighting design practice but will be confirmed at the detailed design stage.

It is concluded in Section 9 that detailed information on the lighting to be used at the Proposed Development is currently unknown; however, the document provides an outline of the lighting requirements and identifies potential measures to control obtrusive light through detailed design of the lighting scheme.

1. Introduction

Background

- 1.1 Perfect Circle JV Limited (PCJV) has been appointed by Highways England Company Limited (Highways England) to perform Ground Investigation (GI) works for the Lower Thames Crossing (LTC) project. AECOM is a core member of PCJV and has been designated responsible for delivery of the investigation as Principal Contractor under a management contractor form of agreement.
- 1.2 The LTC will provide a tunnel crossing of the River Thames downstream of the Queen Elizabeth II Bridge at Dartford. This will entail the construction of a north/ south link road that will join the M25 between J29 and J30 near North Ockenden, cross the A13 at Orsett, then continue south under the River Thames via two 15.8m diameter bored tunnels and join the A2 east of Gravesend. The Planning Application describes the proposed development as set out below:
- 1.3 The complete project will involve construction of new highways, including cuttings, embankments, underpasses, overpasses, interchange enhancements and new technology; major tunnel construction, including ground treatment, logistic yards and power supplies; structures including bridge construction and demolition, site clearance, diversions and associated works.
- 1.4 The project will require several satellite compounds to provide laydown areas for equipment used during the GI, as well as to provide welfare and office facilities for drilling and supervising staff. Construction activities will consist of installing new (or upgrading existing) hard-standing and placing portacabins.

The Purpose and Structure of this Document

- 1.5 This report is designed to inform transport scoping discussions with Gravesham Borough Council (GBC) and ultimately Kent County Council (KCC) (as highway authority) with regards to the following compound which is proposed to be situated to the south of the river within Gravesham in Kent: Marling Cross (also referred to as Hever Court).
- 1.6 The Proposed Development will require the installation of a number of luminaires to provide visual comfort as well as safe access and egress, which in turn will have the potential to result in obtrusive light at receptor locations.
- 1.7 At the time of submission, the detailed design work for the Proposed Development has not been completed. Therefore, detailed information on the lighting to be used at the Proposed Development is currently unknown. Nevertheless, it is recognised that potential nuisance from lighting of the Proposed Development may be a concern for some members of the public. Therefore, the Applicant has commissioned this strategy in order to provide some definition to the type and level of lighting that will be employed at the Proposed Development.
- 1.8 The following stages have therefore been undertaken in order to consider and define potential constraints on the lighting scheme associated with the Proposed Development:
 - a review of pertinent standards and guidance;
 - identification of the type and location of the light sensitive receptors;
 - classification of the surrounding area with regard to the Environmental Zones as set out in the Institute of Lighting Professionals Guidance Notes for the Reduction of Obtrusive Light;
 - setting obtrusive light limits for the exterior lighting installation;
 - providing a general lighting strategy that is capable of providing visual comfort and performance for various tasks undertaken by site personnel within exterior areas;

- providing a general lighting strategy for the exterior lighting installation that is capable of achieving the obtrusive light limits;
 - providing a general lighting control strategy that enables part lighting to be used at specific locations and at set times in order to facilitate the possible use of infrared CCTV in lieu of security lighting; and
 - providing a general strategy for mitigation measures to adequately control obtrusive light.
- 1.9 At the detailed design stage, a computational light modelling exercise will be undertaken. This will ensure that the Site is adequately lit and that obtrusive light is suitably controlled, in accordance with this Strategy.

The Site

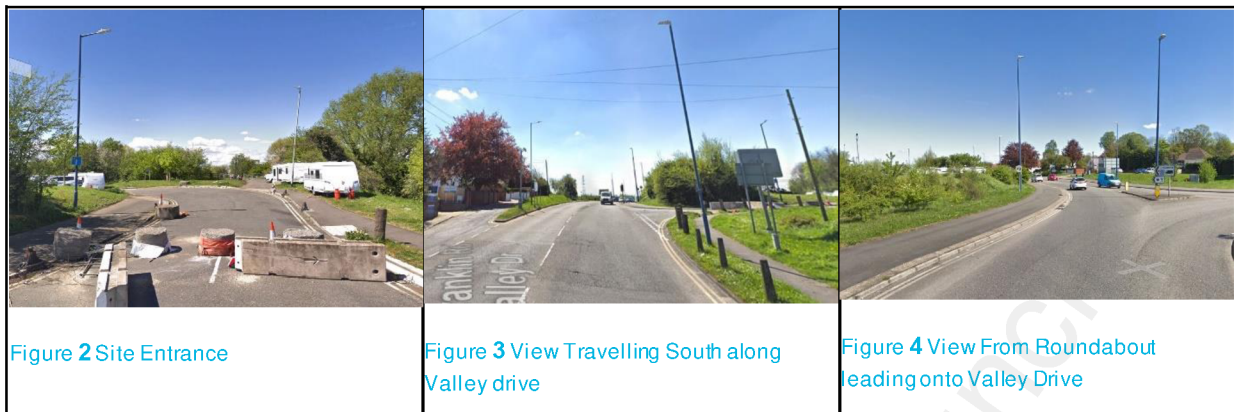
- 1.10 The Marling Cross site is located on the edge of Gravesend approximately 4km to the south east of the town centre. Site access is currently taken via the minor arm of a priority junction with Valley Drive to the northeast of the site. The site is bound by the site access road and a footpath to the north, Valley Drive to the east and open land to the south and west. The site is situated within close proximity to the A2 Watling Street to the south.
- 1.11 The Marling Cross site currently consists of an area of hardstanding which has historically been used as a lorry park. It is understood that the site is currently vacant. See Figure 1 below



Figure 1 Image of existing site

Site Context

- 1.12 The Site perimeter is largely bound by trees and hedgerows, the majority of which will be retained for the Proposed Development.



- 1.13 There are noticeably a variety of street columns ranging from 6-12m in the area.
- 1.14 Figures 2-4 indicate different types of column mounted lighting used in statutory or public area installations.

Proposed Site and Lighting Context

- 1.15 The proposed development will comprise of a site compound associated with the Lower Thames Crossing
- 1.16 Column and building mounted lighting are likely intended to provide general light for safe access and movement of pedestrians and vehicles. Movable, low level task lighting is to be employed when higher light levels are required for site activities. Task lighting is not considered for analysis.
- 1.17 The indicative design set out in Figure 5 utilises 17 No. 8m columns for lighting positioned throughout the site within the Depot boundary. The existing columns just outside the boundary should suffice for visibility of vehicles/drivers on entry and exit. 11 luminaires are mounted to structures within the site at varying heights to a maximum of 5m to suit individual buildings. The lighting design will aim to provide as much unobstructed open space between storage areas and vehicle routes as possible.
- 1.18 Lighting is specified as full cut-off in design and uses neutral white LEDs.

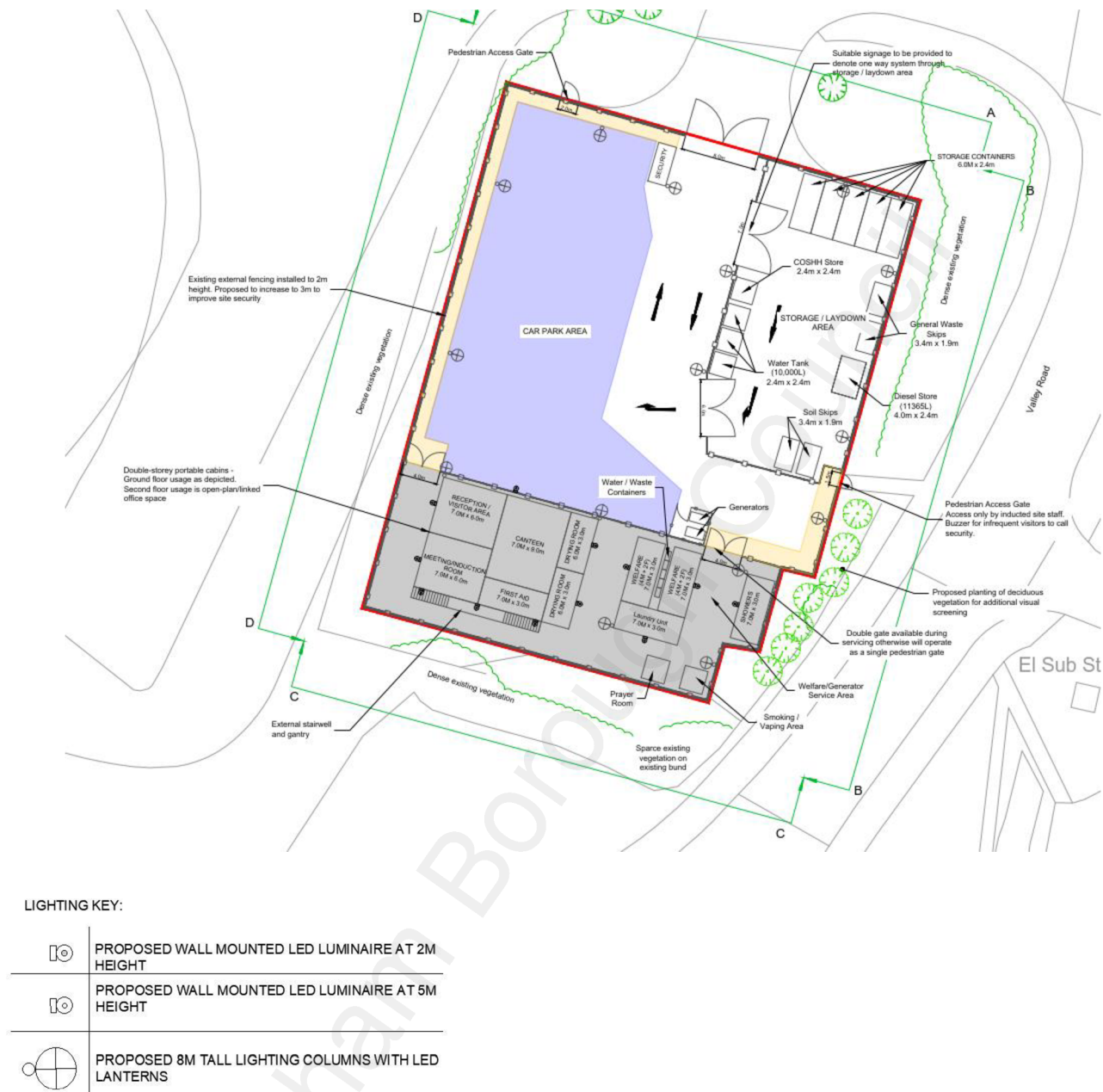


Figure 5 Indicative Lighting Arrangement provided by AECOM Note that some columns will be designated to support lights and CCTV. CCTV will need to be coordinated with the security strategy

Legislation and Planning Policy Context

Legislative Background

- 1.19 Light pollution was introduced within the Clean Neighbourhoods and Environment Act 2005 (Ref 9) as a form of statutory nuisance under the Environmental Protection Act 1990 (the 'EPA') which was amended in 2006 to include the following nuisance definition:
- 1.20 "(fb) artificial light emitted from premises so as to be prejudicial to health or nuisance"
- 1.21 Although light was described as having the potential to cause statutory nuisance, no prescriptive limits or rules were set for impact assessment purposes. Guidance notes for the Reduction of Obtrusive Light produced by the Institute of Lighting Professionals (ILP, 2012) (ref 7) have, therefore, been referred to for the purposes of this assessment.
- 1.22 Guidance produced on Section 101 to Section 103 of the Clean Neighbourhoods and Environment Act (2005) has also been referred to, which places a duty on local authorities to ensure that their areas are checked periodically for existing and potential sources of statutory nuisances – including nuisances arising from artificial lighting. Local authorities must take reasonable steps to investigate complaints of such nuisances from artificial light. Once satisfied that a statutory nuisance exists or may occur or reoccur, local authorities must issue an abatement notice (in accordance with Section 80(2) of the EPA 1990), requiring that the nuisance cease or be abated within a set timescale.

Planning Policy Context

National Policy Statements

- 1.23 The overarching National Policy Statement (NPS) for Energy (EN-1) (Department of Energy and Climate Change, 2011) (NPS EN-1) states:

"The applicant should assess the potential for...artificial light to have a detrimental impact on amenity, as part of the Environmental Statement.

In particular, the assessment provided by the applicant should describe:

- the type, quantity and timing of emissions;
- aspects of the development which may give rise to emissions;
- premises or locations that may be affected by the emissions;
- effects of the emission on identified premises or locations; and
- measures to be employed in preventing or mitigating the emissions."

and

"The IPC should satisfy itself that:

- an assessment of the potential for artificial light...to have a detrimental impact on amenity has been carried out; and
- that all reasonable steps have been taken, and will be taken, to minimise any such detrimental impacts."

National Planning Policy Framework

- 1.24 The National Planning Policy Framework (NPPF) (Department for Communities and Local Government (DCLG), 2019) states that the purpose of the planning system is to contribute to the achievement of sustainable development and constitute the Government's view on what sustainable development in England means in practice for the planning system. A principal concept contained within the NPPF is the presumption in favour of sustainable development and with regard to artificial lighting, the NPPF states:

- 1.25 “...By encouraging good design, planning policies and decisions should limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation...”

International Guidance

- 1.26 The Commission Internationale De L'éclairage (CIE) 150: Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations (the 'CIE 150') (CIE, 2003) (Ref 3) is an aid to formulating guidelines for assessing the environmental effects of exterior lighting and provides limits for relevant lighting parameters to control the obtrusive effects of exterior lighting to tolerable levels. CIE 150 refers to the potentially adverse effects of exterior lighting on both natural and man-made environments.
- 1.27 CIE 126: Guidelines for Minimising Sky Glow (CIE, 1997) (Ref 2) gives general guidance for lighting designers and policy makers on the reduction of sky glow. The report gives recommendations about maximum permissible values for exterior lighting installations. These values are regarded as limiting values. Lighting designers should strive to meet the lowest criteria for the design. Practical implementation of the general guidance is left to national regulations.

National Guidance

ILP Guidance Notes

- 1.28 The ILP Guidance Notes (ILP, 2012) (Ref 11) propose lighting guidance and criteria for local authorities with a recommendation that these are incorporated at the local plan level. The ILP Guidance Notes define various forms of light pollution and describe a series of environmental zones. The ILP Guidance Notes provide suitable criteria against which the effects of artificial lighting can be assessed. This assessment has been based upon these criteria.

ILP Criteria (General Observers)

- 1.29 The obtrusive lighting constraints for the Site are based on statutory guidance issued by the Department for the Environment, Food and Rural Affairs (Defra, 2006) to support the implementation of the Clean Neighbourhoods and Environment Act 2005 and non-statutory guidance on obtrusive light limits published by the ILP. The limits are set out in the ILP Guidance Notes (ILP, 2012).
- 1.30 The ILP has developed an Environmental Zone classification system for the categorisation of receptor locations. This is summarised in Table 2.1 below.

Table 2.1 - ILP Environmental Zone Classifications

Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks
E1	Natural	Intrinsically dark landscapes	National Parks, Areas of Outstanding Natural Beauty etc
E2	Rural	Low district brightness areas	Rural, small village, or relatively dark urban locations
E3	Suburban	Medium district brightness	Small town centres or urban locations
E4	Urban	High district brightness areas	Town/city centres with high levels of night-time activity

- 1.31 For each Environmental Zone, obtrusive light limits for exterior lighting installations are specified and are summarised in Table 2.2 below. These are intended to support decision makers in establishing whether obtrusive lighting is detrimental to local amenity or a potential statutory nuisance.

Table 2.2 - ILP Obtrusive Light Limits for Exterior Lighting Installations

Environmental Zone	Max Sky Glow ULR %	Light Trespass (into windows) E_v (lx)		Source Intensity I (kcd)	
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew
E0	0	0	0	0	0
E1	0	2	1	2.5	0
E2	2.5	5	1	7.5	0.5
E3	5.0	10	2	10	1.0
E4	15.0	25	5	25	2.5

- 1.32 There are also criteria within the ILP Guidance Notes (ILP, 2012) (Ref 7) relating to limiting levels of luminance to buildings i.e. controlling how brightly they are luminated. However, the Site does not have any buildings which are intentionally lit by design and so the luminance criteria are not applicable in this case. As a matter of good lighting design practice however, lighting will be selected, positioned and aimed such that any building luminance is limited.

ILP Criteria (Road Users)

- 1.33 Disability and discomfort glare arising from obtrusive light affecting road users is also addressed within the ILP Guidance Notes (ILP, 2012). Table 2.3 below sets out the threshold increment requirements and the veiling luminance limits.

Table 2.3 - ILP Glare Limits for Exterior Lighting Installations (road users)

Obtrusive Light Limits for Exterior Lighting Installations – Road Users		
Road Classification	Threshold Increment (TI)	Veiling Luminance (L_v)
No road lighting	15% based on adaptation luminance of 0.1 cd/m ²	0.04
ME6 / ME5	15% based on adaptation luminance of 1 cd/m ²	0.25
ME4 / ME3	15% based on adaptation luminance of 2 cd/m ²	0.40
ME2 / ME1	15% based on adaptation luminance of 5 cd/m ²	0.84

BS EN 12464-2: 2014 Glare Criteria (Railways)

- 1.34 Disability and discomfort glare affecting railway users is addressed in BS EN 12464-2: 2014 (BSI, 2014) (Ref1). It is considered a reasonable approach to adopt the lighting scheme glare limits as suitable obtrusive light limits. Table 2.4 below sets out the glare rating limits for the railways.

Table 2.4 - BS EN 12464-2: 2014 Glare Rating Limits for railways and tramways

Type of area, task or activity	R _{GL}
Freight track, short duration operations	50
Walkways in railway areas, open footbridges	50
Freight track, continuous operation	50
Open platforms in freight areas	50
Railway yards handling areas	50
Coupling area	45

2. Lighting design standards and guidance

British Standards

BS EN 12464-2: 2014 'Light and lighting – Lighting of workplaces. Part 2: Outdoor work places' (British Standards Institute, 2014) (Ref 1)

- 2.1 This standard specifies lighting requirements for outdoor workplaces, which meet the needs for visual comfort and performance. All usual visual tasks are considered. Criteria that are potentially relevant to the Site are given in Tables 3.1 to 3.8 below.

Table 3.1 - BS EN 12464-2: 2014 General requirements for areas and for cleaning at outdoor work places

Type of area, task or activity	Average E_m lx	U_o	R_{GL}	R_a
Walkways exclusively for pedestrians	5	0.25	50	20
Traffic areas for slowly moving vehicles (max. 10 km/h), e.g. bicycles, trucks and excavators	10	0.40	50	20
Regular vehicle traffic (max. 40 km/h)	20	0.40	45	20
Pedestrian passages, vehicle turning, loading and unloading points	50	0.40	50	20
Cleaning and servicing	50	0.25	50	20

Table 3.2 - BS EN 12464-2: 2014 General requirements for building sites

	Average E_m lx	U_o	R_{GL}	R_a
Clearance, excavation and loading	20	0.25	55	20
Construction areas, drain pipes mounting, transport, auxiliary and storage tasks	50	0.40	50	20
Framework element mounting, light reinforcement work, wooden mould and framework mounting, electric piping and cabling	100	0.40	45	40
Element jointing, demanding electrical, machine and pipe mountings	200	0.50	45	40

Table 3.3 - BS EN 12464-2: 2014 General requirements for industrial sites and storage areas

Type of area, task or activity	Average E_m lx	U_o	R_{GL}	R_a
Short-term handling of large units and raw materials, loading and unloading of solid bulk goods	20	0.25	55	20
Continuous handling of large units and raw materials, loading and unloading of freight, lifting and descending location for cranes, open loading platforms	50	0.40	50	20

Type of area, task or activity	Average E_m I_x	U_o	R _{GL}	R _a
Reading of addresses, covered loading platforms, use of tools, ordinary reinforcement and casting tasks in concrete plants	100	0.50	45	20
Demanding electrical, machine and piping installations, inspection	200	0.50	45	60

Table 3.4 - BS EN 12464-2: 2014 General requirements for parking areas

Type of area, task or activity	Average E_m I_x	U_o	R _{GL}	R _a
Light traffic, e.g. parking areas of shops, terraced and apartment houses; cycle parks	5	0.25	55	20
Medium traffic, e.g. parking areas of department stores, office buildings, plants, sports and multipurpose building complexes	10	0.25	50	20
Heavy traffic, e.g. parking areas of major shopping centres	20	0.25	50	20

Table 3.5 - BS EN 12464-2: 2014 General requirements for power, electricity, gas and heat plants

Type of area, task or activity	Average E_m I_x	U_o	R _{GL}	R _a
Pedestrian movements within electrically safe areas	5	0.25	50	20
Handling of servicing tools, coal	20	0.25	55	20
Overall inspection	50	0.40	50	20
General servicing work and reading of instruments	100	0.40	45	40
Repair of electric devices	200	0.50	45	60

Table 3.6 - BS EN 12464-2: 2014 General requirements for railways and tramways

Type of area, task or activity	Average E_m I_x	U_o	R _{GL}	R _a
Freight track, short duration operations	10	0.25	50	20
Walkways in railway areas, open footbridges	10	0.25	50	20
Freight track, continuous operation	20	0.40	50	20
Open platforms in freight areas	20	0.40	50	20
Railway yards handling areas	30	0.40	50	20
Type of area, task or activity	Average E_m I_x	U_o	R _{GL}	R _a
Coupling area	30	0.40	45	20

Guidance and Reference Documents

The Society of Light & Lighting (SLL) Handbook (SLL, 2012)

- 2.2 Aimed at lighting practitioners, specifiers and students of lighting, this handbook summarises the fundamentals of light and vision, the technology of lighting and guidance on a wide range of applications, both interior and exterior. It is intended to act as a link between the SLL's 'Code for Lighting' and the Lighting Guides (LG). The handbook also includes a chapter dedicated to exterior workplace lighting (Chapter 17) which has been referred to in the production of this report. Criteria that are potentially relevant to the Site are given in Tables 11 and 12 below.

Table 3.7 - SLL Handbook illuminance recommendations for exterior workplaces

Activity	Minimum maintained illuminance (lx)	Illuminance uniformity
Safe pedestrian movement in low risk areas	5	0.15
Safe movement of slow vehicles	10	0.25
Safe movement in medium risk areas	20	0.25
Normal traffic	20	0.4
Very rough work	20	0.25
Rough work	50	0.25
Safe movement in high risk areas	50	0.4
Normal work	100	0.4
Fine work	200	0.5

Table 3.8 - SLL Handbook recommendations for loading

Application	Horizontal illuminance (lx)	Horizontal illuminance uniformity	Maximum glare rating	Minimum colour rendering index
Loading bay	150	-	-	40
Outdoor loading area	100	0.5	45	20

- 2.3 The SLL Code for Lighting provides information on three areas of lighting practice:
- A summary of the effects of lighting on task performance, behaviour, safety, perception, health, and its financial and environmental costs;
 - A compendium of lighting recommendations relevant to the UK, and
 - Detailed descriptions of the calculations required for quantitative lighting design.
- 2.4 The lighting requirements for workplaces as set out in the SLL Code are very much aligned with those as set out in BS EN 12464-2: 2014 and so are not expanded on in this section.

Other Relevant Policy, Standards and Guidance

2.5 The following best practice guidance has been taken into account informing this assessment:

- CIE 126:1997 – Guidelines for Minimising Sky Glow;
- DEFRA Lighting in the Countryside: Towards Good Practice, July 1997 (Ref 13). Reference document on exterior lighting and classification as it applies to the British countryside. Includes guidance and recommendations for development limitations based on context.
- Bat Conservation Trust (2018) Bats and artificial lighting in the UK (Ref 14): Bats and the Build Environment series. Includes guidance for lighting approaches where bats are present.

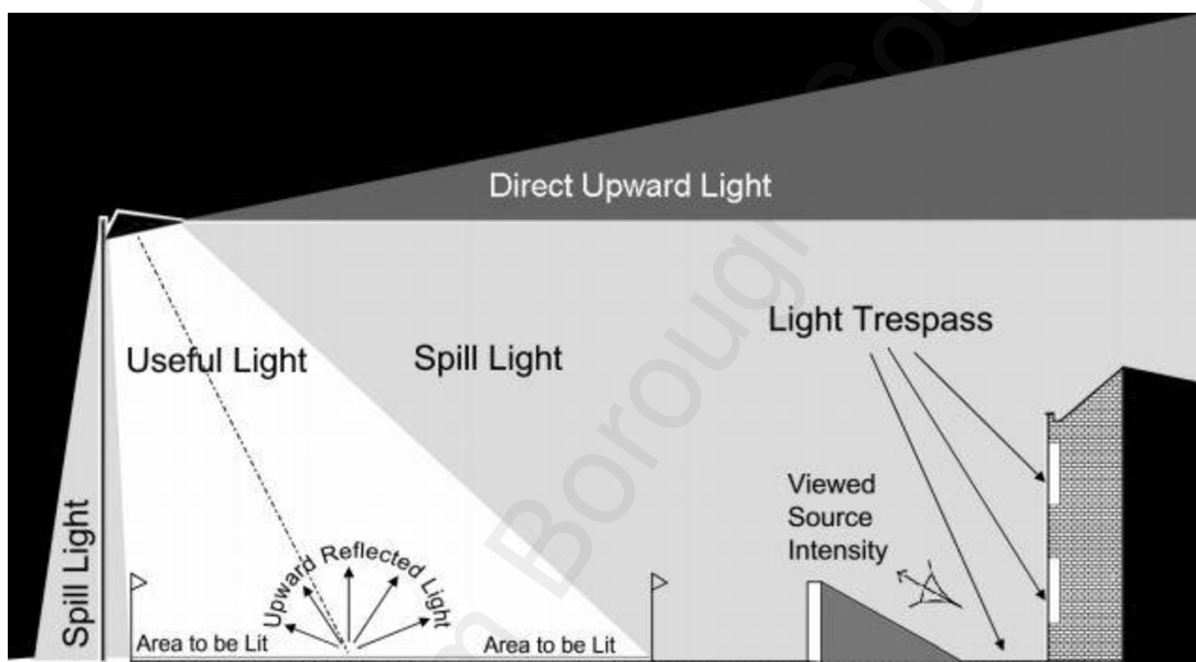


Figure 6 is taken from ILP Guidance Notes for the Reduction of Obtrusive Light to illustrates the types of Obtrusive light

3. Obtrusive light receptors

Introduction

- 3.1 There are several 'categories' of potentially light sensitive receptors: these being, commercial, residential, ecological, road and rail. As the design of the Proposed Development progresses, it will be necessary to scope current and possibly future receptors and undertake a computational light modelling exercise in order to ensure that obtrusive light is suitably controlled. This section sets out indicative light-sensitive receptor locations for consideration when undertaking such an obtrusive light assessment. The indicative light-sensitive receptors are also illustrated in Figure 6 of this report.

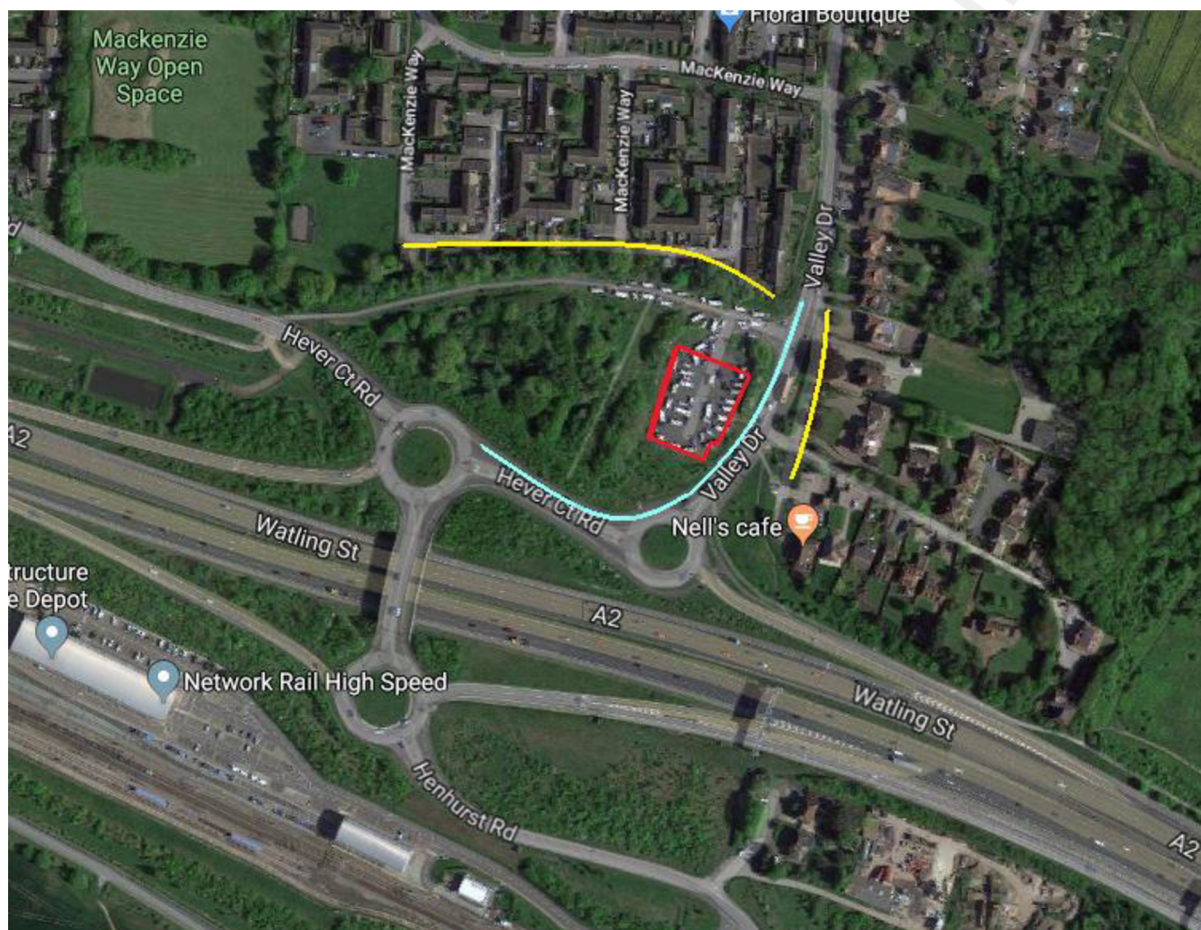


Figure 7 Indicative Receptors

Proposed Site

Residential Receptors

Road Receptors



Residential Receptors

- 3.2 Residential light-sensitive receptor will need to be confirmed, but are currently identified at the following locations:

- Houses opposite the proposed Development, west on Franklin Road. Refer to fig 6
- Houses opposite, the proposed development, North on Mackenzie way. Refer to fig 6

Road Receptors

- 3.3 Valley drive road runs approximately north-south immediately west of the Site. Valley Road joins Hever Court Road to the south west of the Site at a round that then crosses over the A2. Ref to fig 6

Ecological Receptors

- 3.4 The Site possesses a very low value to biodiversity due to the fact it is a large section of tarmac hardstanding surrounded by improved grassland and patches of secondary woodland. The Proposed Development is not due to encroach on the surrounding grassland and woodland and so there are no constraints with regards to protected species or habitats.
- 3.5 There are no statutory or non-statutory designated Sites of Importance for Nature Conservation (SINCs) that could be directly or indirectly affected by the Proposed Development.

4. Operational obtrusive light limits

Proposed Obtrusive Light Limits (Residential Receptors)

- 4.1 It is considered appropriate for the purposes of controlling obtrusive light affecting residential receptors that suitable obtrusive lighting level limits with regard to the ILP Environmental Zone for the areas surrounding the Site would be those as set out in Zone E3 i.e. a suburban area of medium district brightness.
- 4.2 Therefore, the proposed permitted obtrusive light level limits for residential receptors are as follows:
- An on-site Upward Lighting Ratio of 5%;
 - A light trespass limit at residential windows of 10 lx. If the ILP curfew levels were imposed, then this limit would reduce to 2 lx post-curfew; and
 - A source intensity limit when viewed from receptor locations of 10 kcd. If the ILP curfew levels were imposed, then this limit would reduce to 1 kcd post-curfew.

Proposed Obtrusive Light Limits (Road Users)

- 4.3 The Valley Drive Road and Hever Court Road have the potential to be affected by disability glare and veiling luminance associated with the Proposed Development lighting scheme. The constraints criteria to be adopted will be confirmed at a later date upon further analysis that considers the lighting classes already in place. It is important that a suitably segmented analysis is undertaken that accounts for variations in lighting class along this stretch of road.
- 4.4 The proposed permitted obtrusive light level limits for road users are as follows:
- No road lighting: threshold increment of 15% based on adaptation luminance of 0.1 cd/m² and veiling luminance of 0.04;
 - ME6/ ME5: threshold increment of 15% based on adaptation luminance of 1 cd/m² and veiling luminance of 0.25;
 - ME4/ ME3: Threshold increment of 15% based on adaptation luminance of 2 cd/m² and veiling luminance of 0.40; and
 - ME2/ ME1: Threshold increment of 15% based on adaptation luminance of 5 cd/m² and veiling luminance of 0.84.

Proposed Obtrusive Light Limits (Ecological Receptors)

- 4.5 Whilst no ecological receptors were identified prior to writing this report, the Site lighting scheme will be designed to generally minimise any impact on ecological receptors by means of minimising illuminance at the receptors, along with the 'viewed' source intensity. The permitted obtrusive light level limits for the ecological receptors will be reviewed at detailed design stage and updated if necessary following pre-construction ecological surveys. As indicative constraints for the Proposed Development's lighting design, the following criteria are suggested as being reasonable should low sensitive ecological receptors be identified:
- Target illuminance levels of less than 1 lx;
 - An upper limit illuminance level of 3 lx; and
 - Source intensity values not to exceed ILP human receptor criteria.

5. Site Lighting Requirements - construction phase

Introduction

- 5.1 Construction site lighting may be required as part of on-site security and health and safety requirements. The associated potential obtrusive light effects towards surrounding receptors would be minimised through the controlled application of lighting in accordance with current best practice. It is anticipated that the key temporary lighting sources during the construction phase will be the following:
- General floodlighting and security lighting associated with meeting health & safety and security requirements in temporary parking areas;
 - Security and health & safety lighting associated with specific on-going working areas, where equipment is stored, and safety hazards may be present; and
 - Lighting required for operational purposes associated with any construction work around and after sunset.
- 5.2 Artificial site lighting can result in obtrusive light if poorly controlled. However, when careful consideration is given to the type, location and aiming of construction lighting, its impact, in considering magnitude and duration can be considerably reduced.
- 5.3 Some night-time construction work may be required, and lighting during normal working hours will be necessary during winter months.
- 5.4 Obtrusive lighting can be suitably controlled by adopting the general mitigation measures as set out in this report.

Recommended Lighting Values

- 5.5 The lighting strategy for the Site during construction is given in the form of a lighting requirements specification below. This is intended to be an outline design strategy only rather than a detailed design solution for the reasons presented in Section 2.

Site Lighting Levels

- 5.6 The following lighting levels are considered appropriate for the Proposed Development during the Construction Phase:
- Clearance, excavation and loading: 20 lx maintained average horizontal illuminance, 0.25 minimum uniformity, glare rating limit of RGL 55, minimum colour rendering index of Ra 20;
 - Construction areas, drain pipes mounting, transport, auxiliary and storage tasks: 50 lx maintained average horizontal illuminance, 0.40 minimum uniformity, glare rating limit of RGL 50, minimum colour rendering index of Ra 20;
 - Framework element mounting, light reinforcement work, wooden mould and framework mounting, electric piping and cabling: 100 lx maintained average horizontal illuminance, 0.40 minimum uniformity, glare rating limit of RGL 45, minimum colour rendering index of Ra 40; and
 - Element jointing, demanding electrical, machine and pipe mountings: 200 lx maintained average horizontal illuminance, 0.50 minimum uniformity, glare rating limit of RGL 45, minimum colour rendering index of Ra 40.

6. Site Lighting Requirements - operational phase

Introduction

- 6.1 The Proposed Development will require the installation of a number of luminaires to provide visual comfort, safety and performance. This section sets out the general strategy for the operational site lighting.

Recommended Operational Lighting Values

- 6.2 The lighting strategy for the Site when operational is given in the form of a lighting requirements specification below. This is intended to be an outline design strategy only rather than a detailed design solution.

Operational Site Lighting Levels

- 6.3 The following lighting levels are considered appropriate for the Proposed Development during the Operational Phase:
- Designated walkways - walkways exclusively for pedestrians: 5 lx maintained average horizontal illuminance, 0.25 minimum uniformity, glare rating limit of RGL 50, minimum colour rendering index of Ra 20;
 - Site roads - regular vehicle traffic (max. 40 km/h): 20 lx maintained average horizontal illuminance, 0.40 minimum uniformity, glare rating limit of RGL 45, minimum colour rendering index of Ra 20;
 - Pedestrian routes intersecting and bounding site roads, lorry parking area - pedestrian passages, vehicle turning, loading and unloading points: 50 lx maintained average horizontal illuminance, 0.40 minimum uniformity, glare rating limit of RGL 50, minimum colour rendering index of Ra 20;
 - Car park, possible car parking - car parks: 10 lx maintained average horizontal illuminance, 0.25 minimum uniformity, glare rating limit of RGL 50, minimum colour rendering index of Ra 20;
 - Container storage area - short-term handling of large units and raw materials, loading and unloading of solid bulk goods: 20 lx maintained average horizontal illuminance, 0.25 minimum uniformity, glare rating limit of RGL 55, minimum colour rendering index of Ra 20; and
 - Entrance/Gatehouse, weighbridges – normal work: 100 lx maintained average horizontal illuminance, 0.4 minimum uniformity.
- 6.4 The site is operational between the hours of 8am-6pm, however lighting will be required before and after these hours for safe access, egress and security, directed onto the assets within the site only.
- 6.5 BS EN 12464-2: 2014 (BSI, 2014) states the following with regard to obtrusive illuminance pre and post curfew regulations, "In case no curfew regulations are available, the higher values shall not be exceeded, and the lower values should be taken as preferable limits".
- 6.6 It is considered that a part-lighting strategy could be suitable for the Site. This will not only result in reduced impact of obtrusive lighting due to a reduced on-time but will also serve to reduce energy costs. The lighting could be split into two circuits: 1) security lighting and 2) amenity lighting. Amenity lighting could be split further into amenity for deliveries and amenity for staff. This would allow a part lighting strategy to be adopted across the Site, thus minimising the light impact on the surrounding receptors.
- 6.7 During hours of darkness, a reduction in total lumen output from the lighting scheme may be achieved if controls and sensors are adopted in certain areas. The exact luminaires to be switched off during these times will be carefully considered once staff working patterns and areas to be accessed have been finalised to ensure that suitable lighting levels are maintained.

- 6.8 Photocells are to be used as a primary control on all exterior lighting so that no luminaires will remain switched on during hours of daylight. In addition, programmable timers will be included so that amenity lighting circuits can be programmed to turn on/off as and when needed to suit the delivery times and staff working patterns.
- 6.9 A manual override switch shall be provided to override all control of exterior lighting in the event of an emergency.

7. General obtrusive light impact avoidance measures

- 7.1 Through the adoption of good lighting design practice, incorporating general obtrusive lighting impact avoidance measures such as those described below, obtrusive light will be suitably controlled. It should be noted that the measures listed below are indicative only, and the final measures will be subject to detailed design.

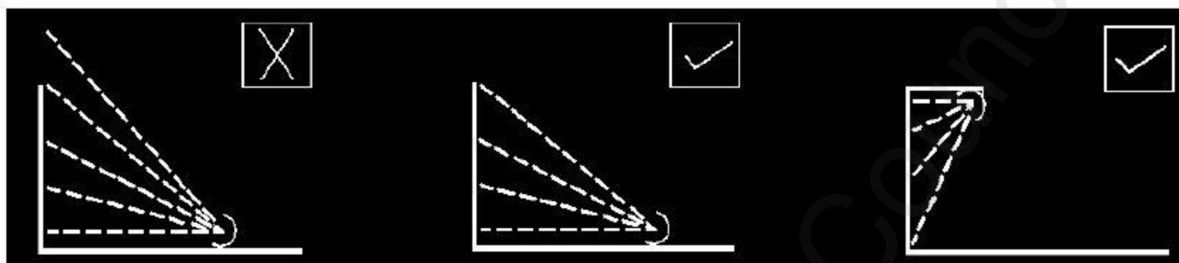


Figure 4 Lighting is directed downwards wherever possible to illuminate its target. If there is no alternative to up lighting, then the use of shields and baffles will help reduce spill light to a minimum. Up lighting is a particularly bad form of obtrusive light and contributes to sky glow.

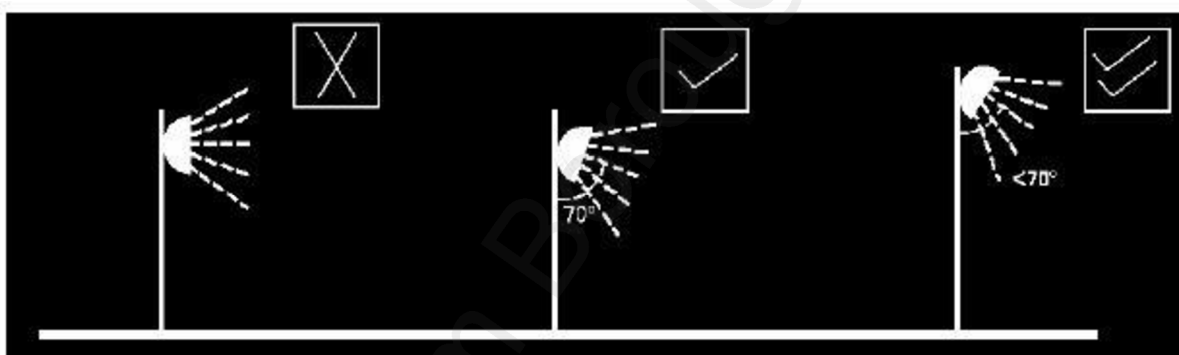


Figure 5 The main beam angle of all lights proposed directed towards any potential observer is kept below 70 degrees (see image below). It should be noted that the higher the mounting height, the lower the main beam angle could be. This reduces the effect of glare and light spill on neighbouring dwellings, passing motorists, pedestrians, etc.

- 7.2 General obtrusive lighting impact avoidance measures may include:

- Adopting a lighting strategy;
- Using photocells as a primary means of control;
- Where possible, adopting LED luminaires to control obtrusive light due to its high directionality and accordingly the achievable ratio of useful to spill light;
- Where full cut-off type luminaires installed at a 0° tilt are not suitable for a particular application, such as sport floodlighting over large pitch areas, it is recommended to use shields, hoods, cowls, or baffles to aid in controlling how light is distributed.
- Careful consideration to column locations and luminaire positioning;
- Optimising column heights;
- Minimising building mounted luminaire heights;
- Adopting luminaires with minimal upward lighting ratio;

- The use of full horizontal cut-off luminaires installed at 0° tilt with flat glass lenses, back reflectors and internal baffles designed to limit views of the lamp and glare and direct light in a controlled pattern are recommended.
- Angling building mounted luminaires to limit the level of building luminance;
- Adopting lamps with similar correlated colour temperatures;
- Lighting the site boundaries with low power periphery lighting with an asymmetric forward optic having good rear spill cut-off characteristics.

8. Conclusions

- 8.1 This report is designed to inform transport scoping discussions with Gravesham Borough Council (GBC) and ultimately Kent County Council (KCC) (as highway authority) with regards to the Marling Cross compound, which is proposed to be situated to the south of the river within Gravesham in Kent.
- 8.2 At the time of submission, the contractor has not been appointed and detailed lighting design work for the Proposed Development has not been completed. However, it is assumed that the strategies and recommendations listed within this document will be followed, to reduce the potential nuisance from lighting.
- 8.3 This document therefore sets out the lighting parameters that the proposed lighting details would need to comply with for site lighting. It also addresses obtrusive lighting by means of specifying off-site obtrusive lighting constraints.
- 8.4 There are a number of street columns of various heights in close proximity to the proposed site. If the guidelines stated within this document are followed, any impact on receptors should be limited and deemed acceptable.
- 8.5 The report also identified potential measures that may be taken to control obtrusive light through the detailed design of the Proposed Development lighting scheme.
- 8.6 A sample calculation was tested using the layout indicated by Figure 5. A luminaire with characteristics matching the description provided as part of the lighting strategy was used as part of the calculated analysis, although it is recommended to review lighting effects once luminaires have been confirmed. The Thorn R2L2 was used for sample analysis. This LED luminaire contains a full cut-off, flat lens which restricts the amount of light contributed in the upward direction as well as limiting views of the LEDs. Luminaires are installed with a zero degree tilt which aids in controlling light distribution, as well as direct upward light contribution. Please note that the colour rendering for this luminaire is higher than $>Ra\ 80$ and may be desirable for CCTV.
- 8.7 New lighting is directed only to the task areas of the compound only. It is likely that a small amount of light may spill beyond the boundary fence, although it is not likely to extend to distances beyond 15 – 20m, primarily due to column mounted luminaires placed in close proximity to the compound boundary and is contained within land associated with the proposed development.
- 8.8 Calculated light spill drops to 5 lux or less within 10m of the site boundary, and drops to 1 lux or less by 20m from the boundary fence.
- 8.9 No light from the proposed installation has been calculated to reach residential properties with the proposed lighting strategy in place.
- 8.10 The predicted effects of new external lighting associated with the proposed development are considered to meet the light spill benchmark for Zone E2.

9. References

- Ref 1. British Standards Institute (2014) BS EN 12464-2: 2014 'Light and lighting – Lighting of workplaces. Part 2: Outdoor workplaces'.
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- Ref 5. Department of Energy and Climate Change (2011) Overarching National Policy Statement for Energy (EN-1)
- Ref 6. Department for Environment, Food and Rural Affairs (2006) Statutory Nuisance from Insects and Artificial Light: Guidance on Sections 101 to 103 of the Clean Neighbourhoods and Environment Act 2005
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- Ref 14. Bat Conservation Trust (2018) Bats and artificial lighting in the UK: Bats and the Built Environment series. [online] Available at: <https://www.theilp.org.uk/documents/guidance-note-8-bats-and-artificial-lighting/>

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