Southampton to London Pipeline Project

Deadline 6

Appendix G: Outline Lighting Management Plan (clean)

Application Document: 8.51

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Contents

Acronyms

Term	Meaning
CEMP	Construction Environmental Management Plan
CoCP	Code of Construction Practice
DCO	Development Consent Order
ECoW	Environmental Clerk of Works
ES	Environmental Statement
Esso	Esso Petroleum Company, Limited
ILP	Institute of Lighting Professionals
Light pollution	The spillage of light into areas where it is not required. Also known as obtrusive light.
LMP	Lighting Management Plan
Lux (lx)	Illuminance is the quantity of light or luminous flux, falling on a unit area of a surface in the environment. It is designated by the symbol E. The unit is lux (lx).
SDNP	South Downs National Park
SDNPA	South Downs National Park Authority
SSSI	Sites of Special Scientific Interest

1 Introduction

1.1 Overview of Project

1.1.1 Esso Petroleum Company, Limited (Esso) is making an application for development consent to replace 90km (56 miles) of an existing pipeline to transport aviation fuel between Boorley Green in Hampshire and the Esso West London Terminal storage facility in Hounslow. The replacement pipeline is 97km long taking into account that it cannot follow the line of the existing pipeline along its whole length due to new developments and environmental constraints.

1.1.2 Esso has already replaced 10km of pipeline between Hamble and Boorley Green in Hampshire. The replacement pipeline starts near Boorley Green at the end point of the previously replaced pipeline. The route runs generally in a northeast direction via Esso's Pumping Station in Alton. It terminates at the Esso West London Terminal storage facility. The areas of land to be permanently or temporarily used for the project are known as the Order Limits.

1.1.3 Works to install and commission the pipeline are expected to start from grant of Development Consent Order (DCO) and be completed by early 2023. Certain advance works may take place prior to development consent where consented under alternative regimes, for example, the Town and Country Planning Act 1990.

1.1.4 The development authorised by the DCO must be undertaken in accordance with the Construction Environmental Management Plan (CEMP) pursuant to Requirement 6 of the DCO.

1.2 Purpose of the Lighting Management Plan

1.2.1 This Lighting Management Plan (LMP) applies to the construction phase of the project and does not apply to any post construction operations as the above ground infrastructure does not require any permanent installed lighting. The final LMP(s) will be included as Appendix G to the final CEMP and would be developed in accordance with the Outline LMP. The final CEMP and appendices will be produced prior to construction and will be submitted and approved by the relevant planning authorities in accordance with Requirement 6 in the DCO. Esso and its supply chain of contractor(s) would adopt the control measures set out in the final LMP(s) when undertaking the construction of the project.

1.3 Aims and Objectives

1.3.1 The overarching aim of the LMP is to reduce lighting impacts at local receptors during the construction of the pipeline and to maintain positive working relationships with local communities and the relevant planning authorities.

1.3.2 The objectives of the Outline LMP are to define:

- the contents and scope of the final LMP(s);
- existing good practice measures in relation to lighting set ; and
- details that will be set out in the final LMP(s).

1.4 LMP Roles and Responsibilities

1.4.1 Overall roles and responsibilities for the project will be presented in the final CEMP. The main roles and responsibilities specific to the Outline LMP are set out in Table 1.1 along with the specification for the roles where applicable. The final LMP(s) will include further details in relation to organisational structure and the individuals with specific responsibilities.

Table 1.1: Roles and Responsibilities

Roles and Specification	Responsibilities
Environmental Manager	Responsible for producing the final LMP(s) and for producing the methodologies for managing lighting on the project. Also responsible for obtaining the approval of the relevant planning authority.
Environmental Clerk of Works	Responsible for ensuring the mitigation set out in the final LMP(s) is implemented, for undertaking periodic checks on site, and for investigating lighting issues or complaints.

1.5 Document Structure

1.5.1 The Outline LMP includes:

- Section 2: This contains a summary of the geographical context based on the details set out in ES Chapter 10 (**Application Document APP-050**).
- Section 3: This includes the main body of the LMP, with good practice measures and details about methods that would be employed to prevent or reduce lighting impact during construction, with specific reference to dark night skies within the South Downs National Park (SDNP).
- Section 4: This outlines the site checks and reporting that would be undertaken in respect of lighting impact.

2 Geographical Context

2.1 Introduction

2.1.1 The Order Limits pass through predominantly rural areas to the south in Hampshire and in the SDNP. The northern parts are generally more suburban and urban, with the Order Limits passing through Farnborough, Frimley, Lightwater and Chertsey.

2.1.2 Therefore, in line with the rural and urban areas, the installation works passes through areas with different levels of light pollution, with the highest light pollution in the urban (northern) areas and the lowest when passing through the rural areas in the SDNP.

2.1.3 Based on zoning under the UK Guidance Notes for the Reduction of Obtrusive Light GN01:2020 (see Appendix A), the Order Limits pass through Zones E1 to E4.

2.1.4 Within the SDNP, based on the SDNP Dark Skies Technical Advice Note April 2018 (see Appendix B), the Order Limits pass through Zone E1b: Transition and Zone E1a: Intrinsic Rural Darkness.

2.1.5 The landscape chapter assessed the impacts of lighting on dark skies (see paragraph 10.5.71 in ES Chapter 10 (**Application Document APP-050**)). There could also be localised, short-term effects of lighting on human receptors and ecological receptors.

2.1.6 In summary, for the purposes of the LMP there are four different elements of the works to consider:

- normal pipe laying operations;
- exceptional working requirements with specific, occasional and short-term extended working hours;
- temporary construction compounds; and
- logistics hubs.

2.2 Receptors

2.2.1 Human receptors include residential properties and community receptors including schools, shops, hotels, places of work, places of worship and recreational areas (such as golf courses, parks and footpaths). Residential properties are located within the suburban and urban areas. Other examples of receptors within the Order Limits include schools and public parks.

2.2.2 Ecological receptors include the following:

- protected species for example bats; and
- general sensitive wildlife e.g. fish

2.2.3 Landscape receptors include the following:

- the South Downs National Park (SDNP).

3 Control Measures

3.1 Introduction: Lighting Standards and Guidance

3.1.1 The concept of 'Environmental Zones' has informed this Outline LMP. This concept was introduced by the Commission Internationale de l'Eclairage and updated by the Institute of Lighting Professionals (ILP) in its publication Guidance Notes for the Reduction of Obtrusive Light GN01:2020 for the UK, and was modified by the South Downs National Park Authority (SDNPA) in its policy publication: SDNP Dark Night Skies Technical Note (April 2018) for application to the South Downs National Park (SDNP).

3.1.2 The existing lighting context of the area surrounding the proposed pipeline will be considered against the system of lighting classification identified in these two documents to develop appropriate levels of lighting performance.

3.1.3 The following lighting standards and guidance documents, in addition to providing zoning data, provide minimum requirements for the construction lighting for the works:

- British Standards:
  - BS EN 12464-2:2014 – Light and lighting. Lighting of work places. Part 2 Outdoor work places.
- Local policy:
  - SDNPA's Dark Night Skies Technical Note (April 2018).
- Institution of Lighting Professionals (ILP):
  - ILP. GN01: 2020 Guidance Notes for the Reduction of Obtrusive Light GN01:2020; and
  - ILP Bats and Lighting in the UK.

3.2 Good Practice Measures

3.2.1 Esso has made a number of good practice measures which would reduce lighting impacts. These were set out in the Register of Environmental Actions and Commitments in ES Chapter 16 (**Application Document APP-056**). The measures are indicated by a reference number, for example 'G25'. The ones relating to methods that would reduce lighting impacts are listed in Table 3.1 and would be included in the final LMP(s). This section also includes further detail as appropriate.

Table 3.1: Good Practice Measures Relevant to the Outline LMP

Commitment Number	Commitment
G25	Any activity carried out or equipment located within a logistics hub or construction compound that may produce a noticeable nuisance from dust, noise, lighting etc would be located away from sensitive receptors such as residential properties or ecological sites where practicable
G28	Construction workers would undergo training to increase their awareness of environmental issues. Topics would include but not be limited to … location and protection of sensitive environmental sites and features.

Commitment Number	Commitment
G45	Lighting would be of the lowest luminosity necessary for safe delivery of each task. It would be designed, positioned and directed to reduce the intrusion into adjacent properties and habitats.
G46	Relevant guidance on mitigating the impact of artificial lighting on bats would be applied. This includes good practice measures that would: • limit illumination of confirmed bat roosts, or trees with moderate or high potential to support bat roosts. • limit times that the lights are on and consider factors such as height of lighting columns and use of light sources with minimal ultra violet.

3.2.2 At Deadline 3, Esso responded to a question from the SDNPA regarding meeting the criteria of the Dark Night Skies Technical Note as follows (**REP3-016**):

> '[Esso] *confirms that the project would ensure that temporary lighting during construction would accord with the SDNPA's Dark Night Skies Technical Note (April 2018). This will be secured through the Lighting Management Plan which* [Esso] *confirmed at the Issue Specific Hearing on the dDCO, will be included as part of the Construction Environment Management Plan (CEMP), secured by draft DCO Requirement 6. An outline CEMP will be submitted at Deadline 4 and will demonstrate that several of the criteria will be included.*'

3.2.3 This Outline LMP addresses the proposed approach for the entire pipeline route and for the additional requirements for compliance with the SDNPA's Dark Night Skies Technical Note (April 2018) which are applied as per Section 3.9 below.

3.3 Construction Programme

3.3.1 The construction schedule has yet to be developed in detail, as this would be undertaken during the detailed design stage. The high-level construction programme will be included within the final CEMP.

3.4 Description of Works

3.4.1 A project description is set out within ES Chapter 3 (**Application Document APP-043**). This describes the main works that would be undertaken before, during and after installation of the pipeline.

3.4.2 This section of the final LMP(s) will contain additional details based on the appointed contractor's final construction design and methodology, which would include:

- site planning and preparation as applicable for:
  - normal pipe laying operations;
  - exceptional working requirements with specific, occasional and short-term extended working hours;
  - temporary construction compounds; and
  - logistics hubs;
- additional requirements for the SDNP; and
- training for construction staff.

3.5 General Requirements

3.5.1 Unless stated otherwise below, the construction lighting will be installed in accordance with: GN01:2020, BS EN 12464-2-2014 (Outdoor Workplaces) and the requirements of G45 (lowest lux levels) and G46 (impact on bats). Appropriate assessment, design and checks would be undertaken to ensure compliance with the final LMP(s).

3.5.2 In accordance with commitment G45, lighting shall be the lowest average lux levels necessary for safe delivery of each task and shall be positioned and directed to reduce the intrusion into adjacent properties and habitats.

3.5.3 Design would include the following as appropriate:

- appropriate assessments of receptors and impact, including up-to-date advice on the location of light sensitive receptors, such as nocturnal species including but not limited to bats, which shall be obtained from the Ecology / Environmental team;
- performance of lux calculations;
- the use of appropriate correlated colour temperature (CCT) lighting;
- the use of appropriate lighting fixtures, heights, hoods/cowls and louvres, whether fixed or mobile;
- the use of timers;
- the use of sensor operated systems;
- the use of bat friendly red LED lighting technology; and
- potential use of infra-red lighting for security purposes.

3.6 Construction Operations

3.6.1 In accordance with the general requirements above, construction activities will be lit as necessary during the working hours authorised under Requirement 14 of the DCO and as set out in the CoCP at section 2.20. It should be noted that a period of one hour may be utilised either side of the core construction working hours at the start and end of each day to include activities such as job start meetings, toolbox talks, safety briefings, training, refuelling plant & equipment, setting up of material &and equipment, installation of traffic management systems, and general housekeeping measures. Noise and light emissions will be kept to a minimum and these start-up and shut-down activities would not involve the operation of construction plant and equipment. Outside these hours, no lighting will be permitted outside of logistics hubs, temporary construction compounds or areas where exceptional work is required.

3.7 Exceptional Working (Out of Hours)

3.7.1 Exceptional working, will be specific, occasional and of short duration. During exceptional working, areas be will lit in accordance with commitment G45, including the requirements of BS EN 12464-2-2014 (Outdoor Workplaces), and lighting shall still be the lowest average lux levels necessary for safe delivery of each task and shall be positioned and directed to reduce the intrusion into adjacent properties and

habitats. When not required for safe working, the requirements of GN01:2020 and commitment G46 (impact on bats) will be met.

3.8 Logistics Hubs and Temporary Construction Compounds

3.8.1 Logistics hubs and temporary construction compounds will require security lighting and operational lighting and, in addition to the general requirements in Section 3.5, will be lit in accordance with commitment G25 (location within logistics hubs and construction compounds). Security lighting will be a sensor lighting system with variable lighting levels through the evening and bat friendly red LED lighting technology where applicable.

3.8.2 Construction lighting may be required for activities taking place at the start and end of each day (including start-up and shut-down activities where necessary) and in instances where operations are required to support exceptional working (out of hours). Where temporary construction compounds are dormant the lighting will, if possible, be turned off.

3.9 Additional Requirements Associated with the SDNP

3.9.1 For all locations within the SDNP, as well as the A31 logistics hub (which is adjacent to SDNP) including sensitive ecological areas, the approach documented in Sections 3.6, 3.7 and 3.8 above applies, except that the requirements of the SDNP Dark Skies Technical Advice Note replaces those of GN01:2020. This applies additional constraints on lux levels, curfews and more stringent zoning.

3.9.2 Notwithstanding paragraph 3.9.1 above, when undertaking exceptional working out of hours, it may be necessary to temporarily relax the requirements of the Dark Skies Technical Note in order to provide a safe working environment.

3.10 Training for Construction Staff

3.10.1 The final LMP(s) will contain details of training and toolbox talks for staff in relation to reducing lighting impacts during works. This would be in accordance with commitment G28: '*Construction workers would undergo training to increase their awareness of environmental issues……*'.

3.10.2 This would include:

- Training the operatives in how to correctly position the mobile units and make them aware of the locations of the key sensitive receptors. Note: there will be no tilt allowed on these units.
- Toolbox talks regarding ongoing checks of equipment, effectiveness of lighting/mitigations etc.

4 Site Checks

4.1 Installation Design Check

4.1.1 Upon completion of fixed lighting column installation, the installation will be checked to ensure it has been completed as outlined in the appropriate LMP and detailed lighting design. Installation checks shall be in accordance with BS EN 13201-4:2003 (methods of measurement). This will be required both when the installation is complete and in the event that subsequent changes are made to the lighting scheme. These checks will be undertaken by the contractor and confirmed by the Environmental Clerk of Works (ECoW).

4.2 Ongoing Checks

4.2.1 The contractor(s) will be responsible for record keeping and site checks during the construction period. The contractor would undertake regular audits and inspection as part of the compliance with the requirements of the final LMP(s). This would be in addition to the regular environmental inspections undertaken by the ECoW. Table 4.1 in the final LMP(s) will set out the site checks that would be undertaken during construction. Examples are provided in Table 4.1.

Table 4.1: Proposed Lighting Checks for Illustration

Action	Responsibility	Frequency
Logistics hubs and temporary construction compounds: Visual inspections and light readings to monitor for non-compliance with the lighting design and conformance with the LMP.	Contractor	Weekly
Exceptional working (out of hours): Visual inspections and light readings to monitor for non-compliance with the lighting design and conformance with the LMP.	Contractor	Daily
Normal work fronts: Visual inspections to monitor conformance with the LMP.	Contractor	Weekly
Logistics hubs and temporary construction compounds: Checking conformance with the LMP.	ECoW	Weekly
Exceptional working (out of hours): Checking conformance with the LMP.	ECoW	Daily
Normal pipelaying operations: Visual inspections to monitor conformance with the LMP.	ECoW	Monthly

4.3 Complaints Process

4.3.1 The complaints procedure would follow the process set out within the final CEMP. A record would be made of the complaint or incident for audit purposes.

Appendix A: UK Guidance Notes for the Reduction of Obtrusive Light ILP:GN01:2020

GUIDANCE NOTES FOR THE REDUCTION OF OBTRUSIVE LIGHT

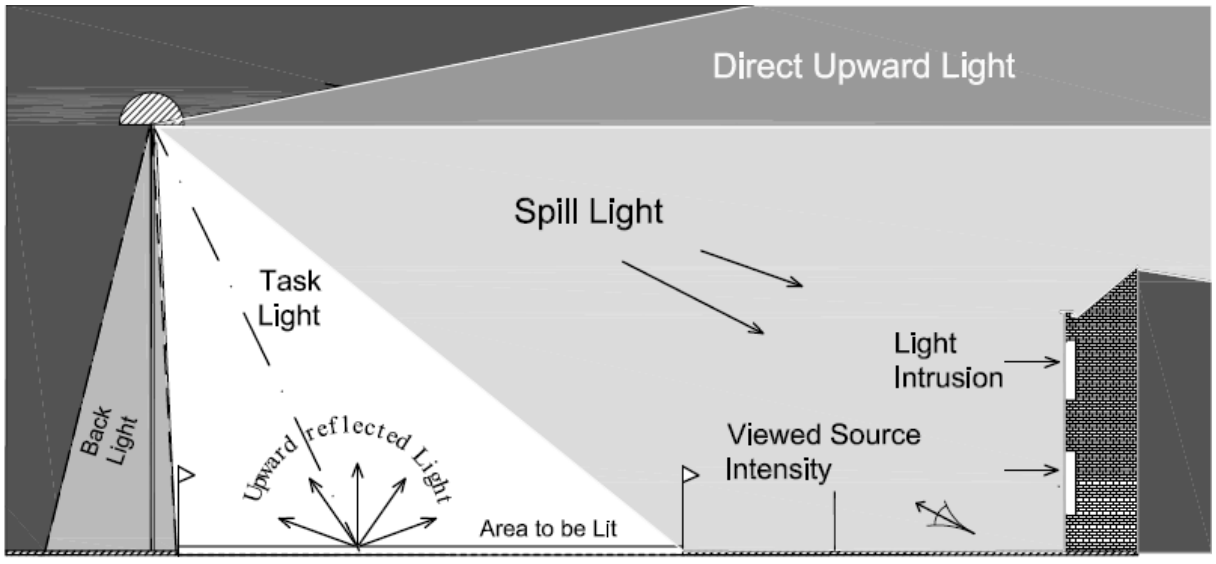
"Think before you light - The right amount of light, where wanted, when wanted."

Man's invention of artificial light has done much to safeguard and enhance our night-time environment but, if not properly controlled, **obtrusive light** (sometimes referred to as light pollution) can present serious physiological and ecological problems.

Obtrusive Light, whether it keeps you awake through a bedroom window or impedes your view of the night sky, is a form of pollution, which may also be a nuisance in law and which can be substantially reduced without detriment to the lighting task.

Sky glow, the brightening of the night sky, **Glare** the uncomfortable brightness of a light source when viewed against a darker background, and **Light Intrusion ("Trespass")**, the spilling of light beyond the boundary of the property or area being lit, are all forms of obtrusive light which may cause nuisance to others and waste money and energy. Think before you light. Is it necessary? What effect will it have on others? Will it cause a nuisance? How can you minimise the problem?

Figure 1 – Types of obtrusive light



Do not "over" light. This is a major cause of obtrusive light and is a waste of energy. There are published standards for most lighting tasks, adherence to which will help minimise upward reflected light. Organisations from which full details of these standards can be obtained are given on the last page of this leaflet.

Dim or switch off lights when the task is finished. Generally a lower level of lighting will suffice to enhance the night time scene than that required for safety and security.

"Good Design equals Good Lighting"

Any lighting scheme will consist of three basic elements: a light source, a luminaire and a method of installation.

Light sources (Lamps)

Remember that the light source output in LUMENS is not the same as the wattage and that it is the former that is important in combating the problems of obtrusive light.

Most nightime visual tasks are only dependant on light radiated within the visual spectrum. It is therefore NOT necessary for light sources to emit either ultra-violet or infra-red radiation unless specifically designed to do so. It is also understood that light from the shorter wavelengths of the spectrum has important effects on both flora and fauna that should be considered.

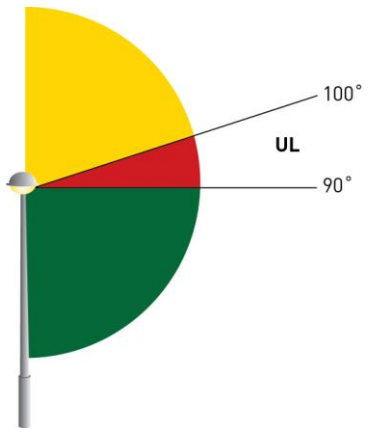
Research indicates that light from the blue end of the spectrum has important non-visual effects on the health of the human body, in particular in our sleep/wake patterns. It is therefore important to appreciate that while in obtrusive light terms the use of blue light should be minimised, there are many night-time tasks such as driving and sports where to be fully awake is an important aid to safety.

Luminaires

Care should always be taken when selecting luminaires to ensure that appropriate products are chosen and that their location will reduce spill light and glare to a minimum.

Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. The most sensitive/critical zones for minimising sky glow are those between 90° and 100° as shown in Figure 2 and referred to as the lower, upward light output zone (UL).

Figure 2 – Critical luminaire angles For minimising sky glow



For most sports and area lighting installations the use of luminaires with double-asymmetric beams designed so that the front glazing is kept at or near parallel to the surface being lit should, if correctly aimed, ensures minimum obtrusive light.

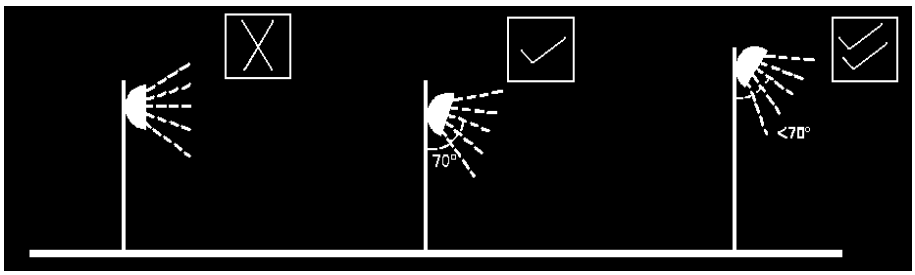
Appendices 1 and 2 to these notes gives more details of how to choose and if necessary modify luminaires.

Installation

In most cases it will be beneficial to use as high a mounting height as possible, giving due regard to the daytime appearance of the installation. The requirements to control glare for the safety of road users are given in Table 3.

Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. With regard to domestic security lighting the ILP produces an information leaflet GN02:2009 that is freely available from its website.

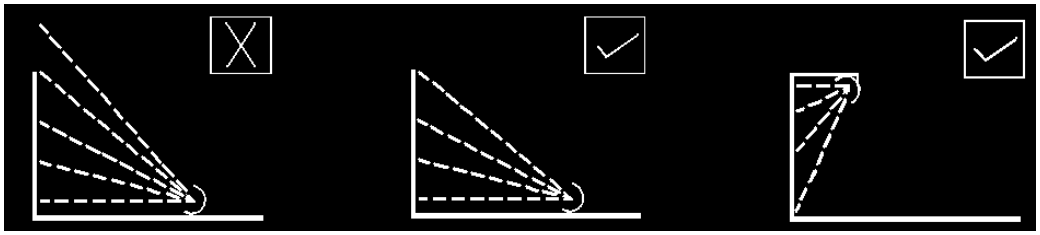
Figure 3 – Luminare aiming angles



When lighting vertical structures such as advertising signs, direct light downwards wherever possible. If there is no alternative to up-lighting, as with much decorative lighting of buildings, then the use of shields, baffles and louvres will help reduce spill light around and over the structure to a minimum.

For road and amenity lighting installations, (see also design standards listed on Page 5) light near to and above the horizontal should normally be minimised to reduce glare and sky glow (Note ULR's in Table 2). In rural areas the use of full horizontal cut off luminaires installed at 0° uplift will, in addition to reducing sky glow, also help to minimise visual intrusion within the open landscape. However in some urban locations, luminaires fitted with a more decorative bowl and good optical control of light should be acceptable and may be more appropriate.

Figure 4 – Façade Illumination



Since 2006 "Artificial Light" has been added to the list of possible Statutory Nuisances in England, Wales and Scotland. The monitoring of such nuisances will be the responsibility of Environmental Health Officers (EHOs) for which separate guidance is being produced.

With regard to the planning aspect, many Local Planning Authorities (LPAs) have already produced, or are producing, policies that within the planning system will become part of their local development framework. For new developments there is an opportunity for LPAs to impose planning conditions related to external lighting, including curfew hours.

The Scottish Executive has published a design methodology document (March 2007) entitled "Controlling Light Pollution and Reducing Energy Consumption" to further assist in mitigating obtrusive light elements at the design stage.

ENVIRONMENTAL ZONES

It is recommended that Local Planning Authorities specify the following environmental zones for exterior lighting control within their Development Plans.

Table 1 – Environmental Zones

Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks
E1	Natural	Intrinsically dark	National Parks, Areas of Outstanding Natural Beauty etc
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

Where an area to be lit lies on the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.

NB: Zone E0 must always be surrounded by an E1 Zone.

DESIGN GUIDANCE

The following limitations may be supplemented or replaced by a LPA's own planning guidance for exterior lighting installations. As lighting design is not as simple as it may seem, you are advised to consult and/or work with a professional lighting designer before installing any exterior lighting.

Table 2 – Obtrusive Light Limitations for Exterior Lighting Installations – General Observers

Environmental Zone	Sky Glow ULR [Max %](1)	Light Intrusion (into Windows) E_v [lux] (2)		Luminaire Intensity I [candelas] (3)		Building Luminance Pre-curfew (4)
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Average, L [cd/m^2]
E0	0	0	0	0	0	0
E1	0	2	0 (1*)	2,500	0	0
E2	2.5	5	1	7,500	500	5
E3	5.0	10	2	10,000	1,000	10
E4	15	25	5	25,000	2,500	25

ULR **= Upward Light Ratio of the Installation** is the maximum permitted percentage of luminaire flux that goes directly into the sky.

E_v **= Vertical Illuminance in Lux -** measured flat on the glazing at the centre of the window.

I **= Light Intensity in Candelas (cd)**

L **= Luminance in Candelas per Square Metre (cd/m^2)**

Curfew **= the time after which stricter requirements (for the control of obtrusive light) will apply**; often a condition of use of lighting applied by the local planning authority. If not otherwise stated - 23.00hrs is suggested.

***** **= Permitted only from** Public road lighting installations

(1) Upward Light Ratio – Some lighting schemes will require the deliberate and careful use of upward light, e.g. ground recessed luminaires, ground mounted floodlights, festive lighting, to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

(2) Light Intrusion (into Windows) – These values are suggested maxima and need to take account of existing light intrusion at the point of measurement. In the case of road lighting on public highways where building facades are adjacent to the lit highway, these levels may not be obtainable. In such cases where a specific complaint has been received, the Highway Authority should endeavour to reduce the light intrusion into the window down to the post curfew value by fitting a shield, replacing the luminaire, or by varying the lighting level.

(3) Luminaire Intensity – This applies to each luminaire in the potentially obtrusive direction, outside of the area being lit. The figures given are for general guidance only and for some sports lighting applications with limited mounting heights, may be difficult to achieve.

(4) Building Luminance – This should be limited to avoid over lighting, and related to the general district brightness. In this reference building luminance is applicable to buildings directly illuminated as a night-time feature as against the illumination of a building caused by spill light from adjacent luminaires or luminaires fixed to the building but used to light an adjacent area.

Table 3 – Obtrusive Light Limitations for Exterior Lighting Installations – Road Users

Road Classification (1)	Threshold Increment (TI)	Veiling Luminance (Lv)
No road lighting	15% based on adaptation luminance of 0.1cd/m^2	0.04
ME6/ ME5	15% based on adaptation luminance of 1cd/m^2	0.25
ME4/ ME3	15% based on adaptation luminance of 2cd/m	0.40
ME2 / ME1	15% based on adaptation luminance of 5cd/m^2	0.84

TI = **Threshold Increment** is a measure of the loss of visibility caused by the disability glare from the obtrusive light installation

Lv = **Veiling Luminance** is a measure of the adaptation luminance caused by the disability glare from the obtrusive light installation

(1) = **Road Classifications** as given in BS EN 13201 - 2: 2003 Road lighting Performance requirements. Limits apply where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and for viewing directions in path of travel. For a more detailed description and methods for determining, calculating and measuring the above parameters see CIE Publication 150:2003.

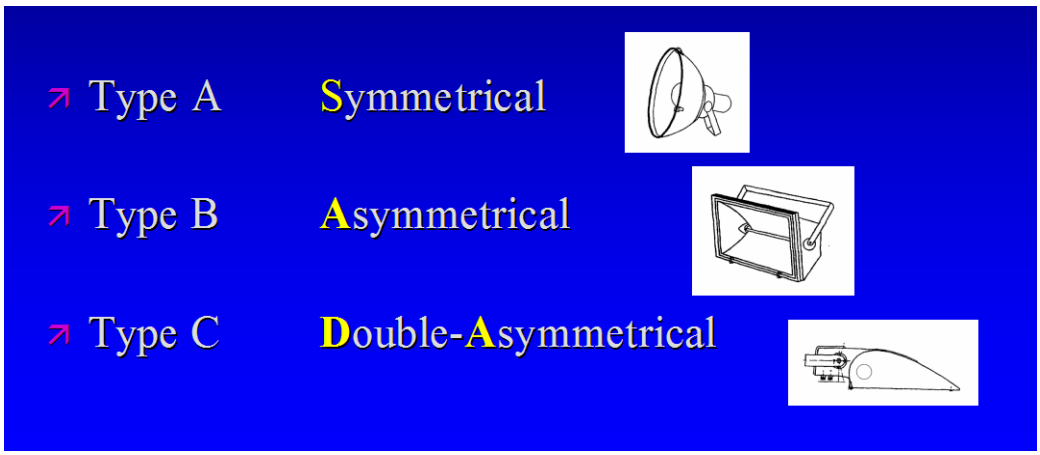
RELEVANT PUBLICATIONS AND STANDARDS:

British Standards: www.bsi.org.uk	BS 5489-1: 2003 Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas BS EN 13201-2:2003 Road lighting – Part 2: Performance requirements BS EN 13201-3:2003 Road lighting – Part 3: Calculation of performance BS EN 13201-4:2003 Road lighting – Part 4: Methods of measuring lighting performance. BS EN 12193: 1999 Light and lighting – Sports lighting BS EN 12464-2: 2007 Lighting of work places – Outdoor work places	
Countryside Commission/ DOE	Lighting in the Countryside: Towards good practice (1997) *(Out of Print but available on www.communities.gov.uk/index.asp?id=1144823)*	
UK Government / Defra www.defra.gov.uk	Statutory Nuisance from Insects and Artificial Light – Guidance on Sections 101 to 103 of the Clean Neighbourhoods and Environment Act 2005 Road Lighting and the Environment (1993) (Out of Print)	
CIBSE/SLL Publications: www.cibse.org	CoL	Code for Lighting (2002)
	LG1	The Industrial Environment (1989)
	LG4	Sports (1990+Addendum 2000)
	LG6	The Exterior Environment (1992)
	FF7	Environmental Considerations for Exterior Lighting (2003)
CIE Publications: www.cie.co.at	01	Guidelines for minimizing Urban Sky Glow near Astronomical Observatories (1980)
	83	Guide for the lighting of sports events for colour television and film systems (1989)
	92	Guide for floodlighting (1992)
	115	Recommendations for the lighting of roads for motor and pedestrian traffic – Second Edition (2010)
	126	Guidelines for minimizing Sky glow (1997)
	129	Guide for lighting exterior work areas (1998)
	136	Guide to the lighting of urban areas (2000)
	150	Guide on the limitations of the effect of obtrusive light from outdoor lighting installations (2003)
	154	The Maintenance of outdoor lighting systems (2003)
ILP Publications: www.theilp.org.uk	TR 5	Brightness of Illuminated Advertisements (2001)
	TR24	A Practical Guide to the Development of a Public Lighting Policy for Local Authorities (1999)
	GN02	Domestic Security Lighting, Friend or Foe
ILP/CIBSE Joint Publications	Lighting the Environment - A guide to good urban lighting (1995)	
ILP/CSS Publications	Joint Code of Practice for the installation, maintenance and removal of seasonal decorations. (2005)	
ILP/CfDS Joint Publication www.dark-skies.org	Towards Understanding Sky glow. 2007	
IESNA www.iesna.org	TM-15-07 (R) Luminaire Classification System for Outdoor luminaires	

NB: These notes are intended as guidance only and the application of the values given in Tables 2 & 3 should be given due consideration along with all other factors in the lighting design. Lighting is a complex subject with both objective and subjective criteria to be considered. The notes are therefore no substitute for professionally assessed and designed lighting, where the various and maybe conflicting visual requirements need to be balanced.

APPENDIX 1 - PROPOSED OUTDOOR LUMINAIRE CLASSIFICATION SYSTEM

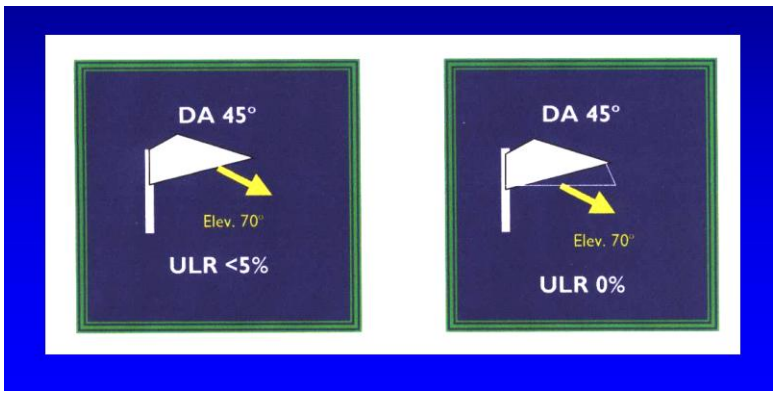
Variable Aim Luminaires – General Classifications:



Proposed labelling System:

Fixed Position luminaires

Variable Aim Luminaires
(Shown here for a 45° Double-Asymmetric luminaire aimed at 70° – with and without a cowl).



APPENDIX 2 - ILLUSTRATIONS OF LUMINAIRE ACCESSORIES FOR LIMITING OBTRUSIVE LIGHT (images provided by Philips and Thorn)

Cowl (or Hood)

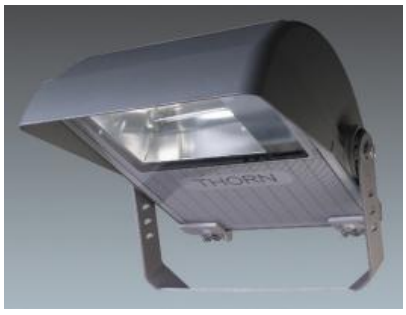
External Louvre

SHIELD

SHEILD "Barn Doors"

Double Asymmetric Luminaire

Simple Hood



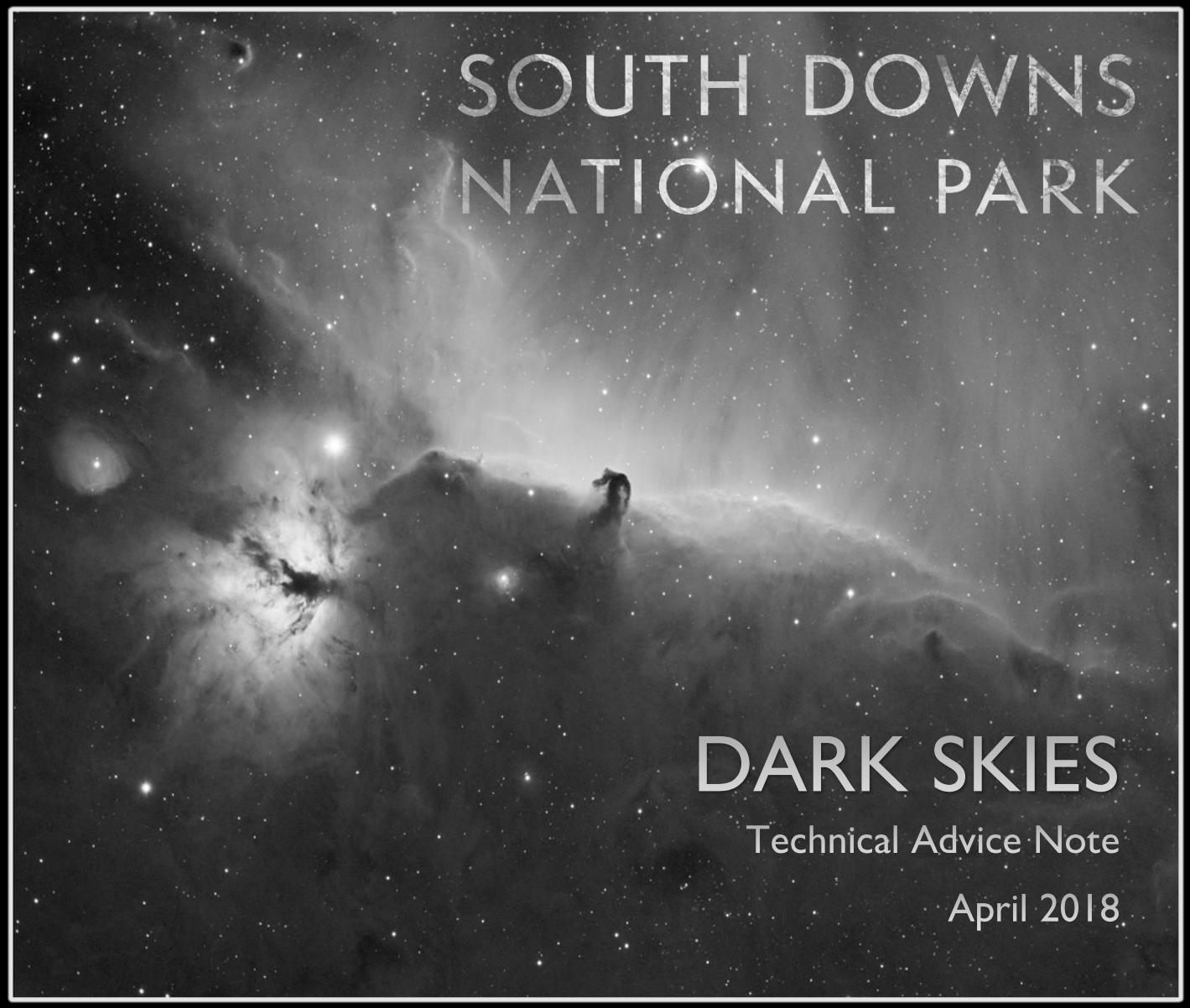
Circular Louvre

Cowl & Louvre

Internal Louvre (horizontal)

Internal Louvre (vertical)

Appendix B: SDNP Dark Skies Technical Advice Note April 2018


SOUTH DOWNS
NATIONAL PARK
DARK SKIES
Technical Advice Note
April 2018

Prepared by Dan Oakley: Dark Skies Lead

South Downs National Park Authority
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North Street
Midhurst
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GU29 9DH
www.southdowns.gov.uk

This guidance is supported and endorsed by;

All astronomical pictures in this guidance have been taken from within or around the South Downs. They show what a tremendous and inspirational resources the dark skies of the South Downs National Park are. All non-credited images are credit SDNPA Dan Oakley

Front Page: Horse Head Nebula. Jason Howells.

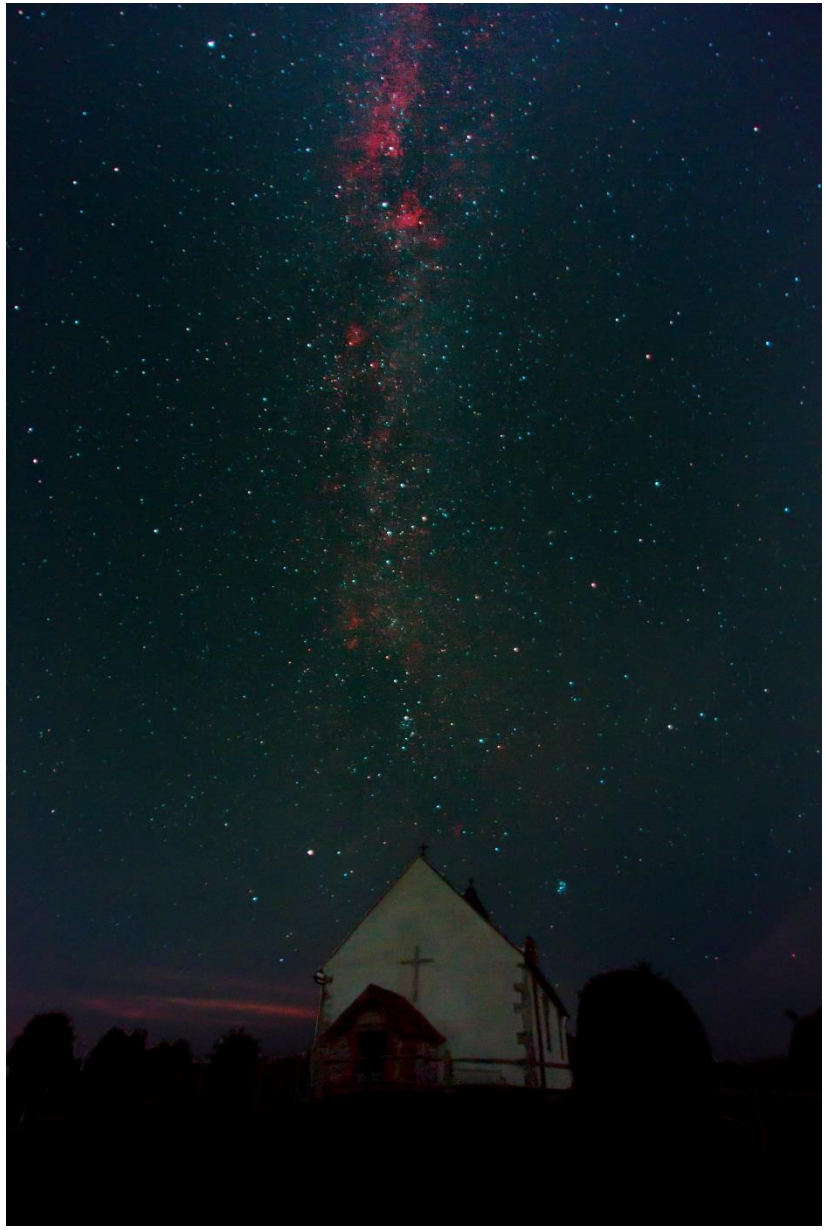


Table of Contents

1 INTRODUCTION

This guidance sets out the South Downs National Park Authority's (SDNPA) approach to lighting design and the protection and enhancement of dark skies. Its aim is to provide developers and planners with the necessary information to submit and assess lighting schemes which are appropriate to the landscape, including the South Downs International Dark Sky Reserve, designated in May 2016. The guidance will cover;

- Overview of the importance of Dark Skies
- Lighting Terminology and impacts
- When planning permission should be sought – applying mostly to non-domestic lighting and general development
- The use of spatially weighted policies in dark zones designed to protect dark skies and reduce light pollution
- What should be considered in a lighting assessment - if planning permission is required
- Best pratice for *all* lighting, domestic and non-domestic.

In general, most forms of minor domestic lights on a single dwelling should not require planning consent. However, simple installation recommendations are provided to ensure that all lighting follows best pratice.

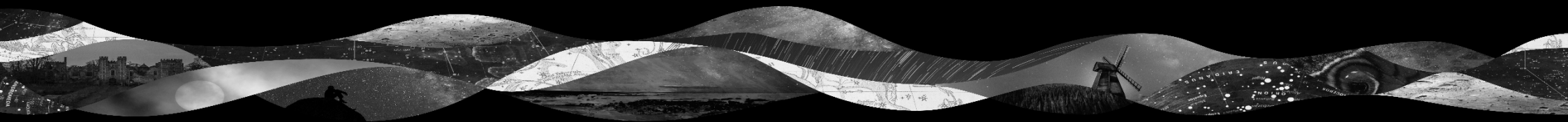
The SDNPA acknowledges that there is a duty of care to provide lighting to satisfy health and safety concerns and does not seek to eliminate or ban lighting regardless. However, the management of our dark skies relies upon good lighting design that is appropriate for the rural or urban setting, and does not unnecessarily pollute or pose a significant impact to the special quality of a starry sky. The SDNPA advocates the simple and effective principles that should apply to any lighting, domestic or otherwise;

Think before you light: The right amount of light, where needed, when needed.

2 GENERAL LIGHTING PRINCIPLES

Good installation of lighting applies to any installation domestic or otherwise. The following best practice principles should be followed to ensure good lighting that reduces light pollution and its impact on dark skies.

- **New lighting should not adversely degrade the sky quality beyond the immediate area to be lit**
- **Angle Lights Downward – no unnecessary light above or near the horizontal**
- **Lamps of 500 lumens and less are appropriate for most domestic purposes**
- **Lamps above 500 lumens should be installed in dark sky friendly fixtures that prevent unnecessary upward light**
- **Point where the light is needed not in a direction that causes a nuisance to neighbours or wildlife**
- **Switch off when not needed. Use proximity sensors. Avoid dusk-till-dawn sensors**
- **Light to the appropriate illuminance – do not over light needlessly**
- **Avoid bright white and cooler temperature LED's**
- **Install at the lowest possible height to achieve lighting levels**
- **Use and shut the curtains at night**



3 DARK SKIES IN THE SOUTH DOWNS

3.1 Why they are important

Dark skies are a special quality of the South Downs and benefit both people and wildlife. They are generally defined as skies relatively free of light pollution where you can see a clear starry sky and importantly, our own galaxy the Milky Way, stretching as a ribbon of faint stars across the sky.

Evidence shows that in the last few decades the South East of England has suffered a decline in quality; dark skies have gradually brightened as urban development and the population grows. Despite this growth and brightening of the region, the skies of the South Downs are of sufficient quality that much of the rural landscape still lies under dark skies where the Milky Way can clearly be seen. This means that we have to protect and strive to enhance them for the benefit of wildlife and people alike so we can continue to engage with nature on a galactic scale.

The importance of dark skies to the South Downs landscape has been captured in the 2014-2019 SDNP Partnership Management Plan (PMP) which lays out how the Authority and its partners will meet the statutory purposes and duty for a National Park.

One of the key questions for the SDNP was: despite the development pressure on the landscape – 'do we have dark skies?' To answer this the SDNPA conducted a Sky Quality survey across the entire National Park and beyond to establish the extent of darkness shown in Figure 1. What we discovered is that around 70% of the National Park area has skies dark enough to qualify for a designation under International Dark Sky Association rules. This– and the subsequent zoning – may change with future surveying.

The quality of dark skies were measured with a Unihedron Sky Quality Meter (SQM). It measures the brightness (magnitude) of an area of sky (arc second). The units are magnitudes per arc second^2 – denoted as SQM which is a measurement of sky brightness (magnitudes) of an area of sky (arc second squared). Larger values of SQM indicate darker skies and it is a logarithmic (non-linear scale).

The National Park purposes are

1. To conserve and enhance the natural beauty, wildlife and cultural heritage of the area
2. To promote opportunities for the understanding and enjoyment of the special qualities of the National Park by the public

The National Park Authority also has a duty when carrying out the purposes:

- To seek to foster the social and economic well-being of the local communities within the National Park in pursuit of our purposes.

Dark skies are encapsulated within the PMP under;

- **Policy 3: Protect and enhance tranquillity and dark night skies**

Future surveys may show changes in this map, which may require re-drawing of dark zones

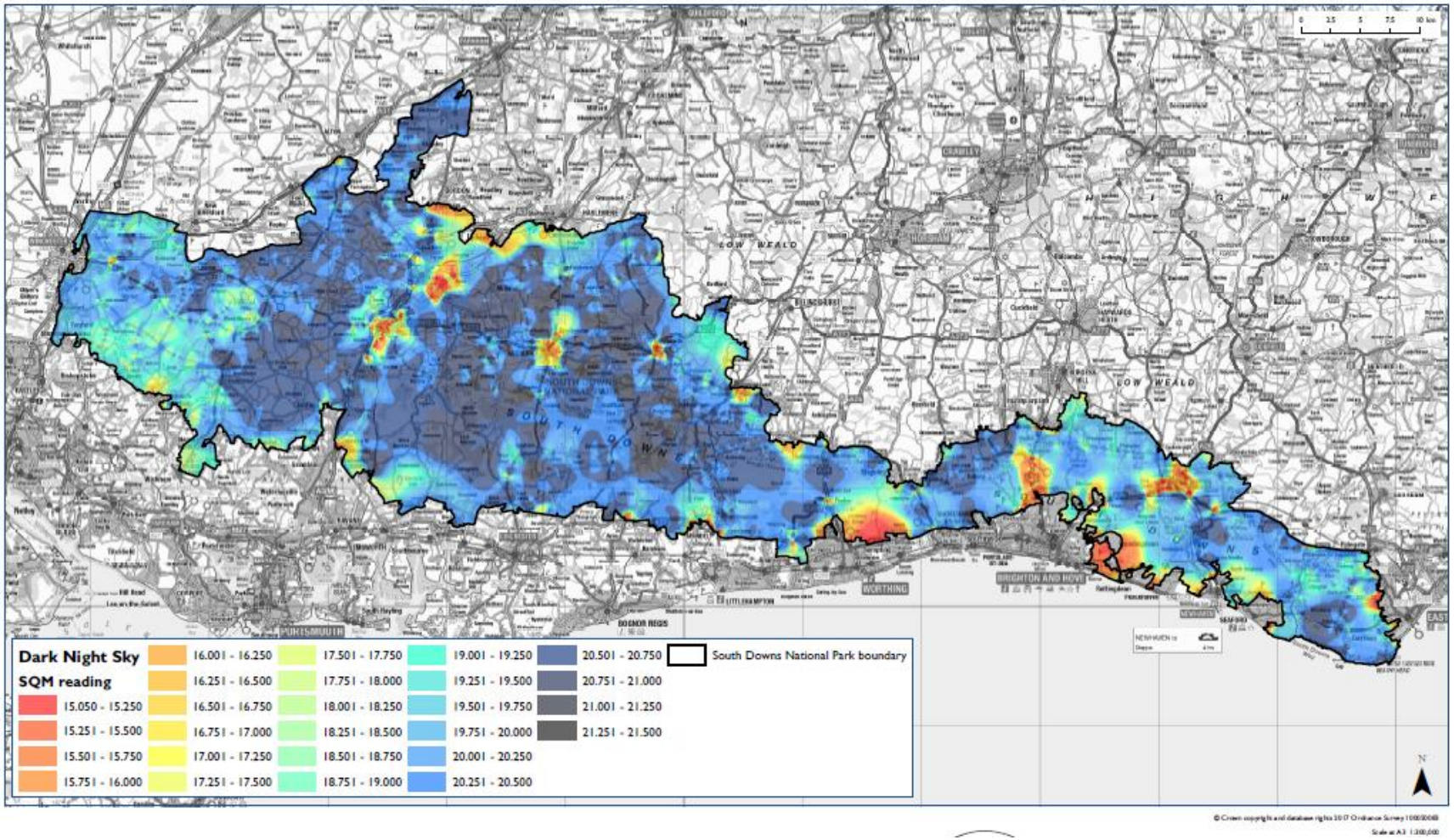


FIGURE 1 - SKY QUALITY MAP (MAGNITUDES PER ARCSECOND^2)

3.2 Two Landscapes

A dark sky is generally thought of as the ability to observe stars overhead, but this tends to neglect the importance of the landscape below it. It is far more useful to regard the protection of dark skies as two distinct landscapes; the skies above and the land below.

The 'above' landscape is fairly obvious; it is the unobstructed sky full of stars. This landscape is predominately affected by sky glow from the street lights of the larger urban environment, but can also be significantly affected by over-bright single sources at the local domestic level. The International Dark Sky Reserve was created based upon measurements of over-head sky quality throughout the park. This guidance will recommend lighting designs that minimise light spill into the air including installation angles, surface illuminance and lights-off curfews.

The 'below' landscape describes more the 'continuity' of darkness across the Downs themselves which should be free of point sources of light. The nature of a less populated landscape means that lamps can stand out due to the higher contrast between light and dark. While these sources may contribute relatively less to the overhead quality except in the immediate vicinity, being able to manage a landscape as a continuous dark habitat is of equal importance to protect this special quality and the relative tranquilly is offers; an interrupted view of the landscape below is just as important to us and to wildlife, as the interrupted view above.

Every effort should be made to consider external lighting and internal light spill that does not affect both the upward and downward dark landscapes. This guidance will recommend development design that minimises light intrusion in a dark landscape, including shielding, contrast and excessive glazing.

4 THE SOUTH DOWNS INTERNATIONAL DARK SKY RESERVE – 'MOORE'S RESERVE'

The South Downs was awarded International Dark Sky status in May 2016 to reflect the quality of skies and the commitment the SDNPA and its partners have shown in addressing light pollution and having a due regard for dark skies. The IDA define;

> An IDA International Dark Sky Reserve (IDSR) is a public or private land possessing an exceptional or distinguished quality of starry nights and nocturnal environment that is specifically protected for its scientific, natural, educational, cultural, heritage and/or public enjoyment. Reserves consist of a core area meeting minimum criteria for sky quality and natural darkness, and a peripheral area that supports dark sky preservation in the core. Reserves are formed through a partnership of multiple land managers who have recognized the value of the natural nighttime environment through regulations and long-term planning.

Designated as only the 11th in the world, the IDSR takes in the entire SDNP boundary, but is largely defined by a critical core and buffer zone base where the darkest skies can be found, Figure 2. The boundary was drawn using geographical boundaries (roads, woodland boundaries, Rights of Way) under skies measuring 20.5 mags arcs^{-2}. This value was the general measurement where the Milky Way can be easily seen by a non-astronomical expert in the South Downs with the naked eye and is above the minimum 20 magnitudes per arcsecond^2 required for a 'bronze level' dark sky designation. Surrounding the main core is a required buffer zone, determined at 2km and derived from direct measurements from the transition from bright to dark skies. The conditions in the core zone are generally the best within National Park, and the South East of England, and will receive every protection to retain them.

In addition to the core and buffer, Figure 2 shows areas that measured sky quality readings between the 20 mags arcs^{-2} minimum level for IDA designation and 20.5 mags arcs^{-2}. Although these areas are consistently brighter than the core and buffer areas, as skies of sufficient IDSR quality they remain of value to protect and distinguish from other areas of the park that are brighter, e.g. urban areas.

Some areas of the reserve measure in excess of 21 SQM, indicating skies of sufficient quality to be regarded as a 'silver level' dark sky designation. As the bulk of the measurements recorded between 20.5 and 21 SQM, Moore's Reserve is categorised as bronze level. For comparison, gold level – an unpolluted natural sky - begin at 21.75 SQM.

Categorising the landscape according to general darkness, allows the SDNPA to take a weighted zoning approach to policies to ensure that lighting is appropriate to the immediate environment. The IDA reserve core, buffer and minimum brightness areas form the basis for this zoning.

Future surveying of sky quality may require updates and a re-drawing of the dark sky zones. Refer to the latest map on the website.

5 POLICY ZONING

Using the sky quality measurements the South Downs National Park has been categorised into a number of dark zones, shown in Figure 2. The zones reflect the quality of the sky overhead, the IDSR designation and the general level of street lighting. This zoning allows us to apply existing guidance's on obtrusive lighting in combination with specific SDNPA policies. They are designed to protect intrinsic and highly valued dark skies without prohibiting lighting in brighter urban areas. To correspond to the definitions in existing guidance's, the Institution of Lighting Professionals (ILP) Guidance use of Environmental Zones (EO to E4) will be used. Each 'E' zone describes recommended lighting designs for the ambient sky quality. Under this guidance, E4 is an additional city centre lighting environment, and is not applicable to most of the SDNP. E2 – Rural areas, are superseded by the National Park (E1) and Core (E0) designations, and is also not applicable.

The following table summarises the application of policies referenced to the appropriate section. Any development should make sure the lighting design complies with the guidance in for Obtrusive light (Section 8.1), that it considers general design in the landscape (8.2), that the recommended maximum lux on a surface is not exceeded and is appropriate (8.3) and that an preferred dark curfew (lights-off) time is set (8.4).

Zone	Description	SQM Range	8.1 Obtrusive Light	8.2 Design Impact	8.3 Max Lux	8.4 Preferred 'lights-off' curfews		
						Night Usage	Evening	Astronomical
E0	Dark Sky Core	20.5+	√	√	√			√
E1(a)	Intrinsic Rural Darkness and buffer	20 to 20.5	√	√	√		√	
E1(b)	Transition	~15 to 20	√	√	√*	√		
E3/E4	Urban	< 15	√	√		√		

TABLE 1- ZONAL LIGHTING POLICIES

* Subject to design. See section 8.,3

It is unlikely that minor domestic light fittings will be subjected to these policies. Best practice should still be followed nevertheless.

It will be highly likely that these policies will apply to most forms of development and any non-domestic lighting designs.

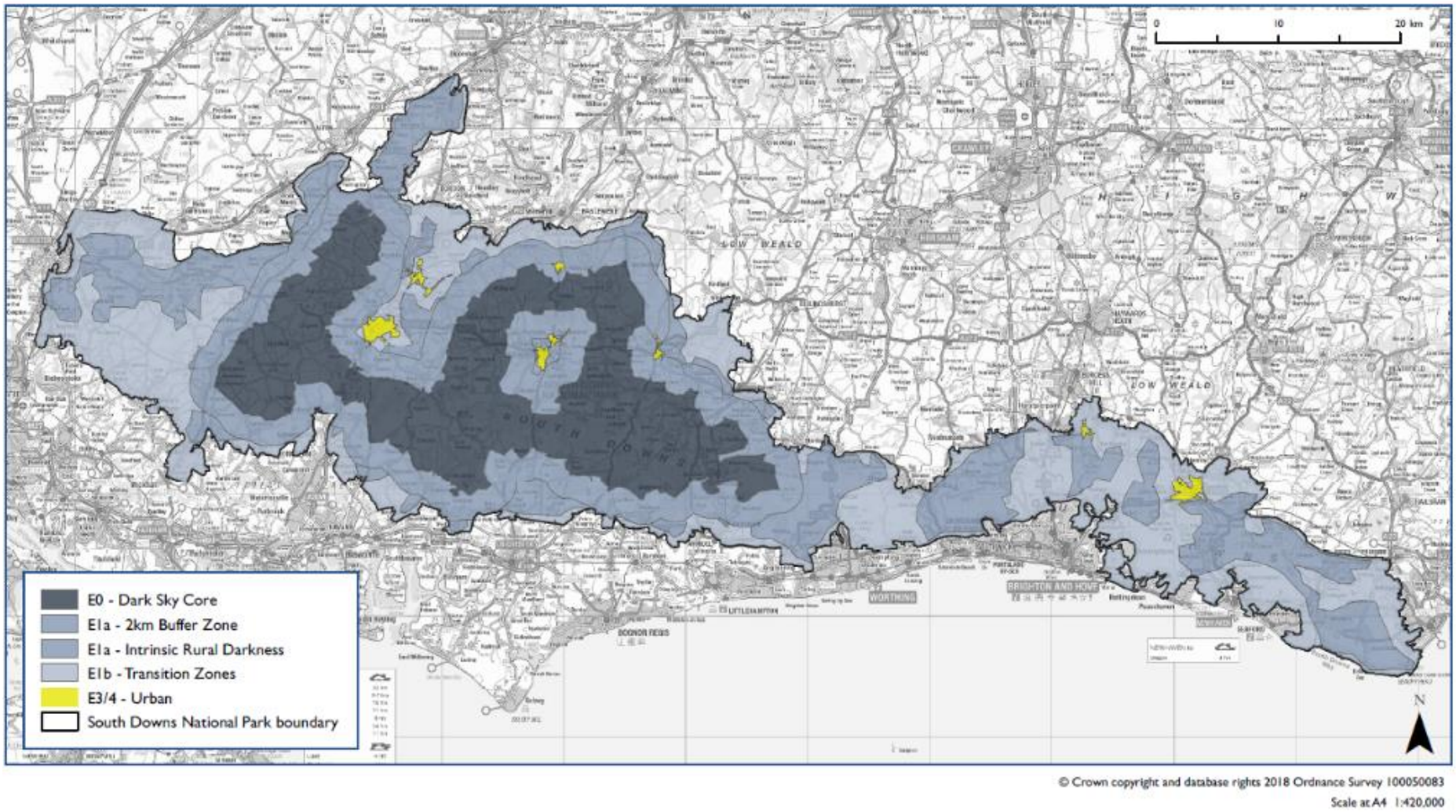


Figure 2 - South Downs International Dark Sky Reserve – Dark Zones

5.1 Dark Zones

5.1.1 The Reserve Core and areas – above 20.5 SQM. (EO)

The International Dark-Sky Reserve was drawn using geographical boundaries (roads, woodland boundaries, RoW) under skies measuring 20.5 SQM. This value was the general measurement where the Milky Way can be easily seen by a non-astronomical expert in the South Downs with the naked eye. The map shows the main core boundary and a required buffer zone surrounding it, which was determined as the distance (2km) from an urban to intrinsic ambient sky. The conditions in the core zone are generally the best within National Park, and the South East of England, and as such will receive every protection to retain them as such. The ILP classify this zone as E0 – Dark Skies Reserves.

5.1.2 Intrinsic Rural Darkness and Buffer – between 20 and 20.5 SQM. (E1a)

These are areas that measure 20 SQM and above, excluding the core zone. They include other areas in the National Park that would be classified as a 'dark sky' and includes isolated areas that may not be connected to the main core. The Milky Way will be visible and in some areas measurements may approach 21 SQM and are therefore of great importance. The ILP would classify this as E1 – National Park.

5.1.3 Transition Zones – areas between 15 and 20 SQM. (E1b)

These are areas that lie between dark zones and the urban environment and measure between 15 and 20 SQM. Conditions in this zone will be variable but most rural areas will measure near to the 20 SQM darkness limit. While the skies are relatively brighter it is still important to reduce light pollution as these areas have the potential to become dark zones in the future. The ILP would classify these zones under E2 rural but– is superseded by the South Downs NP designation.

In areas where the buffer zone overlays these transitional skies, stronger buffer zone policies will apply. This is to afford the core the strongest level of protection.

5.1.4 Urban Areas – 15 SQM and lower (E3 and E4)

These are areas that are have high ambient brightness and generally measure below 15 SQM. Street lighting will typically be present in town centres, larger roads and residential streets. The ILP classify these areas as E3 (small town centres or suburban locations) and will include most parts of the larger towns in the National Park such as Midhurst, Lewes and Petersfield.

E4 (larger city centres with high levels of night time activity) will refer to larger market town centres. As they have not been mapped on Figure 2, a specific need for E4 lighting will need to be justified.

Pleiades – Robin Durant

5.2 Approximate Zone Determination

Use the map in Figure 2 and in the local plan online maps to provide an approximate determination. Note that in **all areas except the urban environment the zone will be *at least* E1**. The following guidelines may be useful:

- Secluded rural environments in the central area of the National Park are likely to be E0 – Dark Skies Reserve
- Most rural locations outside the central area will be intrinsically dark, E1(a).
- Some quiet rural environments either in the far Western or Eastern National Park from the Arun eastwards are likely to be at least E1 (b) – Transition Zone
- Rural environments on the edge of the National Park or near to a large town, especially within 2km are likely to be E1(b) – Transition Zone
- Urban residential environments with extensive street lighting will be E3
- Urban centres inside and outside the National Park with a higher levels of night time activity with street lighting will be E4.

As a general rule of thumb:

If you live in a rural setting, roughly 2km from the nearest streetlit town, there is a high probability that your local skies are of sufficient quality to be classified as a 'dark sky' and be able to see the Milky Way.

The weighed zoning policies will not differ substantially between these dark sky areas.

The installation requirements in all rural areas (E0, E1) will be almost identical.

Orion and Running Man Nebula – Simon Downs

6 LIGHT POLLUTION

6.1 Three Types

There are three generally accepted types of pollution associated with obtrusive light.

Sky glow

This is the brightening of the night sky which can be seen emanating in the horizon from cities or other brightly illuminated areas and is the main source of pollution across the Downs. It is caused by the illumination of air molecules and particles and is created both by reflected surfaces and badly directed light. Light that travels near the horizontal is the most damaging as it travels furthest and lowest through the atmosphere. This can be avoided by ensuring lights are pointing down.

Glare

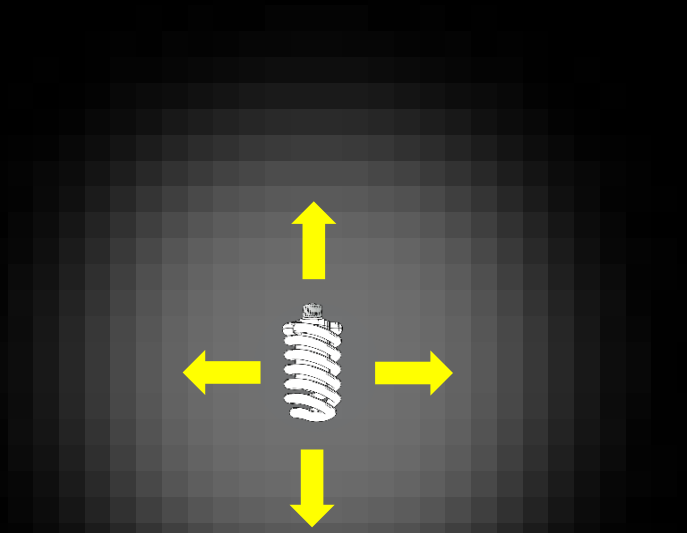
This is the uncomfortable brightness of a light source when viewed against a contrasting darker background. Due to the rural and less populated character of the landscape, lights in rural areas will be relatively higher in glare than in urban areas. This is particularly noticeable when looking from raised viewpoints into the darker landscape below.

Light Intrusion

This is the "Trespass" of light spilling beyond the property or area being lit. Although this pollution generally relates to windows and intrusion into private property, light intrusion also applies to habitats and areas of high species interest.

6.2 Lumens, Candela and Lux

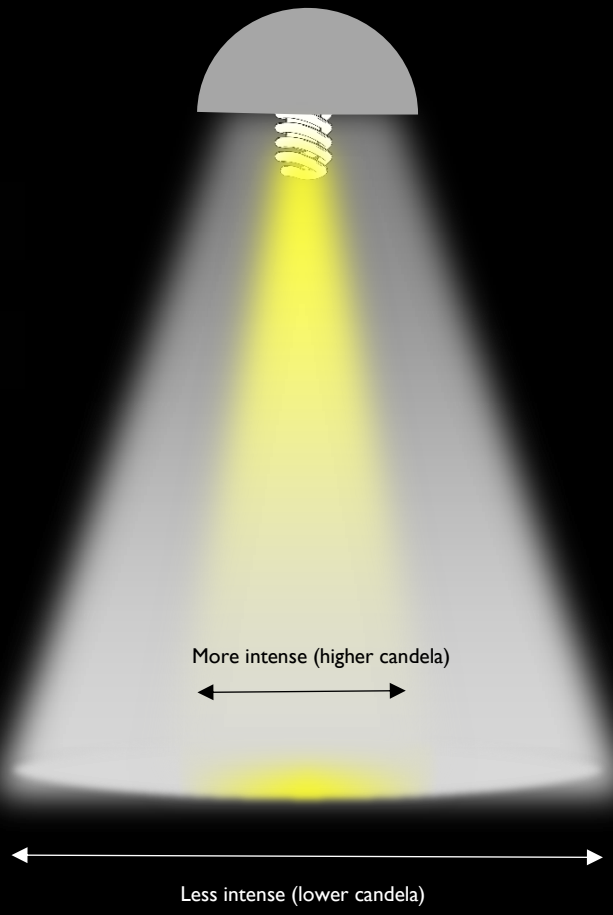
Lux and lumens are properties of light that are useful to assess the appropriateness of lighting installations The weighted polices in Table 1 are aimed to ensure that the output (lumens), Intensity (candela) and illuminated brightness of surfaces (lux) is appropriate within the SDNP.



Lumens – The total light radiated by a lamp.

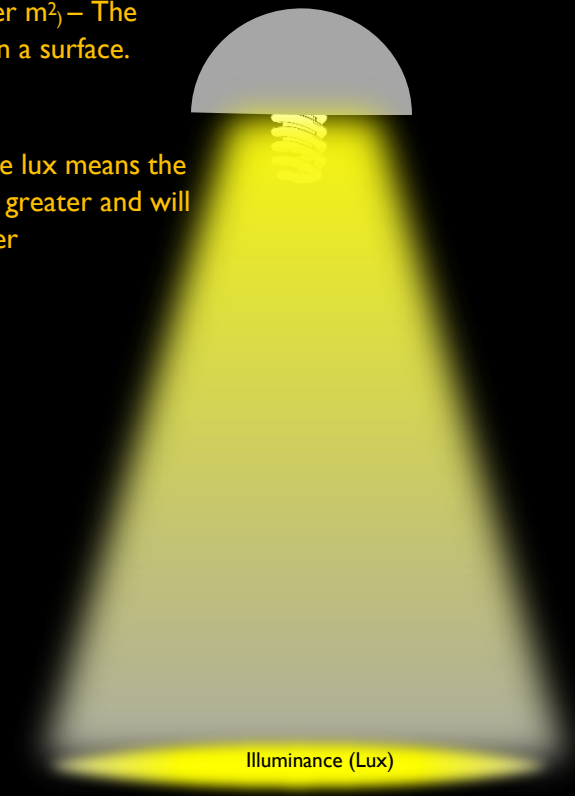
500 lumens is sufficient for most domestic needs

Candela (cd) – the intensity of light in a given direction



Lux (lumen per m^2) – The illumination on a surface.

A higher value lux means the illumination is greater and will appear brighter



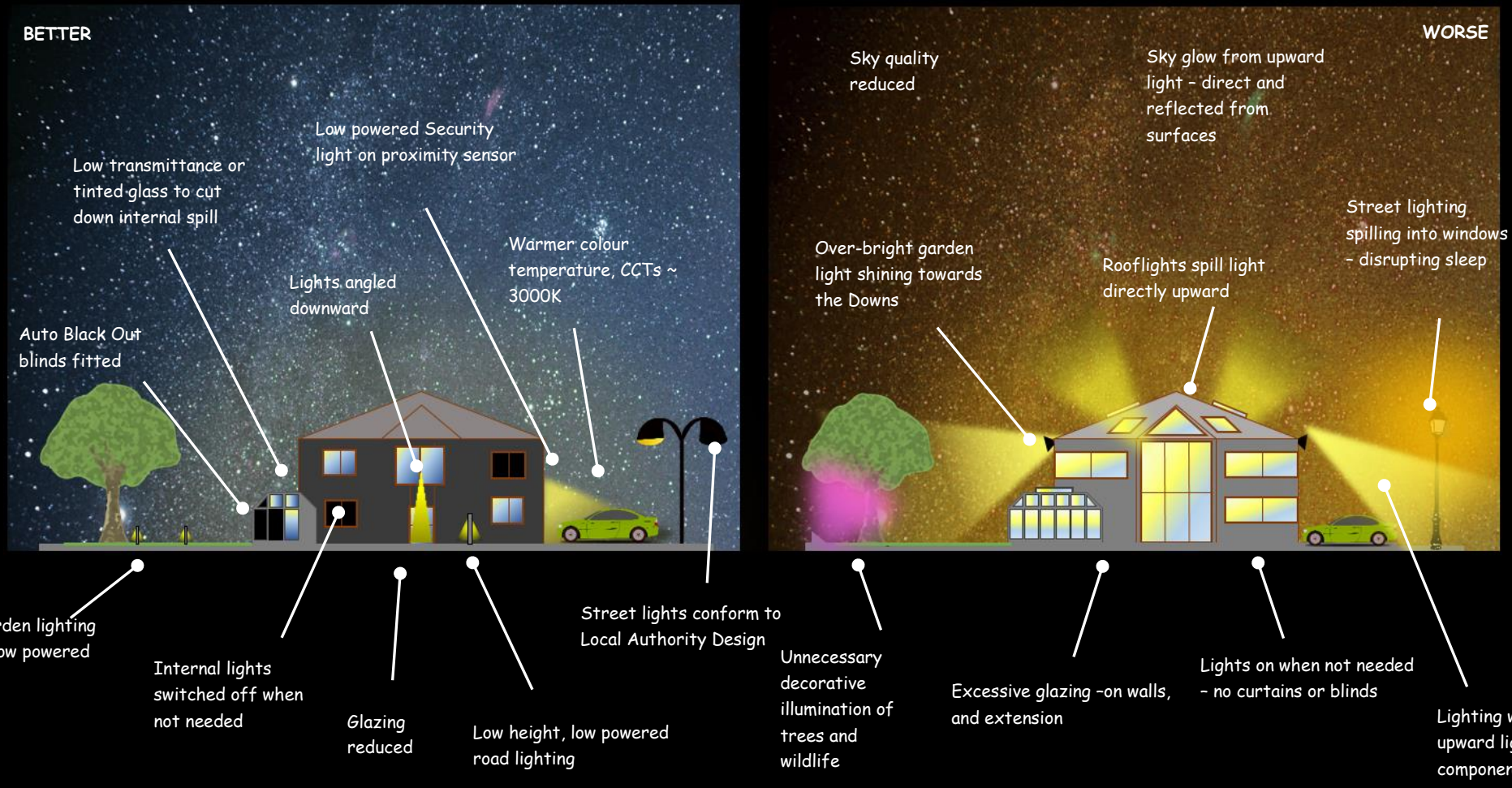
6.3 Good and Bad Lighting

6.3.1 Domestic

These principles apply to single dwellings and larger estates.

KEY POINTS

- Use lights less than 1000 lumen
- Shield lights above 500 lumens
- Use proximity sensors or timers
- Angle lights downwards
- Use curtains and blinds

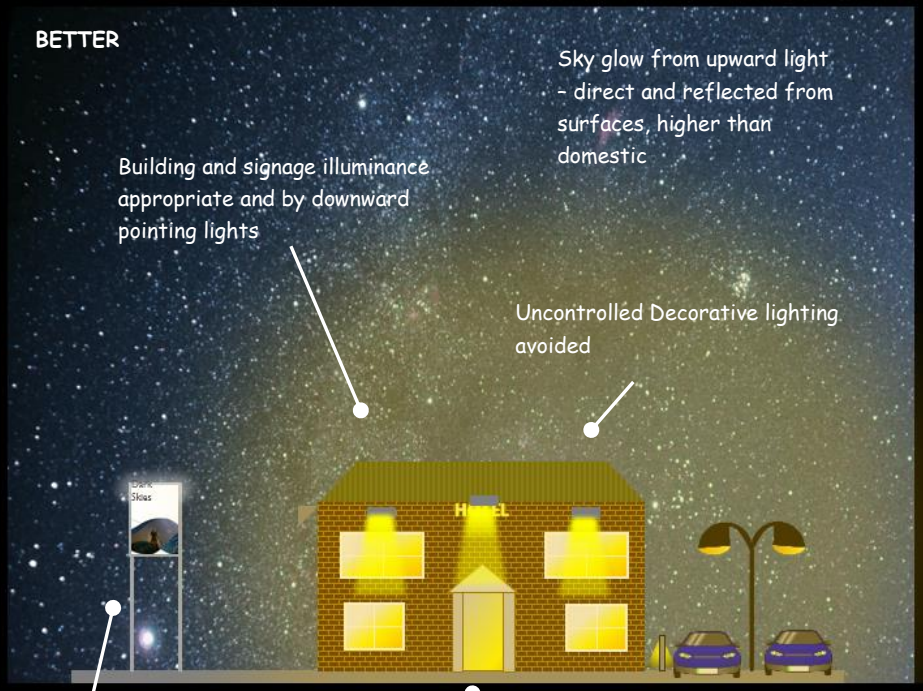


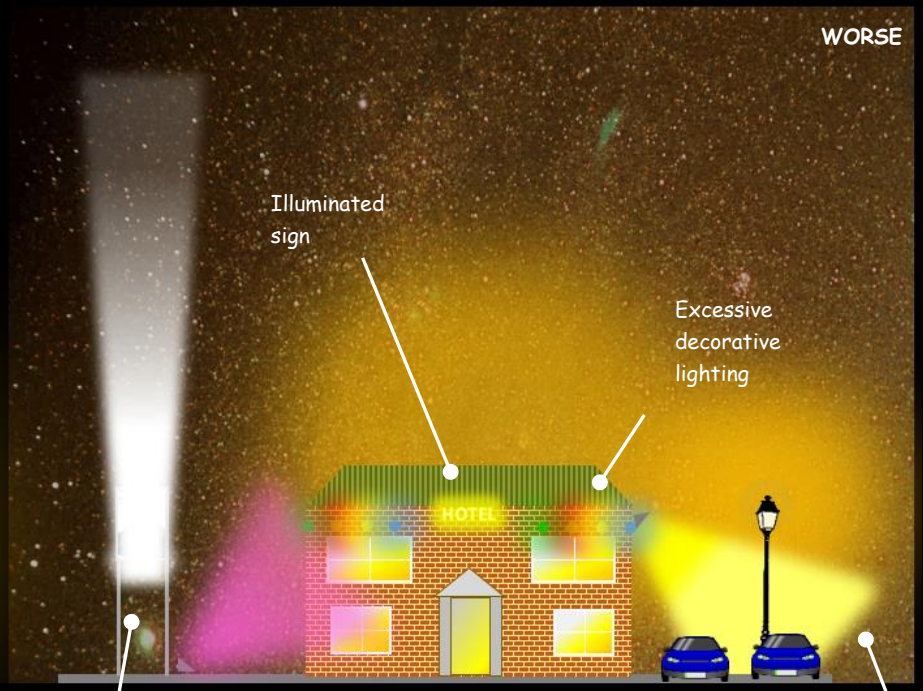
6.3.2 Commercial

This applies to smaller commercial properties, pubs and smaller retail.

KEY POINTS

- Shield lights above 500 lumens
- Use proximity sensors or timers
- Angle lights downwards
- Turn off at close of business
- Avoid uncontrolled decorative lighting



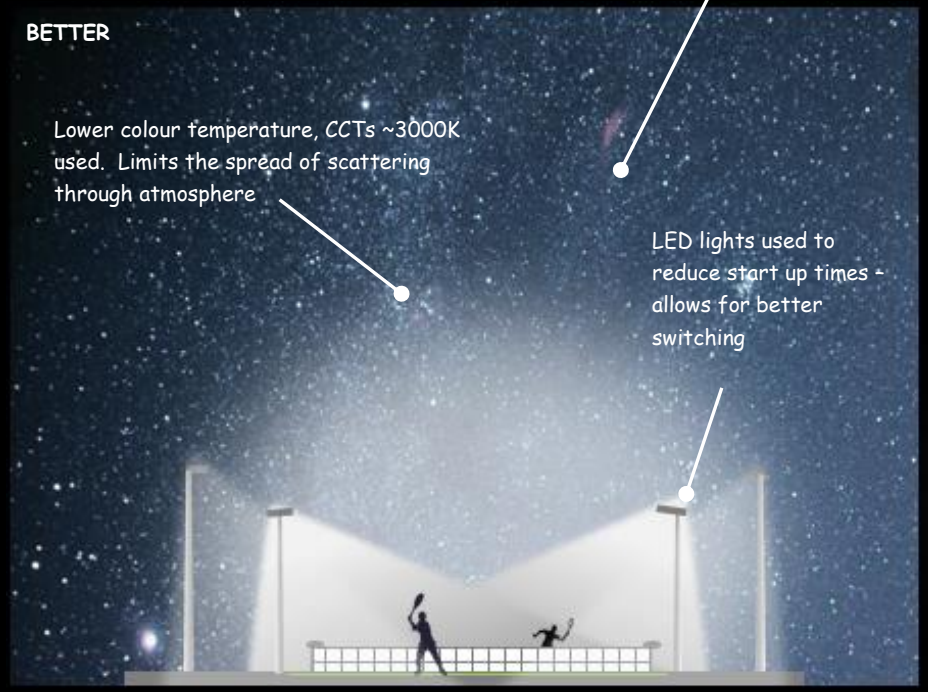


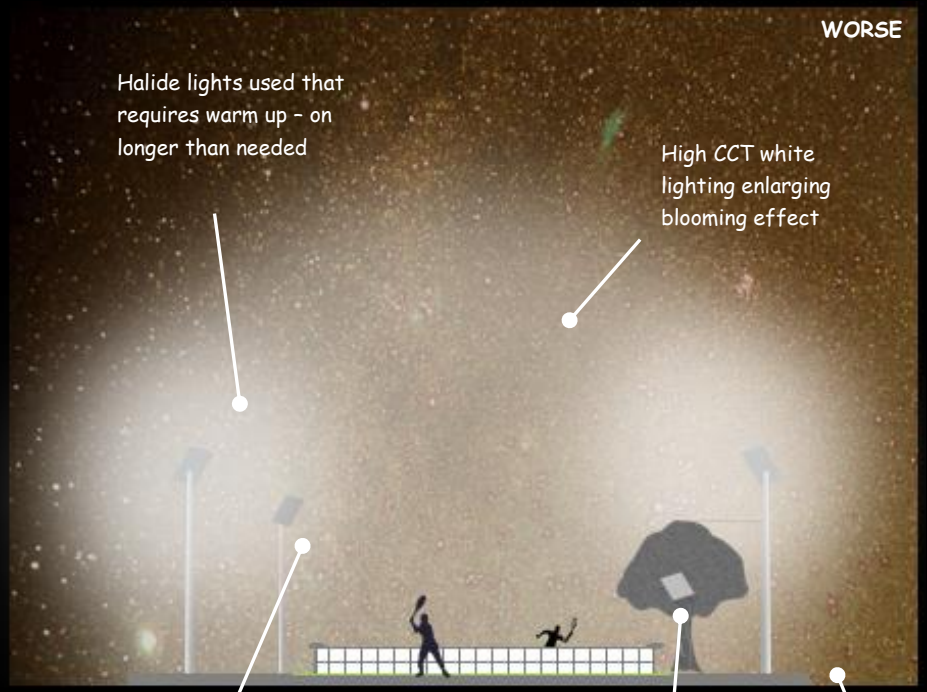
6.3.3 Sports

Lighting designs will be different between sports, but the principles apply throughout.

KEY POINTS

- Design scheme in accordance with standards
- Limit hours of use
- Situate closer to urban locations
- Use low reflective surfaces
- Use shielding



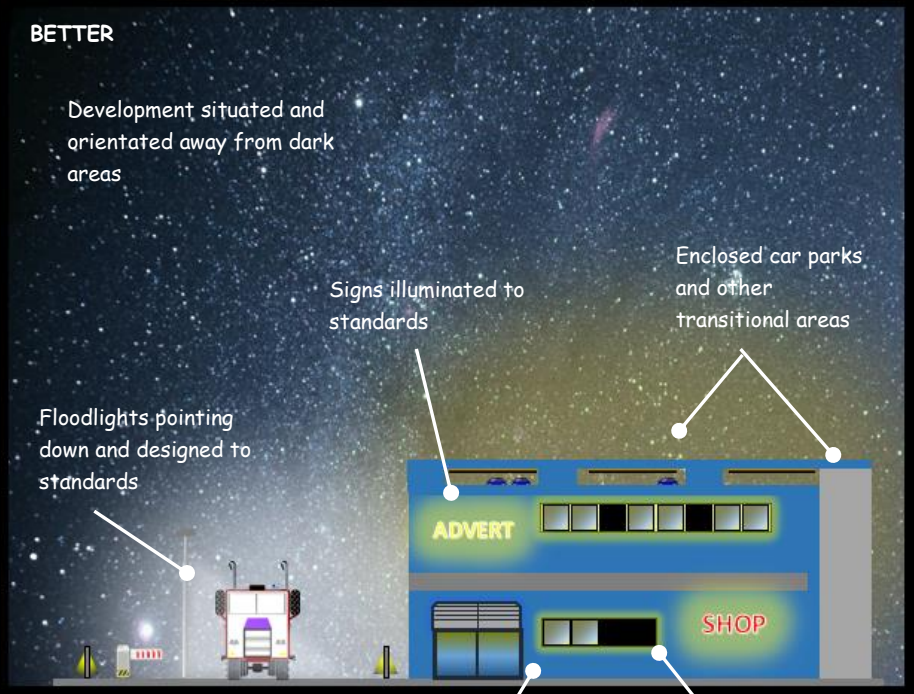


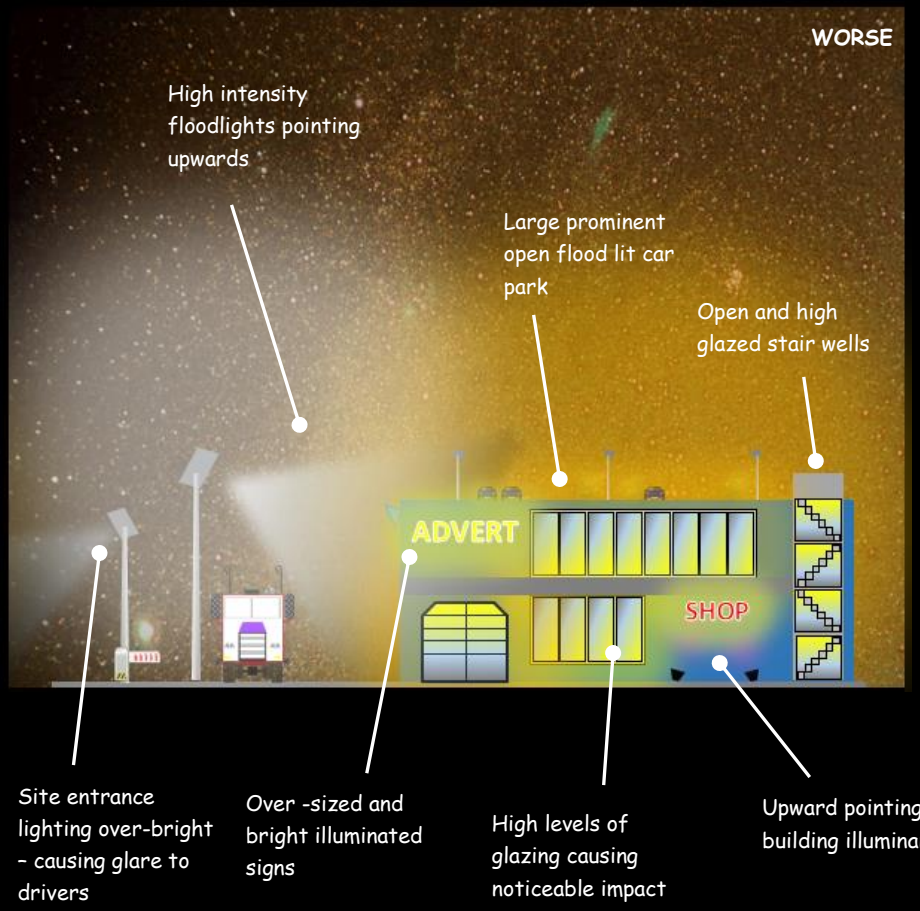
6.3.4 Industrial

This applies to larger developments such as offices, warehouses, distribution and retail centres.

KEY POINTS

- Design scheme in accordance with standards
- Turn off when not needed
- Angle lights downwards
- Situate further away from rural locations
- Avoid tall lighting columns in open areas

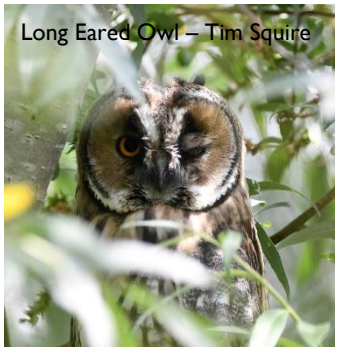




6.4 Impact of Light Pollution

The impact of light pollution isn't confined to seeing stars and a nuisance to humans.

6.4.1 Wildlife


Long Eared Owl – Tim Squire

The impact of artificial light on wildlife is a growing area of research. The evidence is showing that light can be very disruptive to many different species, not just from a disruption to their circadian body clocks, but also as a barrier to migration, movement and ecosystem integrity. We have all seen the impacts of a bright light on moths, which for some species – particularly bats – can be opportunistic. However, that benefit comes at a loss for the integrity of immediate and surrounding habitats. Evidence shows that artificial light causes negative phenology adaptions in many species and disrupts the movement of species in an otherwise dark habitat. For example, glare from artificial lights can impact wetland habitats that are home to amphibians such as frogs and toads, whose night-time croaking is part of the breeding ritual. Artificial lights disrupt this nocturnal activity, interfering with reproduction and reducing populations.

6.4.2 Health and Wellbeing

It has long been known that light pollution can disrupt the circadian rhythms (body clocks) of people. While the impacts of lights that shine directly into windows can be immediately understood, the general brightening of the sky can lead to further health issues. Disruption to sleep will produce poor circadian regulations which can cause loss of attention, increased stress and fatigue. Recent studies now show that particularly blue-light rich lighting – suppresses the increase of the hormone Melatonin, which regulates the bodies sleep-awake cycle[1]. Poor lighting can also impact on more intangible health concerns. A recent study 'Wellbeing and community on the dark island of Sark'[2] showed that wellbeing is intrinsically linked to the ability to see a full starry sky.

6.4.3 Energy

If lighting is installed or designed badly then light will spill into areas or into the sky where it is not needed. If the light is not illuminating anything then this is waste of energy and a loss of efficiency. New LED designs offer a cheaper method to light, but only effective design and installation will produce the most efficient and cost effective design.

For larger street light programmes the costs can quickly accumulate. The CPRE notes that some local authorities' plans to adopt part night lighting schemes are justified more on energy saving than dark sky protection.

Wasted light is wasted energy, wasted energy is wasted money.

6.4.4 Crime

It is not a given that installing a security light will deter crime.

The Commission for Dark Skies notes that, 'there is still no proven link between lighting levels and crime rates, due to the complex nature of the subject, and simplistic conclusions cannot hide the fact that crime is a societal problem, not a lighting problem. Recent switch-offs and dimming after midnight by more than half of Britain's local councils show that darkness does not encourage crime – it reduces it."

On the domestic level, security lighting can have the opposite effect. Bright lights can create contrasting dark spots that people can hide within, unseen from the outside. Badly installed lights can also be triggered by wildlife which reduces the effectiveness of the lights purpose.

1 - British Astronomical Association's Campaign for Dark Skies *Blinded by the Light? A handbook on light pollution* Chapter 4 'Light pollution and human health' Steven W Lockley Ph.D

2 – Sark in the Dark: Wellbeing and Community on the Dark Sky Island of Sark; Ada Blair

6.5 Assessing Light pollution and Sky Quality

Sky quality can vary throughout the year and in an individual night. Weather, season, aircraft contrails, planetary inclination all play a role in how dark the sky can be. The SQM map in Figure 1 is a composite of many months work of measurements and indicates a snap-shot of the SDNP that was sufficient to meet the requirements of the IDA application. Consequently the derivation of the zonal map in Figure 2 approximates general conditions and in most cases, should be used to determine the application of policies.

However, it may be necessary to assess the quality of the sky over the proposed development. There are a number of options;

- Use the SDNP and IDA methodology using a Unihedron SQM-L meter.
- Observe the Milky Way and other key astronomical objects, (Andromeda Galaxy, Orion Nebula) with the naked eye.
- Count the number of stars in Orion. If you can count more than around 20 stars then this is indicative of dark skies. In the South Downs you can expect to observe ~30 on a clear night.

The need for an exact determination will be assessed on application.

6.6 Environmental Nuisance

Poorly installed lighting can be illegal as a statutory nuisance.

Under section 79(1)(fb) of the Environmental Protection Act 1990, local authorities have a duty to take reasonably practicable steps to investigate complaints of 'artificial light emitted from premises so as to be prejudicial to health or a nuisance'. If satisfied that a statutory nuisance exists or is about to occur or recur, the local authority (district councils, *not* the SDNPA) must serve an abatement notice under section 80 of the Act requiring that the nuisance is abated or restricted to prevent its occurrence or recurrence.

Local authorities take into account a number of things when assessing complaints including the reasonableness of the activity being carried out, the time of day of the occurrence, its duration, its frequency of occurrence and whether or not best practicable means was being employed. There is also guidance published by Defra on the legislation which is available to local authority environmental health officers (Statutory Nuisance from insects and Artificial Light).
https://www.gov.uk/guidance/light-pollution

Environmental nuisance can be reduced or avoided if the design steps are followed in this document.

7 LIGHTING DEVELOPMENT IN THE SOUTH DOWNS

7.1 When Planning permission may be required

Minor light fitments on buildings do not usually require planning permission. However, planning permission is likely to be required when;

1) Installing a lighting scheme of such nature and scale that it would represent an engineering operation, and typically be undertaken by specialist lighting engineers,

2) Installing large-scale lighting such as the floodlighting of football stadiums or public tennis courts; and

3) Installing lighting schemes where the character or fabric of a listed building would be affected, which would require Listed building consent

Most forms of **non-domestic** lighting will fall under 1) or 2) and will probably require permission.

If the lighting scheme requires planning permission then a lighting assessment will be required. This will likely need the services of a qualified lighting design engineer. Lighting plan requirements are covered in Table 3

Planning permission will likely be required if the development incorporates increases or large amounts of glazing as internal spill is source of light pollution. Illuminated advertisements are controlled under the advert regulations with additional guidance from the ILP. http://www.legislation.gov.uk/uksi/2007/783/contents/made

If you are at all unsure as to whether planning permission or advertisement consent is required, the South Downs National Park Authority offer a free 'Do I need Planning Permission?' service: https://www.southdowns.gov.uk/planning/do-i-need-planning-permission/

Please note that even if planning permission is not required for your lighting fitment, consideration should be given to National Park purposes and every effort taken to reduce light pollution. The advice and guidance in this document should therefore be followed. Please note that any lighting will also need to consider other relevant legislation. For example, please ensure that the intensity and direction of light does not disturb others. A neighbour might take you to court if you are negligent or cause nuisance.

7.1.1 Sources of non-domestic light requiring permission

There are many different lighting types and installations across the Downs, but some of the most important and potentially damaging are listed below. If your development includes these types of sources then extra effort should be made to control the use. Due to the sheer amount of illuminance, some will be inappropriate in the darkest areas regardless of the efficiency of the lighting design. The list is representative and not exhaustive.

- Sports Floodlighting
- Security Floodlighting
- Street lights
- Illuminated Advertisements
- Architectural 'mood' lighting
- Outdoor concerts or theatrical events
- Car Parks
- Extensive glazing or roof lights (including domestic)

7.1.2 Differences between Domestic and Non-Domestic Lighting

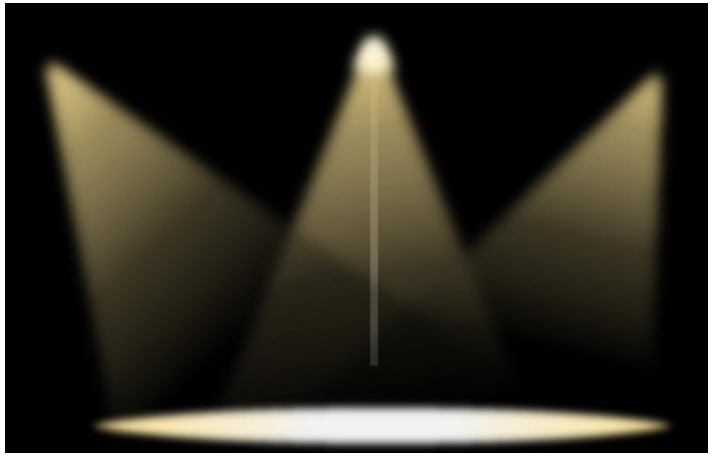
While the criteria in section 7.1 excludes most types of lower powered domestic fixtures, there are types of domestic lighting which can greatly impact on dark skies, such as off-the-shelf security style flood lighting. These have the capability to emit similar levels of intensity as street lighting despite being smaller and easier to install, and can provide excessive amounts of illuminance for most domestic purposes. Such high levels of lighting are not appropriate for domestic installations, particularly in dark areas. Consequently, it is more appropriate when protecting dark skies to consider the lighting level required rather than the physical appearance and installation of the light as referenced in the UK Planning Portal. However, the daytime physical appearance is still an important consideration with any installation.

Given the difficulty in assessing when a light becomes non-domestic in character, the following lumen levels should apply as a guide. Lumens are often quoted on the side of bulbs or on manufactures data sheets as a means of informing brightness.

Lighting above these levels are generally noticeable in the landscape and will reduce sky quality beyond the immediate area. Many off-the-shelf security flood lighting options used for domestic purposes, will exceed all these limits.

Generally, domestic task lighting is considered excessive when;

- The output of a single light or cumulative number of lights illuminating one task area exceeds 1,500 lumens[1] or
- The total light out of the property exceeds 4,500 lumens[2] or
- A surface illuminance over 5 lux in the immediate task area is required[3]
- Any single LED floodlight exceeds 15W[4]



[1] Under IDA 2014 guidelines, lights below 1,000 lumens are sufficient for domestic use and above. In a Dark Skies Reserve this value is 500 lumens and should have Fully-Cut-Off design (flat bowl such that upward light is zero). Most DIY retailers sell domestic style lights up to around 1,500 lumens. The lowest lumen output of a streetlight in the SDNPA is approximately 1,400 lumens (Philips Mini Luma).

[2] The external lighting survey within the SDNP showed that on average there were three external lights per household – rounded up). If three zones are illuminated up to a maximum of 1,500 lumens (see previous condition), this creates a total of 4,500 lumens

[3] 5 lux is the typical illuminance of rural security light. (SLL Code for Lighting 2012)

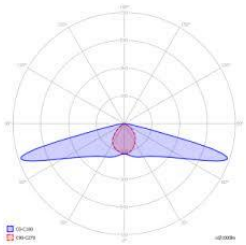
[4] This figure is likely to change as LED efficiency improves

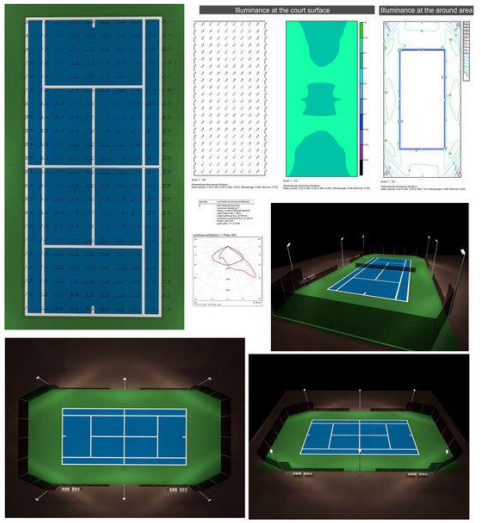
7.2 Lighting Assessment

If planning permission is required then in most cases a lighting engineer will be required to calculate a thorough lighting plan based upon the inclusions defined in Table 1. The plan must show;

- The need for the lighting
- What dark zone the development falls within
- What standards are to be used
- The position of all proposed lighting
- The installation details of all proposed lighting (angle, tilt, height)
- Technical specifications of the lighting including isolux, power, lumen output, colour temperature, CCT
- A modelled illuminance plot of the proposal, detailing spill and average illuminance against lighting guidelines.
- Baseline conditions, including details of any existing lighting, or any nearby lighting that is providing useful levels of ambient lighting should be provided.
- If the proposed lighting exceeds the limits described in this document

The following table summarises the key questions that should be answered in a lighting plan. Descriptions indicated in **BOLD** are the key questions that should be asked by both planner and developer. Any proposals not sufficiently answering these questions should not be approved.





7.2.1 Inclusions and Key Aspects

The following table summarises what should be in a lighting assessment (see also ILP guidance; PLG04 – Undertaking Environmental Lighting Impact Assessments). Links to the appropriate technical information is provided and should be referenced if applied to an application.

Whether submitting, designing or assessing applications, the key questions that must be addressed, are bolded.

TABLE 2- INCLUSIONS AND KEY ASPECTS OF A LIGHTING ASSESSMENT

	INCLUSIONS	DESCRIPTION	REF
	Need		
1	Statement of client needs and parties comments	• **Is the lighting needed?**	8.2.1.1
	Determine Existing Baseline		
2	Existing lighting environment of the site	• What lighting is currently on site? • How is it used and what for? • Are the lights dark sky compliant? • Is there a potential for improvement?	8.2.1.5 8.2.1.7
3	Survey of surrounding area night environment	• What is the surrounding lighting environment? • Are there streetlights nearby? • Are there any alternate providers?	
4	Identification of critical viewpoints	• Are there any Dark Sky Discovery Sites nearby? • Are there any nearby important habitat or wildlife sites? • Is the site visible from any viewpoints? • Is the site visible from any public routes or sites?	8.2.1.3 8.2.1.4 8.2.1.5 8.2.3.5
5	Determination of Dark Zone	• **What dark zone is the site in?**	5.2

	INCLUSIONS	DESCRIPTION	REF
	DESIGN		
6	Lighting Design Objectives	• What are the general lighting objectives? • What standards or policies are to be referenced? • Is it an expected design for the task?	
7	Task Illuminance	• What guidance standards have been used to reference lux levels? • What levels of illuminance are to be used and why? • **Does the illuminance exceed dark zone policy?**	8.3
8	Calculated Predictions	A lighting design should show • A Horizontal plan showing illuminance and uniformity levels across the site • A vertical plan showing illuminance and uniformity levels across the site if buildings are to be intentionally illuminated • Maintained averages (E_{ave}) calculation for task lighting areas – to be compared to guidance standards • **Are the predicted averages consistent with guidance standards?**	8.3
9	Obtrusive light calculation	A lighting design should show • How the lighting design meets the criteria as set out by the ILP for the determined zone when installed (not as bought) • **Do any Luminaires exceed any of the ILP limits for the zone?**	8.1
10	Comparison with Baseline Values	• What is the assessment of the expected cumulative impact? • **Does the design negatively affect the dark landscape?**	8.2.1.9

	INCLUSIONS	DESCRIPTION	REF
11	Luminaire Schedule and Plan	A lighting design should ideally contain details on the luminaires including - Luminaire light distribution type - Lamp type and wattage - Mounting Height - Orientation - Tilt - Lumens - Colour temperature, CCT - Spectrum • Does the colour temperature, CCT exceed the recommendations by the IDA? • Does the tilt when installed exceed guidance by the ILP?	8.2.2.6 8.2.3.1 8.2.3.2 8.2.3.4
12	Mitigation	• Have other mitigation controls been used to bring design into compliance such as, - Curfews - Proximity Sensors - Shielding - Baffles and Louvres - Infra-Red CCTV - Surfaces - Whole estate footprint • **Can curfews be used to prevent harm under astronomically dark conditions?**	8.2.4.1 8.2.4.2 8.2.4.2 8.2.4.3 8.2.4.4 8.4 8.2.3.5 8.2.1.7

8 TECHNICAL DESIGN ADVICE

Table 1 describes the application of weighted policies to the different lighting zones across the SDNP. This section provides details for lighting designers on what should be considered under each of the policy areas.

- 8.1 Obtrusive light
- 8.2 Design impact in the landscape
  - 8.2.1 Landscape Considerations
  - 8.2.2 Light Character
  - 8.2.3 Physical Character
  - 8.2.4 Mitigation
  - 7.2.5 Street Lighting
- 8.3 Maximum lux of Illumination
- 8.4 Preferred 'lights-off' Curfews

8.1 Obtrusive Light

The CIE:150: 2003 and the ILP 'Guidance on the reduction of obtrusive light' provides lighting designers, planners and environmental health officers with recognised technical limitations on stray light. Limits are provided for each environmental zone for each of the main sources of nuisance light pollution; sky glow, glare, spill and also includes, building illuminance.

All development with external lighting should meet or exceed ILP guidance for the environmental zone in which the development is set to take place – not what it will become. The guidance sets out recommended limits for the main sources of light pollution; sky glow, glare and spill.

The limits set out are easily achievable in most lighting designs but some projects, such as sports facilities or urban architectural lighting may not be achievable.

The Institution of Lighting Professionals Guidance on Obtrusive Light can be downloaded either by searching on those key words or from the ILP website. www.theilp.org.uk

Credit: Les Hunt

8.1.1 Institution of Lighting Professionals Guidance: CIE EN 2001

All development with external lighting should meet or exceed ILP guidance for the environmental zone in which the development is set to take place. The guidance sets out recommended limits for the main sources of light pollution; sky glow, glare and spill.
The limits set out are easily achievable in most lighting designs but some projects, such as sports facilities or urban architectural lighting may not be achievable.

E4 lighting is unlikely to be required through the SDNP except in city centres where there is a higher level of night time activity.

Zone	Sky Glow ULR [Max %]	Light Intrusion (into windows) $E_{Verical}$ [lux]		Luminaire Intensity I [candelas]		Building Luminance Pre-Curfew	Dark Zone
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Average L [cd/m^2]	
E0	0	0	0	0	0	0	Dark Sky Core
E1	0	2	0 (1*)	2,500	0	0	Intrinsic Rural/Transition
E2	2.5	5	1	7,500	500	5	N/A
E3	5	10	2	10,000	1,000	10	Urban
E4	15	25	5	25,000	2,500	25	Urban City

TABLE 3: OBTRUSIVE LIGHT LIMITATIONS FOR EXTERIOR LIGHTING INSTALLATIONS – GENERAL OBSERVERS

ULR = Upward Light Ratio of the Installation is the maximum permitted percentage of luminaire flux that goes directly into the sky.

Some lighting schemes will require the deliberate and careful use of upward light, e.g. ground recessed luminaires, ground mounted floodlights, festive lighting, to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

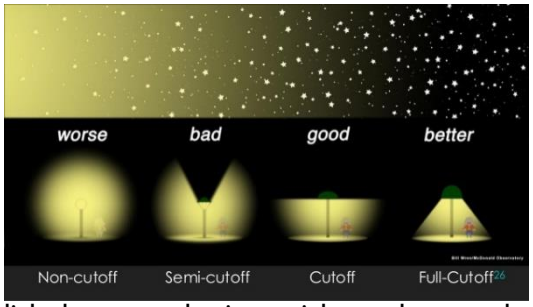
Ev = Vertical Illuminance in Lux - measured flat on the glazing at the centre of the window.

I = Light Intensity in Candelas (cd)

L = Luminance in Candelas per Square Metre (cd/m2)

Curfew = the time after which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied by the local planning authority. If not otherwise stated - 23.00hrs is suggested.
*** = Permitted only for** public road lighting installations

8.1.1.1 *Upward Light - Sky glow*



The upward spill of light should be avoided – it is the worst contributor to sky glow. Upward and near horizontal paths of light can travel a greater distance through dirty air which increases the scattering of light by atmospheric particles such aerosols, water vapour and air pollution. It is this scattering of light that creates the sky glow blooming – or halo- effect, which tends to be more prominent over cities were the density of scattering particles (air pollution) is higher.

This light is often called 'wasted' light as it generally unnecessarily lights nothing but air, pollutes the sky and costs money and carbon to do so. Light installations should aim to design an upward light ratio (ULR) appropriate to the Environment zone but should strive to achieve zero which eliminates upward and side spill. Many luminaires produce a 0% ULR, but only requires a 10° tilt to produce 2.5% ULR. Tilt lights down as the primary mitigation to protect the Downs.

Zero Upward Light Ratio (0%)

Given the availability of lighting types, all proposals should strive to achieve a zero upward light ratio in all environmental zones within the Park (E0 to E3) unless there is a clearly defined design requirement.

8.1.1.2 *Luminaire Intensity – Glare*

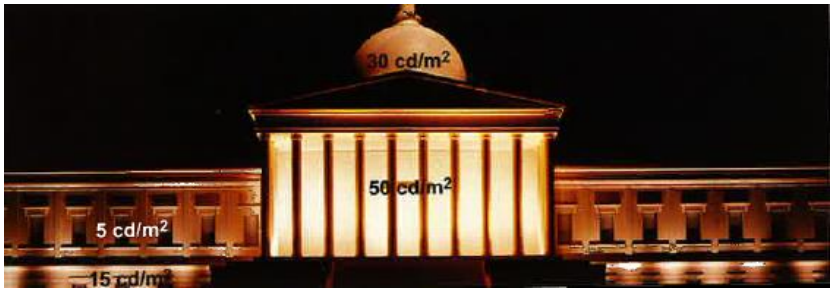
Direct visibility of lights should not be significantly noticeable. Light should be directed to where it is needed, with little of the source visible from surrounding areas. The effect of glare, as viewed by an external observer, is controlled by limiting the viewed intensity as described in Table 5.1.1. Cut-off fixtures, Cowls, baffles and shielding should be used to block any unwanted views of the lights from the landscape and an appropriate source output particularly with light travelling just beneath the horizontal (10° downward direction). Designs should not over light particularly in the direction of sensitive and dark areas. Glare is measured as 'Source Intensity' in Candela's – the strength of light.

8.1.1.3 *Light Intrusion - Spill*

Lights should be installed correctly to reduce the spill of light beyond that of the immediate task area. Lights should not point into neighbours' windows. Any areas that do not require illumination, or areas that should not be lit. This will include hedgerows, ponds, rivers, other habitats and neighbours' property. Spill is measured in Lux – illuminance of a surface (vertical).

8.1.1.4 *Building illuminance*

Buildings are often lit to create a sense of place or to emphasise architectural structures. While this style of lighting is more appropriate and effective in urban environments, it is not appropriate in dark areas. The light from the building surfaces will scatter light in all directions creating sky glow and prominent illumination in the landscape.



Architectural lighting should be appropriate to the environmental zone and show a clear lighting design.

Buildings should only be illuminated appropriate to the environmental zone and show an effective design. Lighting should not unnecessarily point above the horizontal and all the light output should be focused and illuminate only the structure – no light should be lost to the surrounding environment. The lowest power lighting should be used with appropriate optics to illuminate the structure. Due to their uncontrolled optics, general area floodlighting should not be used.

8.1.2 Illuminated advertisement regulations and ILP guidance

Any advertisements – illuminated or otherwise - must first comply with The Town and Country Planning Regulations 2007. These regulations set out when consent is required from the local planning authority for the display of and advert.

Illuminated signs should generally be avoided within the National Park. However, if permitted the ILP Professional Lighting Guide 05 'The Brightness of Illuminated Advertisements' should be used to determine the appropriate level of illuminance for the environmental zones E1b and E3 zones. There should be no Illuminated advertisements in E0 or E1a zones. The guide should be referenced when installing adverts – particularly digital images - including the following reference for the maximum permitted recommended luminance. This is a measure of the "objective brightness" of the sign. It is measured in candelas per square metre, cd/m². A higher value of luminance means the sign is brighter. Luminance is sometimes used to describe other large surfaces such as the façade of a building.

Illuminated area (m²)	E0	E1	E3	E4
Up to 10	0	100	600	600
Over 10	0	n/a	300	300

The IDA are soon to produce guidance on signage with a likely limit of 100 candelas m² and a size limit of 18.6m². Until this is adopted by the SDNPA this should be a design target for E3 zones unless there is a specified need to use ILP standards.

There should be no Illuminated advertisements in E0 or E1a zones.

Additional SDNP guidance.

- All illuminated advertisements installed on properties should be switched off on close of business.
- Any installations on properties should not exceed the height of the property.
- Any peripheral sites with installations should not face towards areas of darkness or lower environmental zones.
- Up lighters should not be used

Also reference Local Plan Advert Policy (SD53)

8.2 Design Impact

The guidance from the ILP and CIE provides a thorough basis for the correct installation of lighting. However, it does not take into account other lighting impacts that are relevant to the South Downs National Park landscape. The following general design guidance should be considered where appropriate to reduce landscape impact.

8.2.1 Landscape considerations

8.2.1.1 *The need for lighting*

From the outset it is important to justify the need for lighting in the first place; only lighting that is vital for the task should be considered. While the SDNPA acknowledges the need for a duty of care to health and safety, not all lighting is needed nor appropriate in the Downs. Examples of this would be architectural or 'mood' lighting, illuminated signage or access pathways. As such lighting proposed as a duty of care must be shown to be essential for health safety and not justified on a general perception that lighting is always needed.

8.2.1.2 *Domestic floodlighting*

Some domestic floodlights are some of the most disruptive and annoying lights. Easily bought, fitted and at low cost, these off-the-shelf 'security' floodlights can be extremely powerful and some types can emit more light than a street light. As these lights are also installed at a much lower height than streetlights the illuminance of the task area will be considerably excessive and will often cause annoyance to neighbours, particularly if they are triggered by PIR sensors throughout the night. At a maximum, these lights should not exceed 1000 lumens and should be installed correctly, so that the fitting is pointing down – not sideways. However, it is far more preferable to install lights that are in-keeping with the daytime and night-time aesthetic that have better optical control. These will be more traditional or modern designs, not lighting that is ugly at all times which should be avoided.

8.2.1.3 *Dark Sky Discovery Sites*

Dark Sky Discovery sites are local places that allow good access to dark skies and are usually centred on rural car parks. They are part of a growing UK wide network of sites and it is probable that the number in the South Downs will increase. As key observation and meeting points they ideally must be free of any direct sources of light pollution. Any lighting installations proposed close to a DSD site should look to avoid any illumination towards or within it.

8.2.1.4 WILDLIFE IN THE SOUTH DOWNS

Any lighting plan should appraise the impact of the installation on wildlife. While any light will have some impact on all species and habitats in the SDNP, there are a few notable varieties that should be especially considered.

Bats

As nocturnal specialists, all bat species in the South Downs are susceptible to artificial light. Due to the decline in numbers, all are protected by the Wildlife & Countryside Act (1981) and the Conservations Regulations (1994). This makes it illegal to: kill, capture or **disturb** bats, obstruct access to roosts or damage/destroy roosts. Lighting in the vicinity of bat roosts causing disturbance could constitute an offense. For planning applications;

- Survey area for bat species
- Do not directly illuminate bat roosts
- Avoid illuminating foraging areas and routes

Birds

Evidence shows that artificial light can reduce sleep in birds, which disrupts the long term circadian rhythm that dictates the onset of breeding. Birds are likely to be disrupted by changes to insect behaviour due to artificial lights. In general;

- Do not directly illuminate important areas for nesting birds – probably wildlife sites.

Invertebrates

Moths attracted to lights are a familiar sight. Artificial light, particularly blue UV rich, significantly impacts invertebrates, disturbing feeding, breeding and movement which may reduce and fragment populations. It is estimated that a third of insects that are attracted to lights will die as a result of their encounter. Evidence also shows that pollination rates in illuminated plans can be reduced by 62% - (Knop et al 2017. Nature 548)

- Avoid illuminating water or reflective surfaces
- Do not illuminate ecologically sensitive areas
- Use colour temperature, CCTs of less than 3000K
- Use narrow band minimal UV sources

Wildlife Sites

While some species are particularly sensitive to light, all important wildlife sites and habitats will be disputed by illumination. As the South Downs has a number of designations, applicants should make sure that any nearby sites that could be effected are noted and illumination avoided. For example:

- Special Areas of Conservation (SAC)
- Special Protection Areas (SPA)
- Ramsar Site's
- Sites of Special Scientific Interest (SSSI)
- National Nature Reserves (NNR's)
- Sites Important to Nature Conservation (SINC's, or similar)
- Registered commons

Barbestelle Bat: Hugh Clark. Nightjar: RSPB. Glow Worm: Robin Scagell

8.2.1.5 *Existing Lighting Levels*

Any existing levels of lighting should be taken into account when considering new installations that illuminate areas. If nearby street, safety or security lighting already provides direct lighting onto a task area then a lighting design should take this into account. New lighting should not be added if existing conditions already provide sufficient lighting. Ambient levels of sky glow should not be taken into account.

8.2.1.6 *Local Amenity Floodlighting*

Amenity floodlighting, particularly sports pitches are one of the biggest threats to dark skies. These installations should be sited in urban areas where there is already a high level of ambient sky glow. If an amenity lighting design is proposed then every effort should be made to assess the surrounding area for access and provision for that activity, where it may be more appropriate to use. Clubs and societies should consider joint use and memberships to prevent the installation of high powered lighting in dark areas.

8.2.1.7 *Overall Footprint*

It may be possible to reduce the overall footprint of a site's lighting design by offsetting against existing lighting that has been poorly installed. Old lighting has often been installed badly with little regard for standards or dark skies and should be improved where possible. This may not mean a complete replacement, but an adjustment to fitting or installation of sensors. Reducing the light pollution of the existing stock may help in lowering the cumulative impact of the proposed lighting which may present a design more favourably.

Relocation and improvement of existing structures could help offset additional lighting and its impact on dark skies.

8.2.1.8 *Innovation*

Technological advances may present new alternatives to lighting that are not covered in this guidance. If the developer is aware of new methods of lighting that generally lower the impact in comparison to existing practices then these should be investigated. In accordance with requirements, any new technologies will still have to comply with the lighting specifications that minimise light pollution to be considered. Although each technology will need to be assessed on its dark skies impact, some possible technologies that *may* be suitable are;

- Glow in the dark pathways
- Eco-luminance
- Smart pathways
- Reflective pavement striping

Eco-Disc Luminescent Discs

Starpath Luminescent materials

8.2.1.9 *Viewpoints*

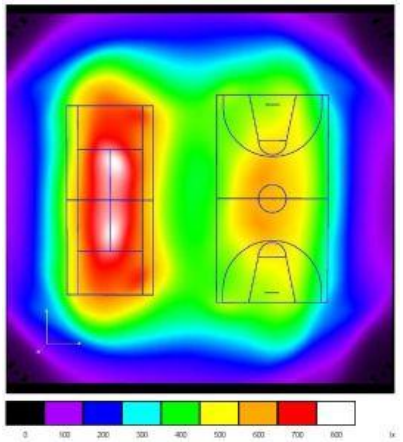
There are many key daytime viewpoints across and outside the park which serve both the daytime and night. Proposals should consider the impact on these viewpoints, particularly in regard to the disruption of the dark landscape continuity. As large scale developments are more likely outside the park, consideration should be given to their impact on dark skies within the park. They can be quite significant.

8.2.2 Light Character

8.2.2.1 *IDA - 500 Lumen Level*

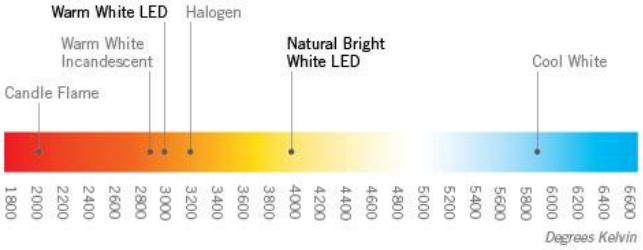
The lowest possible lumen output should be used to generate required lux levels. The International Dark-Sky Association require that any lights above 500 lumens be installed with fully cut-off (where light is prevented from travelling above the horizontal) or "shielded" luminaires particularly in isolated dwellings. This lumen output is sufficient for most domestic purposes and is comparable to a standard 40 to 60W incandescent bulb or a 5W LED lamp, already used in many homes.

8.2.2.2 *Lux – Uniformity*



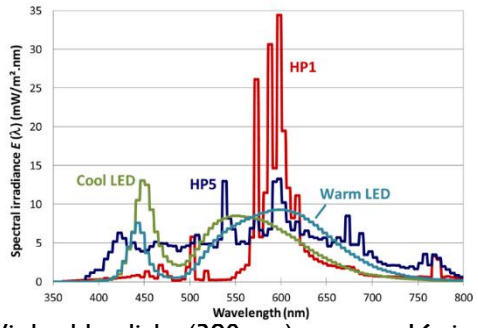
Lux levels should be designed to meet recommended levels for uniformity which prevents the patchy illumination of a surface to be significantly brighter in some areas than others. This is normally expressed as a ratio of the minimum illuminance to the average illuminance on the surface. This is particularly important in car parks and sports designs where an even spread of light is preferred to a patchy coverage. Roads however, may require a lower contrast and higher uniformity to allow for better moving. Uniformity is usually stated in appropriate guidance standards.

8.2.2.3 *Colour temperature, CCT*



The colour temperature of a light sources is often referred to as the CCT of the source. Cool white and blue rich lighting is the most harmful to wildlife and to humans. There is a substantial growing body of evidence that shows that the colour temperature, CCT of the lights can be particularly disruptive to circadian rhythms, sleep patterns and the production of melatonin. The IDA recommended that no installations be designed with a colour temperature, CCT in excess of 3,000K.

8.2.2.4 *Spectrum – Broadness and UV component*



Lights with a broad spectrum should be avoided to eliminate the spill of harmful wavelengths, particularly in the Ultra-Violet which affects wildlife. Atmospheric light scattering makes the sky blue in daytime but causes sky glow from artificial light at night. Violet-blue light (390 nm) scatters 16 times more than Warmer red light (780 nm). Many LEDs produce harsh, often over-bright blue-white light, scattering high into the atmosphere. This can cause more sky-glow than previous Warm Orange (low colour-temperature) lights: the benefits of otherwise good downward direction of light may be negated by blue-richness, over-brightness and glare. The result will be the veiling of the

night sky, as excessive light from road lamps reflects upwards; or emissions from private lighting, much of which has no directional light control, go directly into the environment and the sky from poorly designed lamps.

8.2.2.5 *LED Floodlights vs other types*

LED lighting offers benefits over other lamp types - such as halide lighting - in controlling pollution. Where possible, LED's floodlighting or security lighting should be particularly used for larger scale lighting projects such as sports facilities, because of the following benefits;

- No warm up time – instantly on
- Can turn on and off without needing additional warm up time which allows for smart lighting uses
- Asymmetrical LED's reduce the need for additional shielding (see 8.2.3.1).
- Reduced daytime impact due to smaller fixtures
- Proximity sensors can be fitted

8.2.2.6 *Watts – Building Regulations*

In addition the recommendations in this guidance, it is important that any installation comply with building regulations;

If you are installing an external light which is supplied from your electrical system and fixed to the exterior surface of your house then you should ensure that reasonable provisions are made to enable effective control and/or use of energy efficient lamps. Two options for achieving this are:

- Installing a lamp with a capacity which does not exceed 150W per light fitting and the lighting automatically switches off both when there is enough daylight and also when it is not required at night
- Ensuring that the lighting fittings you use have sockets that can only be used with lamps having an energy efficacy greater than 40 lumens per circuit-watt.

8.2.3 Physical Character

8.2.3.1 *Symmetrical and Asymmetric Luminaires*

Luminaires fall into two categories:

- Symmetrical Luminaire: This is where light is directed in a symmetrical pattern around the luminaire and are useful for lighting large areas to a high level of uniformity, such as decorative installations. The design of the enclosure and the choice of materials are critical in ensuring that the luminaire does not cause undue levels of obtrusive light.

- Asymmetrical Luminaire: Road lighting and area floodlights typically use asymmetrical fittings that direct light in a certain path, either along the road, sports courts or buildings. The use of asymmetrical luminaires allows the design to minimise light spill in unwanted areas or to provide high luminance levels in particular areas. Many off-the-shelf security lights are fitted with asymmetrical design and as such should be installed correctly to only light the intended task areas.

Where possible, use a floodlight where the front glass is designed to be used in the horizontal position. These are often referred to as "flat glass" or Full Cut-off types. They are especially useful for illuminating large areas such as car parks or sports pitches where you don't want any upward light.

8.2.3.2 *Fully Cut-off, cut-off and Semi cut off*

Luminaires can have a variety of glass features that alter the path of light and are classified according to the amount of light that shines about the horizontal. They are;

- Full Cut-off: No light above the horizontal – zero upward light.
- Cut-off: 2.5% light above the horizontal
- Semi Cut off: 5% above the horizontal
- Non Cut off:: No limitation

Full cut-off fixtures (0%), where the glass will be flat to the horizontal, are recommended throughout the national park regardless, especially where the light exceeds 500 lumens.

8.2.3.3 *Daytime Lamp Appearance*

Styles that complement the aesthetic or historic character of the development should be selected over bulky and 'functional' lighting. Where possible domestic fittings should be chosen that inhibit all upward light. This may be difficult in the 'carriage' style luminaire present on many dwelling in the SDNP, but there are LED versions available that house the lamp under the lid – (see image above of IDA approved EZT169L). This will at least prevent direct upward light spill. Many other modern styles are dark sky compliant and have zero upward light and reduce glare.

8.2.3.4 *Low Height Installation*


Hawthorne Pathlight – Landscape Forms

Required lux levels can be obtained with a range of lighting levels at different heights. Sources further away from the surface will require brighter lights with a greater source intensity than those closer to ground level to achieve the same illuminance. To reduce the impact of tall and brighter lights both for visibility in the landscape and glare, installations should be as close to ground level as practicably possible. For example, footpaths should be lit with lower powered, low level bollards or wall lights rather than overhead lighting. However, not all schemes will be able to achieve this, e.g. sports pitches.

8.2.3.5 *Surfaces*

Choices in surface type reflectivity and daytime consideration, can impact on upon the visibility of the installation and the amount of light being reflected back into the atmosphere. Illumination of whiter or mirrored surfaces – including water - should be avoided. Darker colours, such as dark greens or asphalt greys and blacks are preferred due to the reduced reflectivity at higher degrees of incidence.

Evidence shows that illumination of reflected surfaces can impact wildlife. 'Polarisation of light by shiny surfaces attracts insects, particularly egg laying females away from water. Reflected light has the potential to attract pollinators and impact on their populations, predators and pollination rates'. (Bat Conservation Trust)

8.2.4 Mitigation

8.2.4.1 *Proximity and Timed Circuits*

Where possible proximity PIR (Passive Infra-Red) sensors should be fitted to external lighting. This will minimise the amount of time the light is on for and greatly reduce the impact of pollution. Similarly, timed circuits should be used to prevent lights from being needlessly on after a certain time. Effective motion sensors can be effective in deterring crime.

Timed circuits should be set to no more than 5 minutes.

8.2.4.2 *Shielding*

Lighting impacts on both installations and reflections can be mitigated using physical barriers to an observer. These are particularly important where installations are in locations which can be seen from surrounding viewpoints. The daytime impact should be also considered.

There are two basic options

- Fix cowls, baffles to the installation at source.
- Introduce a separate physical barrier such as a tree/hedge line or fencing to soften the impact. Established woodland or wildlife areas should not be considered as a barrier.

Cowl (or Hood)

External Louvre

When selecting shielding, it is important to choose types that do not stand out in the daytime. Some options can be intrusive, particularly on halide lights – LED lighting offers lighting options that will limit the need for additional shielding.

8.2.4.3 *Security Lighting – CCTV*

There is no evidence to suggest that adding lights will act as a deterrent to reduce crime; in fact, it may be the opposite. A badly installed or over bright 'security' light can produce unintended shadow areas for crime to occur unnoticed. As an alternative to bright and damaging floodlighting, low night vision CCTV or wireless camera systems should be installed.

8.2.4.4 *Dusk till Dawn Sensors - Photocells*

Automatic Dusk till Dawn (low light) sensors fitted to lights should be **avoided** unless fitted with a separate curfew switch. They cause lights to be illuminated all night as they will detect the onset of sunset and sunrise and trigger a light to switch on and off. Some types will have low light sensors with a proximity sensor. These are a much better choice as they will only trigger when needed and won't come on at night.

8.2.5 Street Lighting

8.2.5.1 *General Design*

There is no statutory requirement on local authorities in the UK to provide public lighting and the law states that 'the highways act empowers local authorities to light roads but does not place a duty to do so'.

Street lighting should not be considered as required in all cases. It is not mandatory and will not always be appropriate in the Downs. With larger developments within urban settlements, street lighting may be required to illuminate residential roads and minor classes of subsidiary roads. In these cases the **local highways authorities street lighting design guides** should be used to determine design parameters as their guides satisfy IDA requirements.

For more solitary streetlights required at the local parish level, Local Authority street designs should be used for design principles. Information on glare classes is provided below. Where possible for minor or private estate residential roads, low level bollards should be used rather than tall, brighter columns. This will limit the total lumen output, possible glare scattering and reduce the surrounding impact.

8.2.5.2 *Adopted/Non Adopted Street lighting*

If a development requires street lighting which is to be adopted by the local Highways Authority, it is likely that the control of lights will include some dimming or part night schemes, as is the case in West Sussex and Hampshire under the Mayflower CMS system. Any large estate scale street lighting that is not to be adopted into local authority control must install similar control mechanisms to be consistent with the local provision.

Without these controls it is possible that lighting could be at a higher power for the night where the majority will be dimmed. This is particularly important with lighting in dark areas or on the edge of the urban settlements that point to dark zones.

For smaller installations appropriate electronic gear that can control dimming or the switching times should be used.

8.3 Maximum Lux – Maintained Average Illuminance

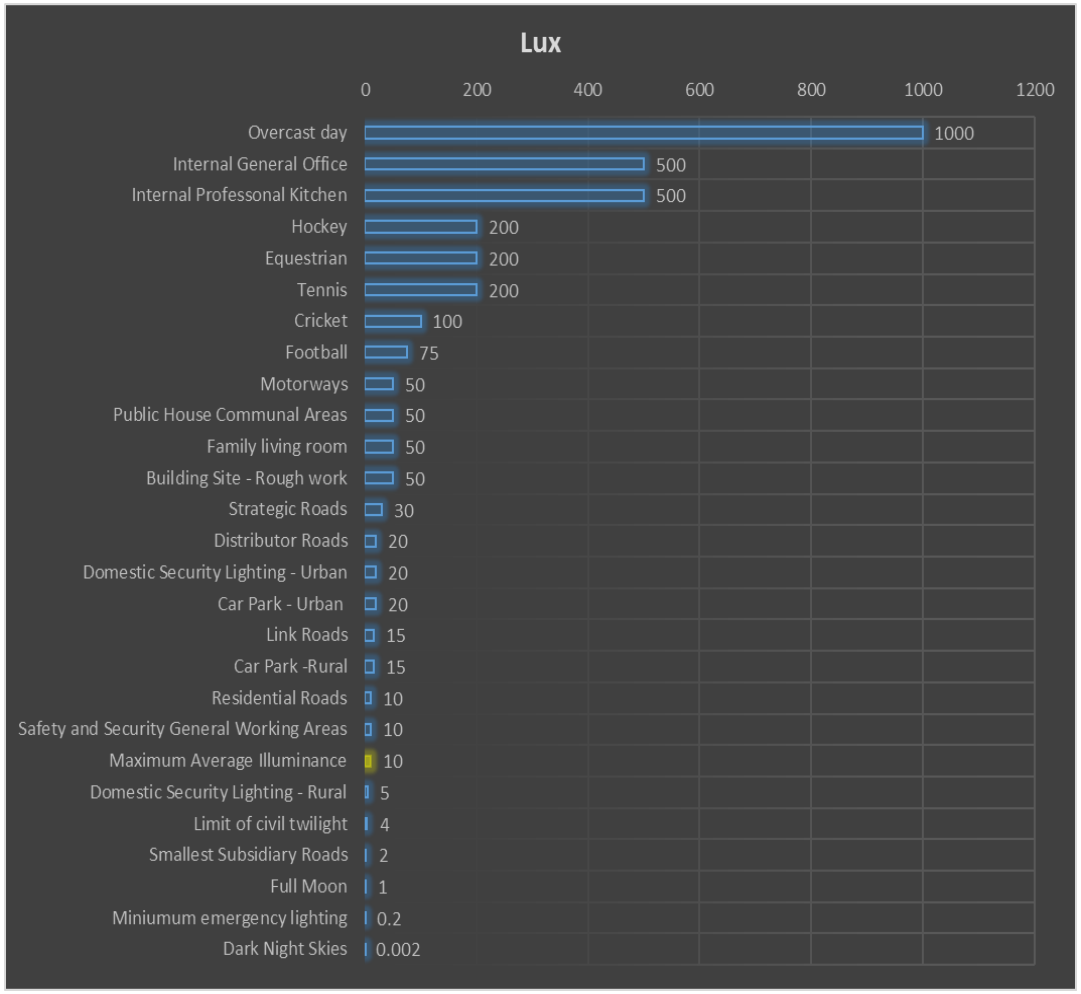


FIGURE 3 - RECOMMENDED AVERAGE LUX ILLUMINATION LEVELS

Lux is defined as the amount of light on a surface: it is best to think of it as the level of light needed on a surface to do a particular task – it is what lighting is for. For example, tasks with a need for high levels of lighting, e.g. tennis courts, will require greater lux levels, while tasks with a need for low level lighting, e.g. pedestrian pathways, will require less. For non-domestic lighting, lux is generally calculated as an average, the maintained illuminance (E_{av}) across a surface, as levels will be vary significantly over a large task area.

It is important that any lighting scheme is designed with the correct levels of light. Obtaining the right level of lux is a complicated task and usually will require the assistance of a lighting engineer to model the design and calculate the average for the task area. The lux level is affected by a number of design features, such as lamp height and direction, number of lamps, lumen output and source intensity. Without proper design the installation of task lighting, areas can be over or underlit which will impact on dark skies and raise issues of health and safety.

Figure 3 shows some example lux levels, showing that non-domestic needs require substantially more light which will have a greater impact in darker areas. The levels have been sourced from a number of guidance documents, e.g. Sports England and the ILE Outdoor Lighting Guide.

In designing a lighting plan, the average level of lux (E_{av}) needed should be referenced according to standard guidance that recommends levels of lighting for different tasks – as shown in Figure 3.

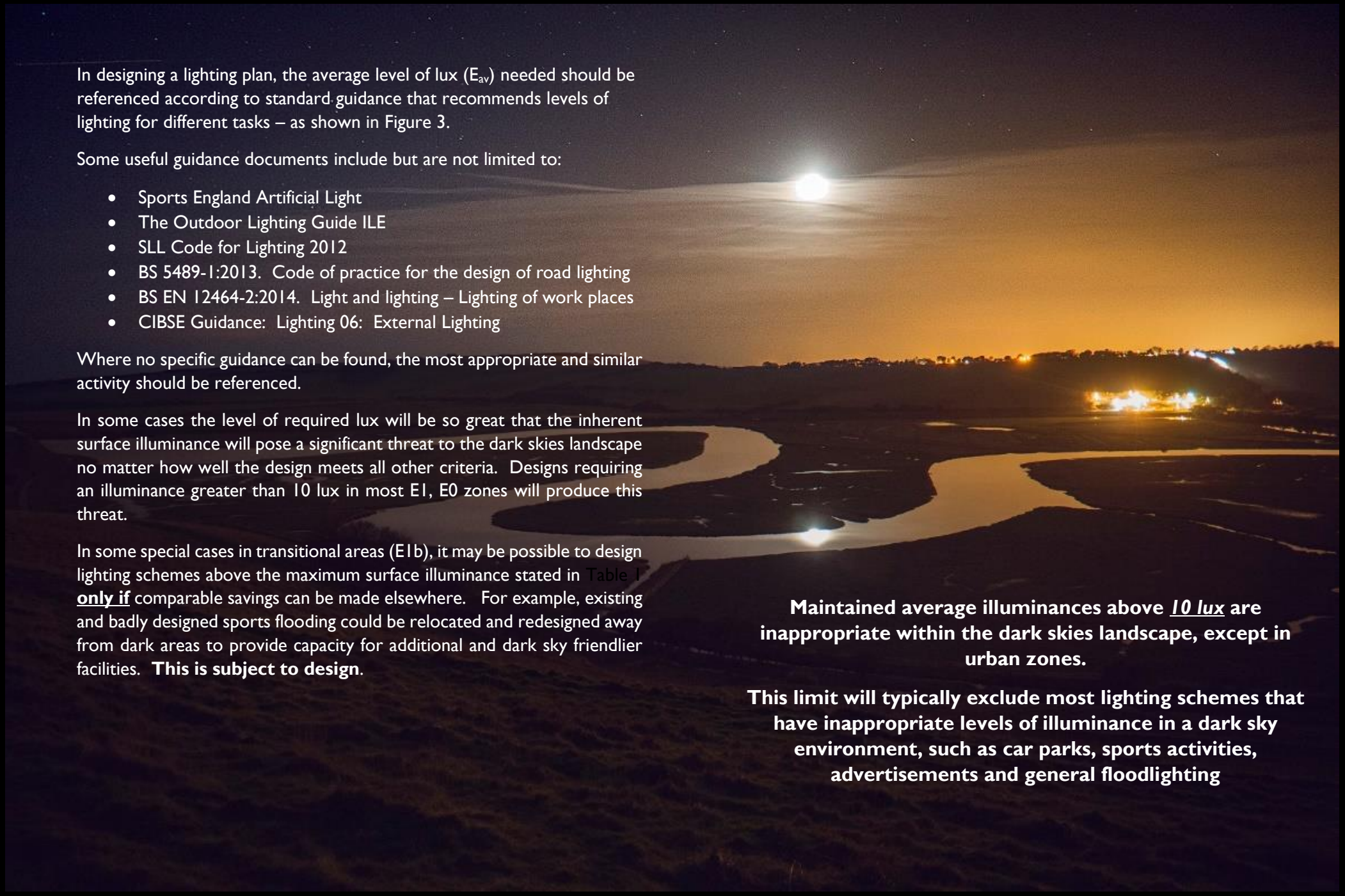
Some useful guidance documents include but are not limited to:

- Sports England Artificial Light
- The Outdoor Lighting Guide ILE
- SLL Code for Lighting 2012
- BS 5489-1:2013. Code of practice for the design of road lighting
- BS EN 12464-2:2014. Light and lighting – Lighting of work places
- CIBSE Guidance: Lighting 06: External Lighting

Where no specific guidance can be found, the most appropriate and similar activity should be referenced.

In some cases the level of required lux will be so great that the inherent surface illuminance will pose a significant threat to the dark skies landscape no matter how well the design meets all other criteria. Designs requiring an illuminance greater than 10 lux in most E1, E0 zones will produce this threat.

In some special cases in transitional areas (E1b), it may be possible to design lighting schemes above the maximum surface illuminance stated in Table 1 **only if** comparable savings can be made elsewhere. For example, existing and badly designed sports flooding could be relocated and redesigned away from dark areas to provide capacity for additional and dark sky friendlier facilities. **This is subject to design**.

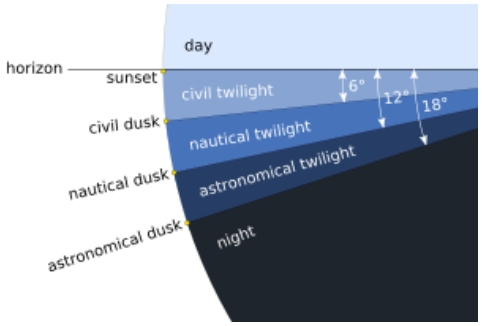


Maintained average illuminances above *10 lux* are inappropriate within the dark skies landscape, except in urban zones.

This limit will typically exclude most lighting schemes that have inappropriate levels of illuminance in a dark sky environment, such as car parks, sports activities, advertisements and general floodlighting

SDNPA Sean Lewis

8.4 Preferred Lights-Off Curfews



To prevent waste and excessive areas of light pollution, curfews should be considered as significant lighting controls; the best light to protect dark skies, is a light that isn't on. All lighting schemes should include a curfew, preferably using the most beneficial to dark skies.

Curfews can be applied at various times during the night and the year. The degree of night-time darkness throughout the year will vary according to the angle of the Sin below the horizon. Around midsummer, for example, it never gets truly dark. During the peak astronomy season in winter, astronomical observations can be made earlier in the evening, requiring earlier times on lighting controls.

To provide some weighting to curfews in dark zones, three general curfews are recommended.

8.4.1 Night Usage – E3/E4 zones and E1(b) – Urban and urban transition

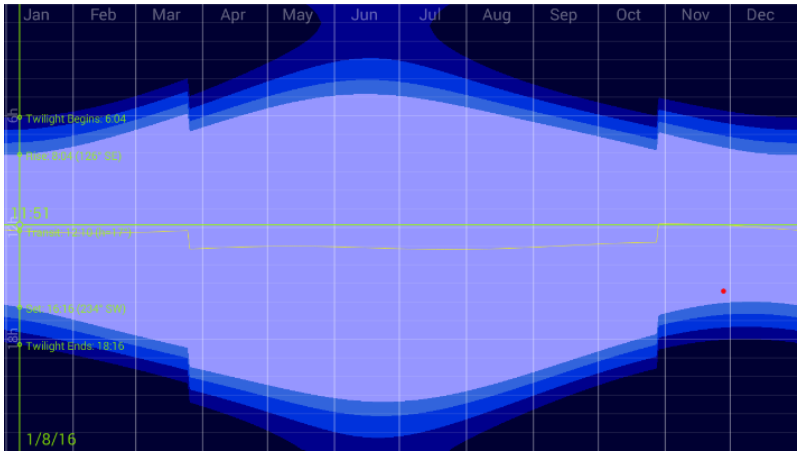
This curfew should be used in urban areas or where the skies are of not enough sufficient quality to be classed as intrinsically dark. Lights should still be extinguished when no longer required or at the end of business hours. Ideally, lights should be off as early as possible and for E3 zones, no later than midnight which is common in many street lighting or part-night lighting schemes.

8.4.2 Evening – E1a Zones Intrinsic rural dark skies

Evening curfews should provide some lighting access for early evening and commuter times, but not impinge on earlier astronomical opportunities. Times should be set as early as possible as and no later than 8pm – except in summer

8.4.3 Astronomical – EO Core Dark Skies

An astronomical curfew is the most restricted lighting regime as it prevents any lighting beyond the onset of astronomical darkness and the ability to engage in naked eye observations of objects such as the Milky Way and the Andromeda Galaxy. The time at which astronomical darkness arrives varies throughout the year. In winter this time can arrive as early as 6pm to 8pm before clocks change in March.



As the twilight/dark image above shows from mid-May onwards until mid-July, the Sun does not set sufficiently to create astronomical darkness; this is the perpetual twilight of 'nautical darkness' and what is considered 'nightfall'. It is important that during these months that the curfew does not follow astronomical darkness but rather an evening curfew of around 9pm. Despite the brighter conditions, astronomical observations are still possible during the summer months and can offer the best views of the centre of the Milky Way.

9 Internal Lighting - Glazing

The spill of light through windows can create significant amounts of light pollution. Internal illuminance demands can greatly exceed most types of domestic rural lighting, so the impact on dark skies can be significant. In general internal glazing will cause light to spill horizontally and – in the case of sky lights – directly upward, which are the most damaging paths of light.

Internal spill can – and will – have a similar impact to external lighting, particularly in interrupting and disrupting the continuity of the dark landscape.

The amount of glazing should be designed to a minimum and mitigation measures will not necessarily be acceptable in all cases. In certain circumstances the mitigation measures may be considered where the SDNPA is satisfied and be adequately controlled. This is more pertinent to non-domestic properties due to the difficulty in domestic enforcement.

Glazing should:

- **Not exceed 25% of the floor area[5]**
- **Avoid large single areas[6] of glazing such as floor to eaves glazing/cart shed openings or single elevations**
- **Not be on roofs without sufficient mitigation**

Mitigation Options

To reduce the light pollution through glass a number of technologies can be used.

- Inward facing glazing– where nearby buildings or courtyards offer shielding – allows for greater flexibility.

- Low Transmittance 'tinted' Glass.
  Light transmission through 'tinted' glass can be reduced with specially coated materials, similar to blackout glass or tinted windows, which can reduce transmittance to ~66%

- Smart Glass
  Smart Glass is made by passing electrical current through the material which changes it transparency. Often used as a security feature in offices, the use of smart glass offers an effective and controllable option to reduce light transmission.

- Electronically timed blinds/shutters/blackout blinds
  Blackout blinds can be very useful in cutting out light spill, particularly where glazing design exceeds recommendations. Conditions may be placed on non-domestic facilities that have a larger potential for internal spill, that require the installation of electronically controlled, blackout blinds that automatically operate

[5] Using Elemental Method Energy Efficiency as reference (building regulations)

[6] >50% glazing on a single elevation is becoming 'large'.

10 Temporary Lighting

10.1 Limits of Planning Control

Temporary installations of a duration of less than 28 days may not require planning control. Some installations such as festivals or music events can nevertheless have a substantial impact on dark skies and could be designed with a regard for dark skies. The following types are the most significant.

10.2 Outdoor Festivals

A festival can produce the highest introduction of light pollution of any activity. Theatrical lighting, lasers, car parks, campsite lighting and large LED screens are designed to be bright, intense and dynamic which can produce impacts that can been seen over many miles. Due to their inherent function no guidance exists for lighting of specific areas or events – each moment is potentially different. Despite this, the principles of good lighting design should still be applied where possible. This will include car park and area lighting, pedestrian areas and some stage lighting.

Despite being generally outside planning control the following recommendations should be regarded:

- Festivals should avoid the winter months where the impact on dark skies is at its greatest throughout the night. In most cases, festivals are summer activities, but care should be still be taken to reduce the pollution.
- Festivals should look to use access roads for patrons that do not encroach into the landscape.
- Festivals should avoid using distance penetrating sources such as sky scanners or lasers, particularly if pointed in the direction of dark sky areas.

BoomTown Festival Facebook

LewesLight Festival Website

10.3 Light Festivals and Art

Lighting festivals are becoming popular events across the UK with many towns and cities hosting spaces for artistic or theatrical lighting. Due to the intrinsic form and function of art, there is no standard guidance for light festivals to use in design. Despite this, the principles of good lighting design should still be applied in the artistic brief.

Lighting festivals should be limited to urban environments where there is a high level of ambient sky glow.

10.4 Temporary Floodlighting

If temporary lighting is used then it is extremely important that the recommendations for lighting in this document are followed. Temporary lighting such as portable floodlight systems are extremely bright to cater for most purposes, but they are highly threatening to dark skies. Due to its design and general use, temporary lighting can be installed badly creating significant light pollution. Care must be taken to ensure that the power and installation of the equipment is appropriate for the task and is not obtrusive to neighbours. It should not be considered an after-thought.

- Where temporary lighting is seen to be used beyond the minimum period of 28 days or with consistent regularity over some years, then planning permission should be sought.
- Temporary and portable floodlighting should not be used in dark areas.
- Temporary and portable floodlighting should not be used for sports facilities. **A permanent design should be proposed.**

Greater Mouse Eared Bat - David King

11 Examples – IDA Dark Sky Friendly Lighting

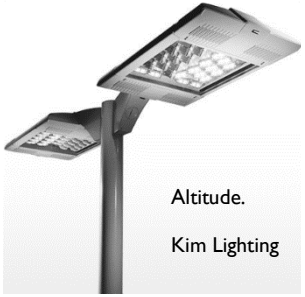
The IDA runs a Fixture Seal of Approval programme that certifies outdoor lighting fixtures as being Dark Sky Friendly, meaning that they minimise glare while reducing light trespass, sky glow and the amount of blue light in in the night time environment.

Although the IDA is American based and does not sell lighting, the types illustrated should serve as good example for the UK.

Some pertinent examples

AMP Deck-Design Pro Squared (Integrated)

Atlas Wall Pak Pro Warm Edition



Altitude.

Kim Lighting

KicK Bollard

8011-91-PL Arbor Hill™ Outdoor Wall Mount

Credit - Robert Crelin

For ideas and examples http://www.darksky.org/fsa/fsa-products/

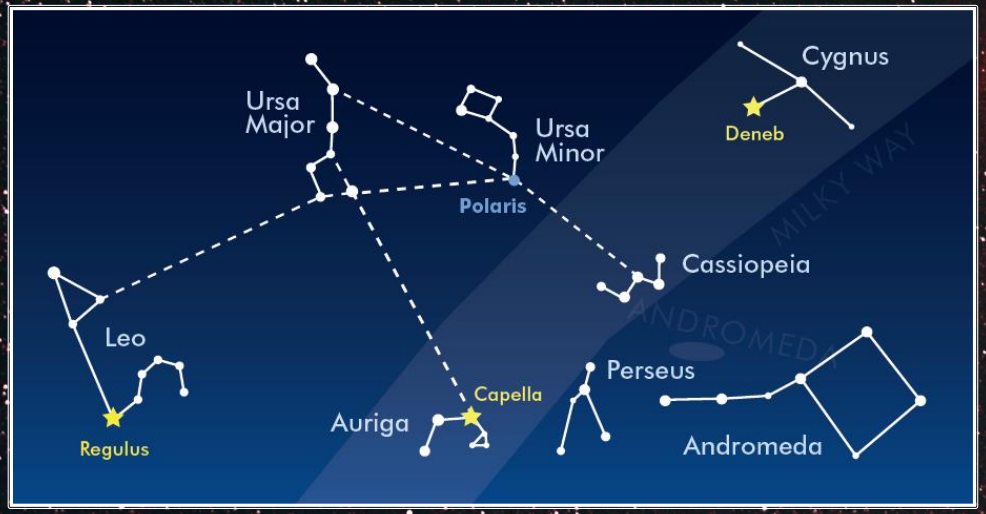
Orion
Paul Taylor

12 Finding Key Dark Sky Astronomical Objects

There are three good observable indicators of dark skies. Let your eyes adjust for 20 mins to the dark for the best results.

You will be beneath a dark sky if you can see

- The Milky Way – a ribbon of faint stars arching across the sky at most times of the year.
- The Orion Nebula – A familiar winter sky object rising in the South West
- The Andromeda Galaxy – Our nearest galactic neighbour, best seen in the late Autumn. It is a faint elliptical cloud found by following the second 'V' of Cassiopeia downwards



13 Further Reading

BSI Standards Publication

- BS 5489-1: 2013 Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas
- BS EN 13201-2:2015 Road lighting – Part 2: Performance requirements
- BS EN 13201-3:2015 Road lighting – Part 3: Calculation of performance
- BS EN 13201-4:2015 Road lighting – Part 4: Methods of measuring lighting performance.
- BS EN 12193: 2007 Light and lighting – Sports lighting
- BS EN 12464-2: 2014 Lighting of work places – Outdoor work places

CIBSE/SLL Publications:

- CLL Code for Lighting (2012)
- The Lighting Handbook (2009)
- LG0 – Introduction to Light and Lighting (2017)
- LG1 The Industrial Environment (1989)
- LG4 Sports (1990+Addendum 2006)
- LG6 The Exterior Environment (2016)

CIE Publications:

- 01 Guidelines for minimizing Urban Sky Glow near Astronomical Observatories (1980)
- 83 Guide for the lighting of sports events for colour television and film systems (1989)
- 92 Guide for floodlighting (1992)
- 115 Recommendations for the lighting of roads for motor and pedestrian traffic – Second Edition (2010)
- 126 Guidelines for minimizing Sky glow (1997)
- 129 Guide for lighting exterior work areas (1998)
- 136 Guide to the lighting of urban areas (2000)
- 150 Guide on the limitations of the effect of obtrusive light from outdoor lighting installations (2003)
- 154 The Maintenance of outdoor lighting systems (2003)

ILP Publications:

- Guidance notes for the Reduction of Obtrusive light. GN01: 2012
- The Outdoor Lighting Guide – 2005. Routledge. ILE Publication.
- The Brightness of Illuminated Advertisements. Professional Lighting Guide 05
- Guidance on Understanding Environmental Lighting Impact Assessments. Professional Lighting Guide 04
- TR 5 Brightness of Illuminated Advertisements (2001)
- TR24 A Practical Guide to the Development of a Public Lighting Policy for Local Authorities (1999)
- GN02 Domestic Security Lighting, Friend or Foe

ILP/CIBSE Joint Publications

- Lighting the Environment - A guide to good urban lighting (1995)

ILP/CSS Publications

- Joint Code of Practice for the installation, maintenance and removal of seasonal decorations. (2005)

ILP/CfDS Joint Publication

- Towards Understanding Sky glow. 2007. Chris Baddiley.

Countryside Commission:

- Lighting in the Countryside: Towards good practice (1997) - *(Out of Print but available on www.communities.gov.uk/index.asp?id=1144823)*

UK Government / Defra:

- Statutory Nuisance from Insects and Artificial Light – Guidance on Sections 101 to 103 of the Clean Neighbourhoods and Environment Act 2005
- Road Lighting and the Environment (1993) (Out of Print)
- National Planning Policy Framework 2012

Sports England

- Artificial Sports Lighting (2012)

Others

- Finding a Million-Star Hotel. Bob Mizon. Patrick Moore's Practical Astronomy Series. Springer. 2016
- Ecological Consequences of Artificial Night Lighting. Rich and Longcore (2006). Island Press
- South Downs International Dark Skies Reserve Application (2016). http://www.darksky.org/idsp/reserves/southdowns/
- English Heritage: External lighting for historic buildings (2007)
- Shedding Light. Campaign to Protect Rural England (2014).
- Night Blight 2016: Mapping England's Light Pollution and dark Skies. Campaign to Protect Rural England (2016).
- Artificial Lighting and Wildlife (2014) and Bats and Lighting in the UK (2009). Bat Conservation Trust.
- A review of the impact of Artificial Light on Invertebrates: Bruce & White and Shardlow 2011. Buglife
- Sark in the Dark: Wellbeing and Community on the Dark Sky Island of Sark. Ada Blair 2016. Sophia Centre Master Monographs
- Blind by the light? A handbook on Light Pollution. British Astronomical Association's Commission for dark Skies (www.britastro.org/dark-skies)
- Light Pollution: Responses and Remedies 2nd Edition. Bob Mizon. Springer 2012