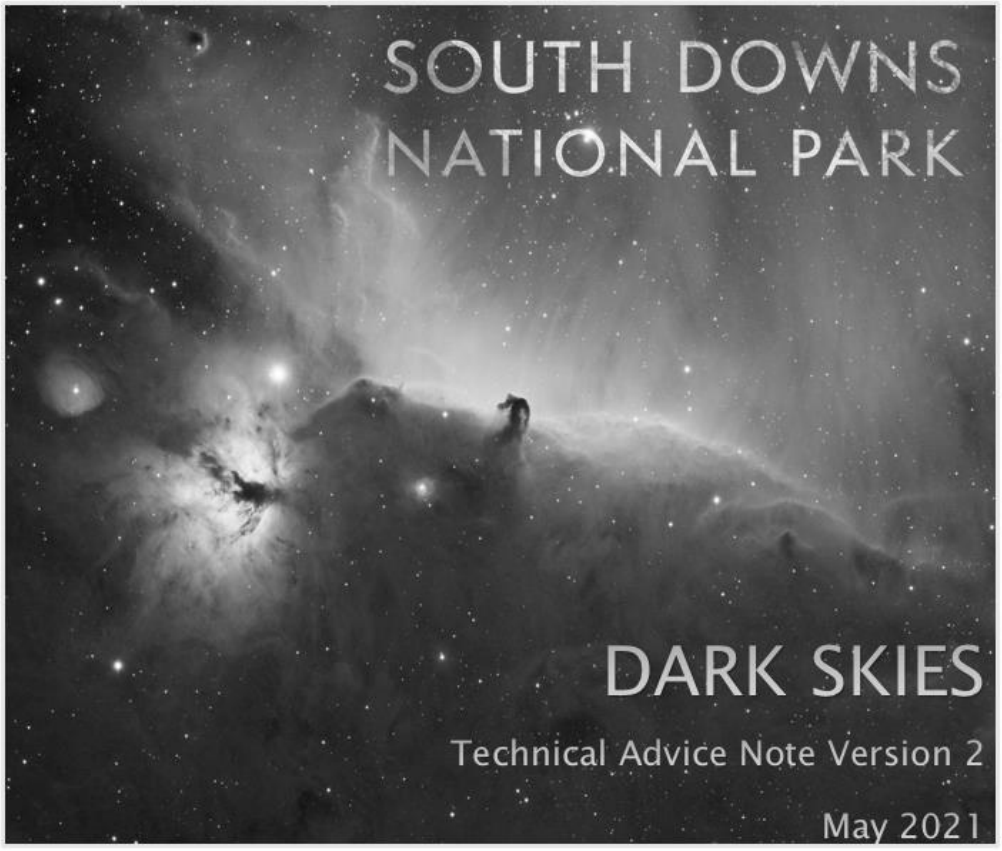
SOUTH DOWNS NATIONAL PARK – DARK SKIES TECHNICAL ADVICE NOTE VERSION 2 – May 2021



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This guidance is supported and endorsed by;

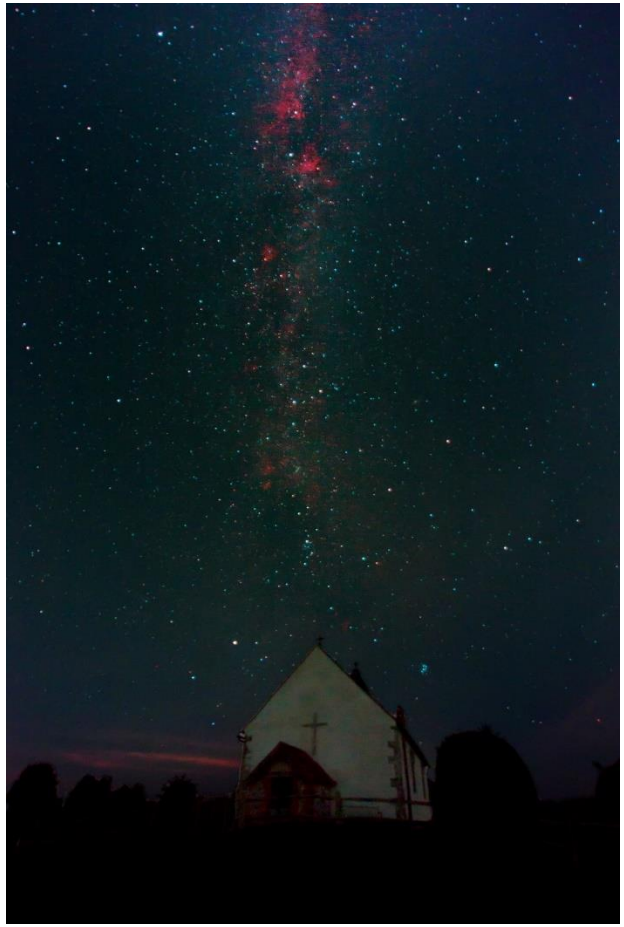
All astronomical pictures in this guidance have been taken from within or around the South Downs. They show what a tremendous and inspirational resources the dark skies of the South Downs National Park are. All non-credited images are credit SDNPA Dan Oakley

Front Page: Horse Head Nebula. Jason Howells.

Document History:

April 2018: Version 1

May 2021; Version 2. Main TAN covers external lighting. Appendix covers internal light spill (glazing) – Separate Document



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Appendix: Glazing: Internal Light Spill:

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 is 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 practice for *all* lighting, domestic and non-domestic.
- NEW for 2021: Revisions on Internal Light Spill (Glazing)
- NEW for 2021: Planners checklists

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 practice.

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 is captured in the 2020-2025 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 through definable 'Outcomes'. South Downs Management Plan

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 covered within Outcome 1 within the PMP under; https://www.southdowns.gov.uk/partnership-management-plan/

- **Outcome 1: Landscape and Natural Beauty**

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).

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

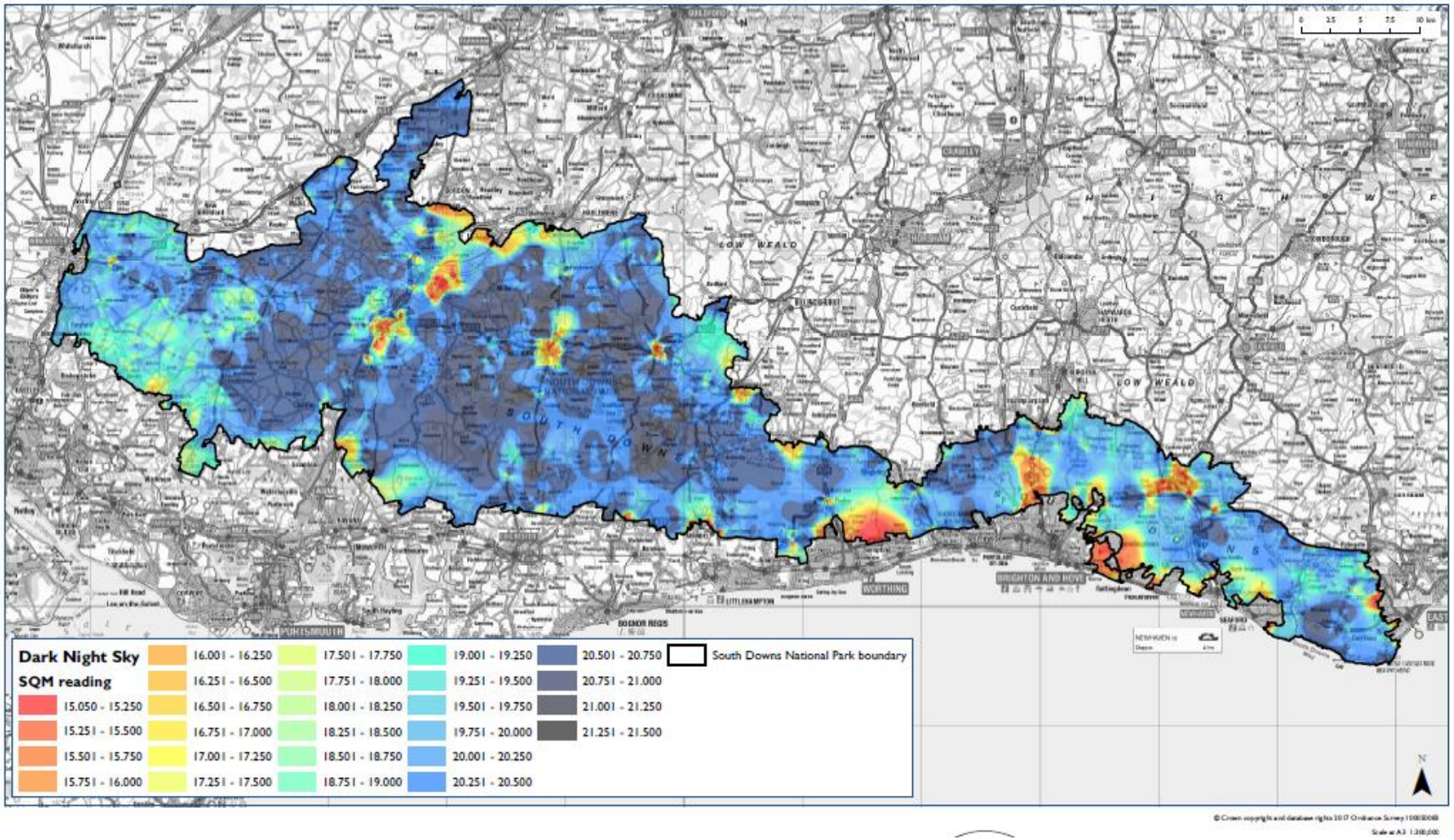


FIGURE 1 - SKY QUALITY MAP (MAGNITUDES PER ARCSECOND^2)

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.

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) subject to design and that an preferred dark curfew (lights-off) time is set (8.4).

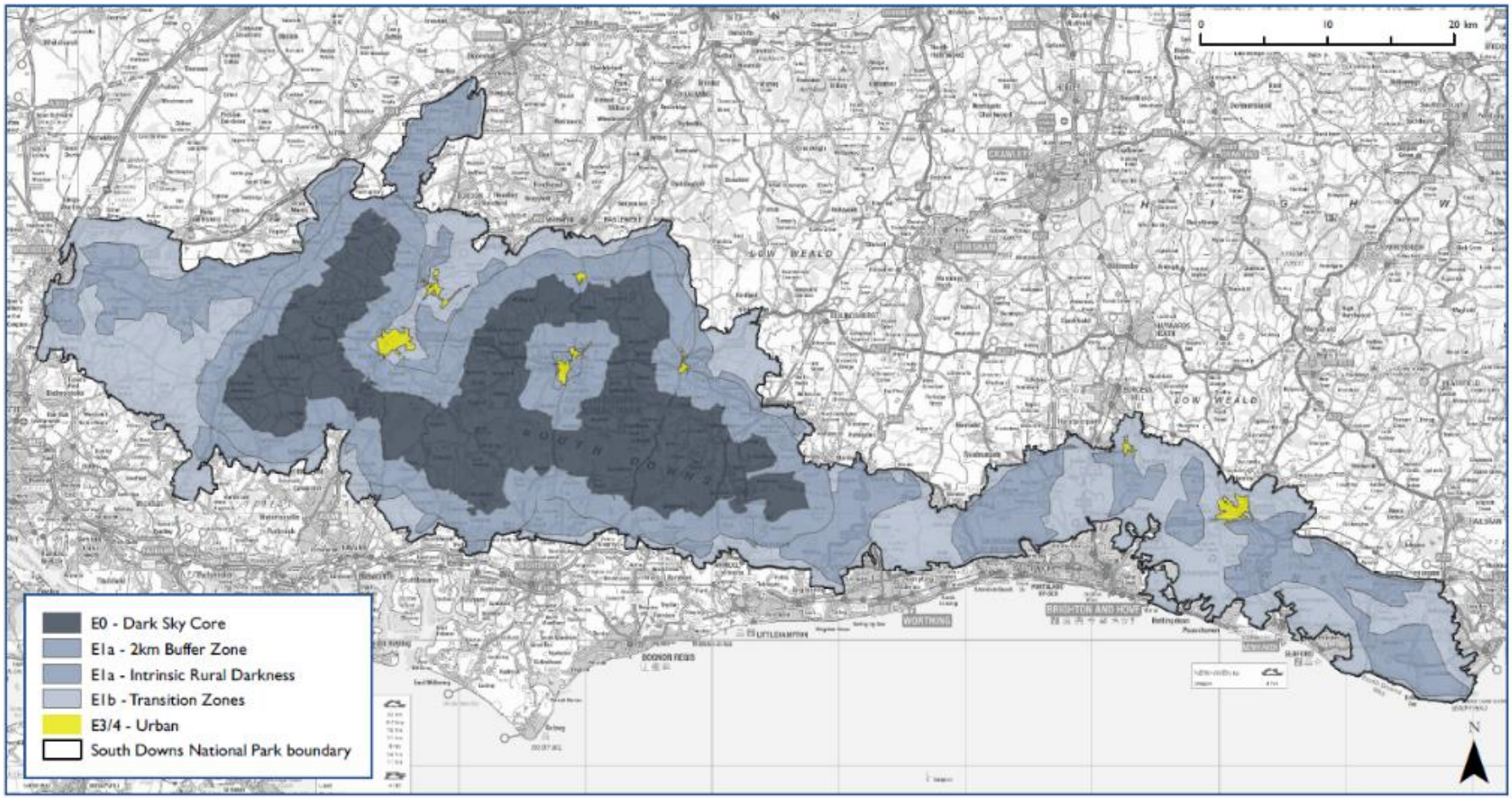
Zone	Description	SQM Range	8.1 ILP Guidance	8.2 Design Impact	8.3 Max Lux	8.4 Preferred Night Usage Curfew	8.4 Preferred Evening Curfew	8.4Preferred Astronomical Curfew
E0	**Dark Sky Core**	**20.5+**	√	√	√			√
E1(a)	**Intrinsic Rural Darkness and buffer**	**20 to 20.5**	√	√	√		√	
E1(b)	**Transition**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

TABLE 1- ZONAL LIGHTING POLICIES

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.

Dark Sky Zone



Scale at A4 1:420,000

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.

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.

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

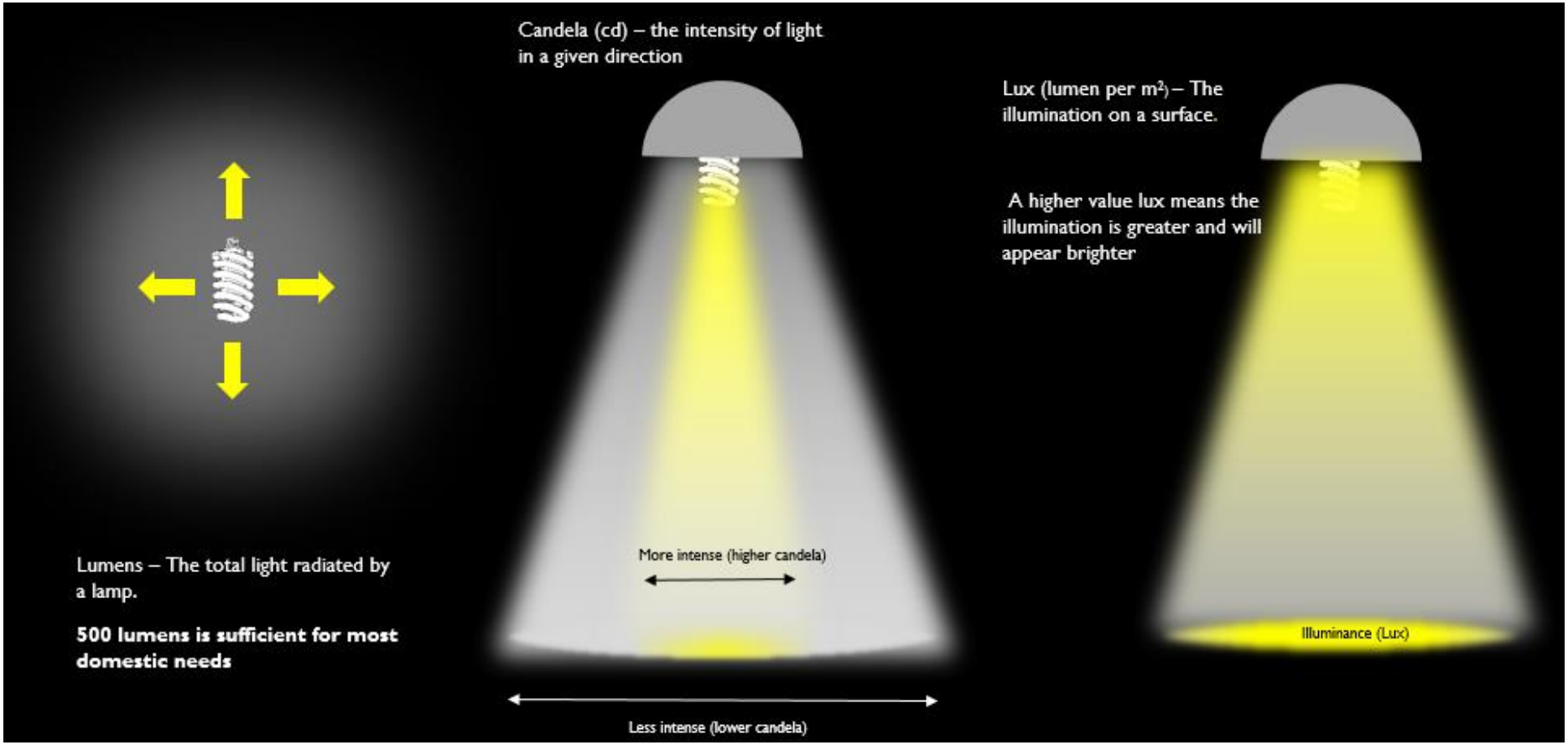
This is the uncomfortable brightness of a light source when viewed against a contrasting darker background. Due to the rural and less populated character of the landscape, lights in rural areas will be relatively higher in glare than in urban areas. This is particularly noticeable when looking from raised 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. A lamp with higher candela will appear more intense (like a torch) than a wider beam

Illuminance (Lux or lumens per m^2) – This is the light from a lit surface. A higher value of lux means the illumination is greater and 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

Good Domestic Example

Design features in image

- Low transmittance or tinted glass to cut down internal spill
- Low powered security lights on proximity sensor
- Lights angled downward
- Warmer colour temperature CCT's. 3000K
- Auto black out blinds fitted
- Garden lighting is low powered
- Internal lights switched off when not needed
- Glazing reduced
- Low height, low powered road lighting
- Streetlights conform to Local Authority Design

Example of worse domestic lighting

Design features to avoid in image

- Over-bright garden lighting shining towards the landscape
- Rooflights spill directly upward
- Street lighting spilling into windows – disrupting sleep
- Unnecessary decorative illumination of trees and wildlife
- Excessive glazing on walls and extension
- Lighting on when not needed – no curtains or blinds
- Lighting with high upward light component

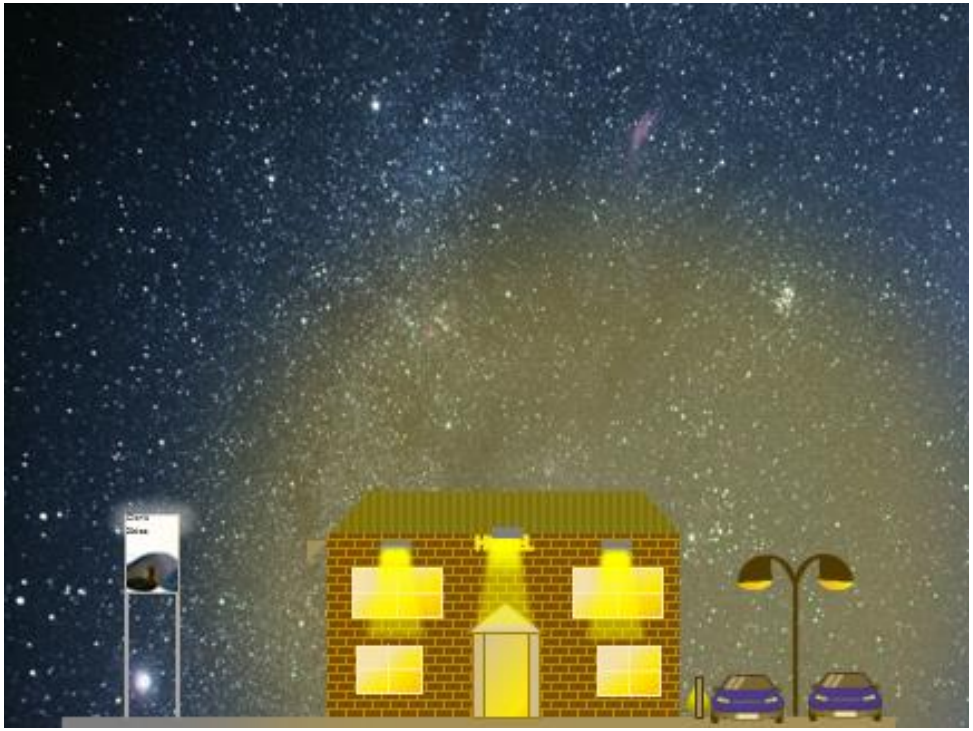
6.3.2 Commercial

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

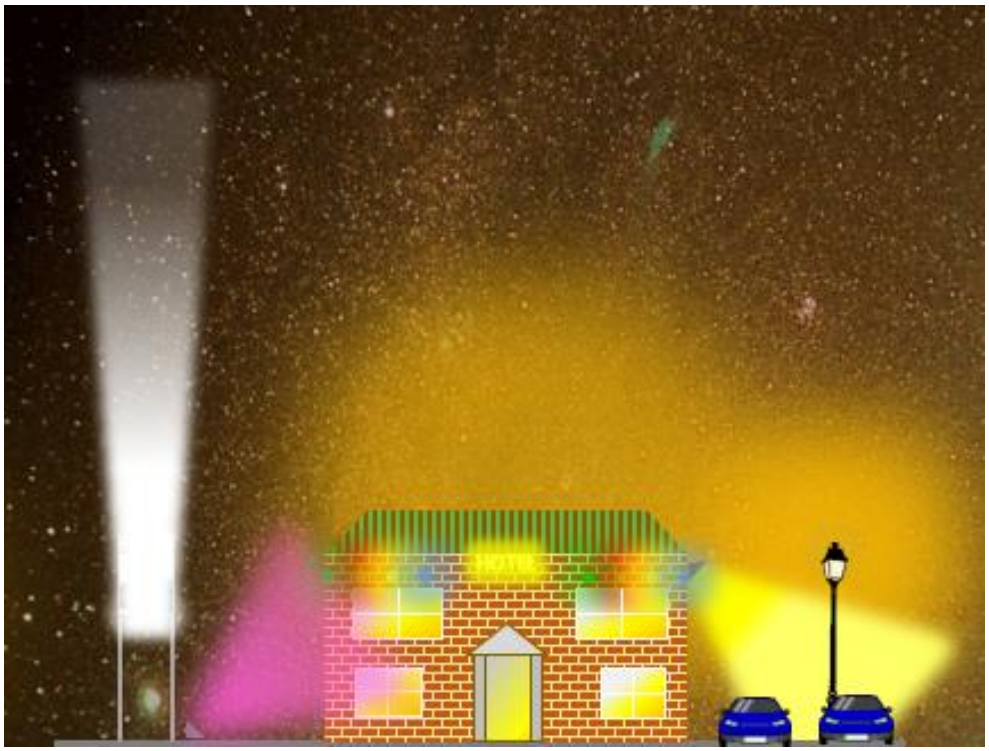
Example of better commercial lighting.



Design features in image

- Sky glow from upward light- direct and reflected from surfaces higher than domestic
- Building and signage illuminance appropriate and by downward pointing lights
- Uncontrolled decorative lighting avoided
- Advertisement illumination low powered and pointing down – easier to read
- Lights switched off at close of business
- Task area lit to the correct illuminance – proximity sensor

Example of worse commercial lighting



Design feature to avoid in image

- Advertisement floodlighting pointing up – hard to read
- Architectural building illumination directed upwards
- Overuse of lighting in car park
- Spill onto adjacent roads and public spaces
- Excessive decorative lighting
- Illuminated sign

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

Example of better sports lighting

Design features in image

- Lower colour temperature, CCTs ~3000K used. Limits the spread of scattering through the atmosphere
- Inherently bright designs still produce noticeable sky glow blooming despite efficiency of lights – inappropriate in dark places
- LED lights used to reduce start up times – allow for better switching
- Lighting confined to the task area – no spill beyond boundary
- Lower reflective surfaces
- Task area lit to the correct illuminance
- Smart switching used – unused courts not lit

Example of worse sports lighting

Design features to avoid in image

- Halide light used that requires warm up – longer than needed
- High CCT white lighting enlarging blooming effect
- Over-bright sports lighting installed badly – pointing upward, too bright for purpose
- High reflective playing surface
- Existing structure used as lighting columns – design not efficient
- Light spilling beyond task area

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

Example of better industrial lighting

Design features in image

- Development situated and orientated away from dark areas
- Signs illuminated to standards
- Enclosed car parks and other transitional areas
- Floodlights pointing down and designed to standards
- Low level walkway lighting
- Glazing reduced – low transmittance glass
- Internal lights off when not needed

Example of worse industrial lighting

Design features to avoid in image

- High intensity floodlights pointing upwards
- Large prominent open flood lit ca park
- Open and high glazed stair wells
- Site entrance lighting over-bright, causing glare to drivers
- Over-sized and bright illuminated signs
- High levels of glazing causing noticeable impact
- Upward pointing building illuminance

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

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.

Long Eared Owl – Tim Squire

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.

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

6.4.3 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.

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). Statutory light pollution Defra

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. UK Legislation for advert legislation

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: 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;

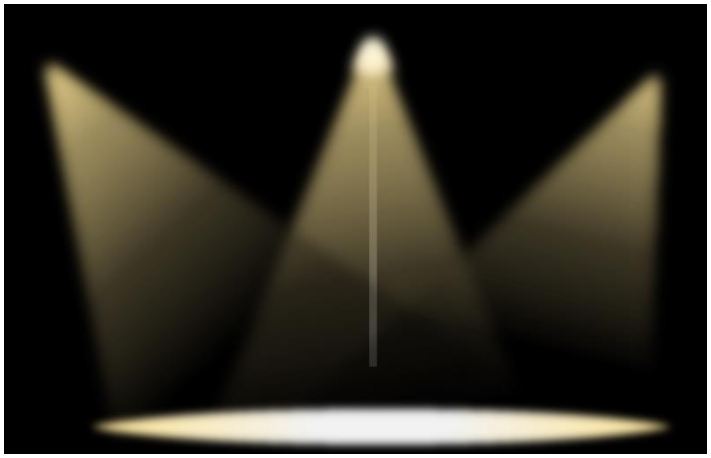
- The output of a single light or cumulative number of lights illuminating one task area exceeds 1,500 lumens[1] or
- The total light out of the property exceeds 4,500 lumens[2] or
- A surface illuminance over 5 lux in the immediate task area is required[3]

[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)

- Any single LED floodlight exceeds 15W[4]



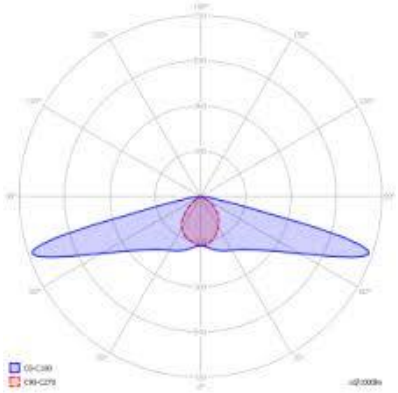
[4] This figure is likely to change as LED efficiency improves

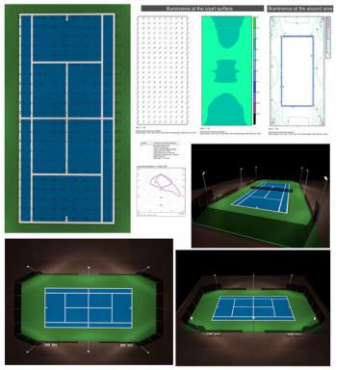
7.2 Lighting Assessment

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?**	9.2.1.1
	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?	9.2.1.5 9.2.1.7
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?	9.2.1.3 9.2.1.4 9.2.1.5 9.2.3.5
5	Determination of Dark Zone	• **What dark zone is the site in?**	5.2
	DESIGN		
6	Lighting Design Objectives	• What are the general lighting objectives?	

	INCLUSIONS	DESCRIPTION	REF
		• 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?**	9.3
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?**	9.3
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?**	9.1
10	Comparison with Baseline Values	• What is the assessment of the expected cumulative impact? • **Does the design negatively affect the dark landscape?**	9.2.1.9
11	Luminaire Schedule and Plan	A lighting design should ideally contain details on the luminaires including - Luminaire light distribution type	9.2.2.6 9.2.3.1 9.2.3.2

	INCLUSIONS	DESCRIPTION	REF
		- 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?	9.2.3.4
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?**	9.2.4.1 9.2.4.2 9.2.4.2 9.2.4.3 9.2.4.4 9.4 9.2.3.5 9.2.1.7

8 PLANNERS CHECKLIST

8.1 External Lighting

IS THE LIGHT NEEDED?

- In most cases the light will be needed and obvious, but the reasons should be clear and evident.
- Aesthetic or dramatic lighting serves little safety or security purposes, so should be avoided unless it is critical to the development.

DETERMINE ENVIRONMENTAL ZONE

- E0 and E1a/b zones should have 'rural' levels of lighting, differing in mitigation schemes. High illuminance lighting should be avoided
- E3/4 zones might have street lighting and brighter 'urban' facilities and on later into the evening. High illuminance in these zones is more appropriate

IDENTIFY THE KEY METRICS

- **LUMENS** – The total output of the lights
- **CCT** – The colour correlated temperature, expressed in Kelvin (K)
  - **3000K is the aim for all lighting**
- **ULR** – The Upward Light Ratio, expressed as a %-age or ratio.
  - **Zero upward light is the aim for all lighting**

IS THE ILLUMINANCE APPROPRIATE?

- **LUX** – This is the measure of light on a surface

  Different areas need different Lux levels. Apart from domestic lighting, the Lux level should be referenced against the appropriate standard, e.g. Sports England Artificial Light. Refer to table ?? for typical Lux levels

  This will be sometimes expressed as E(ave) or the average illumination (E)

ARE THERE ANY MITIGATONS?

- PIR: Lights for pedestrian and vehicle movements/access should have proximity sensors
- Timers: Business should use timers to prevent lights at close of business

CONSIDER THE LOCAL SETTING

- Does the local topography offer any shielding to view points?
- Does immediate surrounding vegetation act as a shield to the surrounding landscape? This is particularly effective for glazed elevations
- Are there any key protected wildlife sites directly adjacent to development requiring less lighting impact?

NO

IS IT DOMESTIC?

YES

ENSURE:

- 500 lumens lamps are preferred
- Any lights above 500 lumens are fully shielded
- Single lamps exceeding 1500 lumens should be avoided
- Lamps should not exceed 3000K
- Proximity sensors or timed switching should be used
- Lights point downwards, below the horizontal
- Illuminance is justified

CATEGORISE NON-DOMESTIC LIGHTING SCHEME

PATHWAY AND STREETLIGHTING

- High impact potential regardless of design efficiency
- Illuminance levels will be high (20 lux+)
- Consistent with Local Authority Managed
- Bollard lighting preferred for small estates
- Should be avoided in E0 and E1 zones
- Often used in E3/E4
- Referenced against illuminance standards
- 3000K
- Downward Facing ULR= 0
- Use smart lighting to illuminate only used courts
- Timers such that Off when not needed
    - Consider sports availability in urban areas
    - Lumens operate within 3000-5000

ADVERTISEMENTS

- High impact potential regardless of design efficiency
- Refer to Advertisements Section Page

SPORTS

- High impact potential regardless of design efficiency
- Illuminance levels will be high (20 lux+)
- Should be avoided in E0 and E1 zones
- Referenced against illuminance standards
- Aim for 3000K (difficult to achieve in small-object sports)
- Downward Facing ULR= 0
- Use smart lighting to illuminate only used courts
- Timers such that Off when not needed
- Consider sports availability in urban areas
- Refer to table ?? for typical illuminance levels, e.g. football, hockey
- Lumens can be very high (10,000)

SPECIAL CASES

- High impact potential
- Lights have special purposes that may conflict with dark skies, e.g. Stage lighting,
- Illuminance reference guidance not often available
- Specific assessment will need to be made
- Examples;
    - Artistic installations
    - Light festivals
    - Temporary event lighting
    - Music festivals
- Lights to be avoided
    - Sky Scanners, Lasers, 3000K+
    - Upward light

PEOPLE AND VEHICLE ACTIVITY

- Medium impact potential regardless of design efficiency
- Illuminances vary from low (5 lux) to high (50 lux) depending on risk
- Will apply in all zones as rural businesses need lighting for employees/visitors
- Referenced against illuminance standards
- 3000K
- Downward Facing ULR= 0
- Use smart lighting to illuminate only used courts
- Timers such that Off when not needed
- Refer to table?? for typical illuminance levels, e.g. car parks, walkways, vehicle movement
- Single light should not exceed 5000 lumens

BUILDINGS

- Non-Essential Lighting
- Useful in city centres/night life for economy
- Should be avoided in E0 and E1 zones
- 3000K
- Up lighters to be avoided
- Illumination of tree's to be avoided
- All light directed at surfaces
- Avoided in rural churches
- Off a close of business

9 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.

- 9.1 Obtrusive light
- 9.2 Design impact in the landscape
  - 9.2.1 Landscape Considerations
  - 9.2.2 Light Character
  - 9.2.3 Physical Character
  - 9.2.4 Mitigation
  - 7.2.5 Street Lighting
- 9.3 Maximum lux of Illumination
- 9.4 Preferred 'lights-off' Curfews

9.1 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

9.1.1 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]** **Pre-curfew**	**Light Intrusion (into windows) $E_{Verical}$ [lux]** **Post-curfew**	**Luminaire Intensity I [candelas]** **Pre-curfew**	**Luminaire Intensity I [candelas]** **Post-curfew**	**Building Luminance Pre-Curfew** **Average L [cd/m^2]**	**Dark Zone**
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.

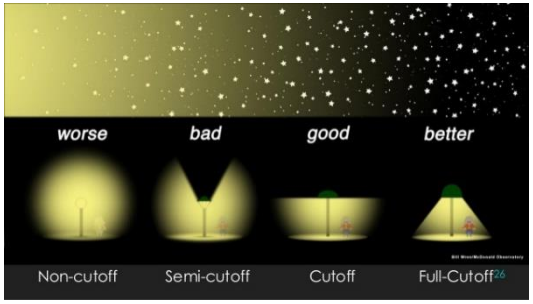
Ev = Vertical Illuminance in Lux - measured flat on the glazing at the centre of the window.

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

9.1.1.1 *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.

9.1.1.2 *Luminaire Intensity – Glare*

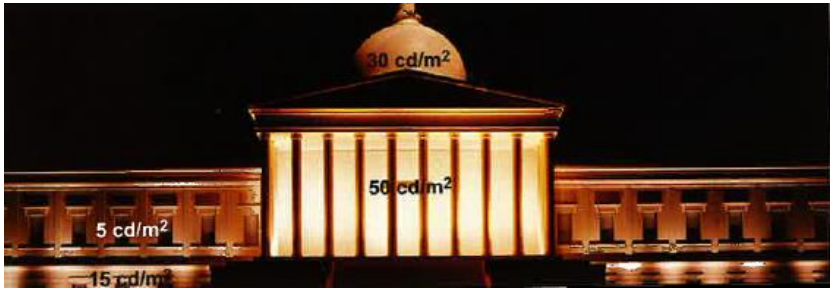
Direct visibility of lights should not be significantly noticeable. Light should be directed to where it is needed, with little of the source visible from surrounding areas. The effect of glare, as viewed by an external observer, is controlled by limiting the viewed intensity as described in Table 5.1.1. 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.

9.1.1.3 *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).

9.1.1.4 *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.

9.1.2 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/m^2. 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 (m^2)		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 m^2 and a size limit of 18.6m^2. 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)

9.2 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.

9.2.1 Landscape considerations

9.2.1.1 *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.

9.2.1.2 *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.

9.2.1.3 *Dark Sky Discovery Sites*

DARK SKY DISCOVERY

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.

9.2.1.4 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

9.2.1.5 *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.

9.2.1.6 *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.

9.2.1.7 *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.

9.2.1.8 *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

9.2.1.9 *Viewpoints*

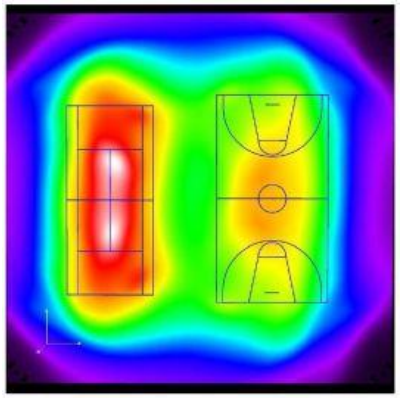
There are many key daytime viewpoints across and outside the park which serve both the daytime and night. Proposals should consider the impact on these viewpoints, particularly in regard to the disruption of the dark landscape continuity. As large scale developments are more likely outside the park,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

9.2.2 Light Character

9.2.2.1 *IDA - 500 Lumen Level*

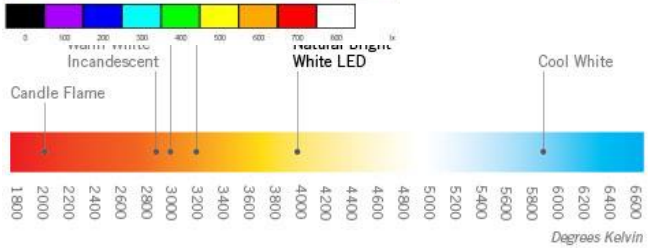
The lowest possible lumen output should be used to generate required lux levels. The International Dark-Sky Association require that any lights above 500 lumens be installed with fully cut-off (where light is prevented from travelling above the horizontal) or "shielded" luminaires particularly in isolated 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.

9.2.2.2 *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.

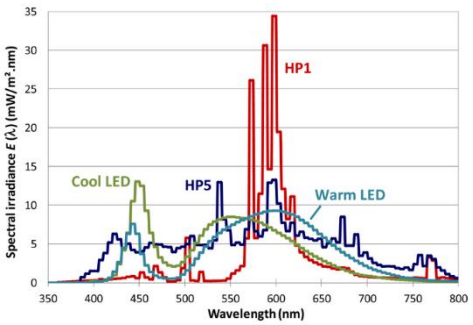
9.2.2.3 *Colour temperature, CCT*



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.

9.2.2.4 *Spectrum – Broadness and UV component*

Lights with a broad spectrum should be avoided to eliminate the spill of harmful Ultra-Violet which affects wildlife. Atmospheric light scattering makes the sky glow from artificial light at night. Violet-blue light (390 nm) scatters 16 times (780 nm). Many LEDs produce harsh, often over-bright blue-white light, atmosphere. This can cause more sky-glow than previous Warm Orange (low benefits of otherwise good downward direction of light may be negated by blue-glare. The result will be the veiling of the night sky, as excessive light from road emissions from private lighting, much of which has no directional light control, go and the sky from poorly designed lamps.



wavelengths, particularly in the blue in daytime but causes sky more than Warmer red light scattering high into the colour-temperature) lights: the richness, over-brightness and lamps reflects upwards; or directly into the environment

9.2.2.5 *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 9.2.3.1).
- Reduced daytime impact due to smaller fixtures
- Proximity sensors can be fitted

9.2.2.6 *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.

9.2.3 Physical Character

9.2.3.1 *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.

9.2.3.2 *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.

9.2.3.3 *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.

9.2.3.4 *Low Height Installation*

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.

9.2.3.5 *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)

9.2.4 Mitigation

9.2.4.1 *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.

9.2.4.2 *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.

9.2.4.3 *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.

9.2.4.4 *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.

9.2.5 Street Lighting

9.2.5.1 *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.

9.2.5.2 *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.

9.3 Maximum Lux – Maintained Average Illuminance

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 under-lit which will impact on dark skies and raise issues of health and safety.

The table below 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.

Illumination Example Types	Lux
Overcast day	1000
Internal General Office	500
Internal Professional Kitchen	500
Hockey	200
Equestrian	200
Tennis	200
Cricket	100
Football	75
Motorways	50
Public House Communal Areas	50
Family living room	50
Building Site - Rough work	50
Strategic Roads	30
Farm Yards	20
Distributor Roads	20
Domestic Security Lighting - Urban	20
Car Park - Urban	20
Link Roads	15
Car Park -Rural	15
Residential Roads	10
Safety and Security General Working Areas	10
Maximum Average Illuminance	10
Domestic Security Lighting - Rural	5
Limit of civil twilight	4
Smallest Subsidiary Roads (Domestic Areas)	2
Full Moon	1
Minimum emergency lighting	0.2
Dark Night Skies	0.002

TABLE - RECOMMENDED AVERAGE LUX ILLUMINATION LEVELS

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 **Error! Reference source not found.**.

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.

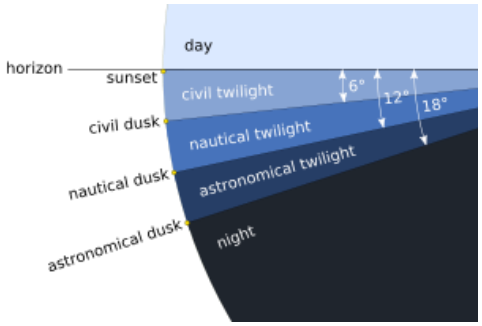
In some cases the level of required lux will be so great that the inherent surface illuminance will pose a significant threat to the dark skies landscape no matter how well the design meets all other criteria. Designs requiring an illuminance greater than 10 lux in most E1, E0 zones will produce this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

9.4 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.

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

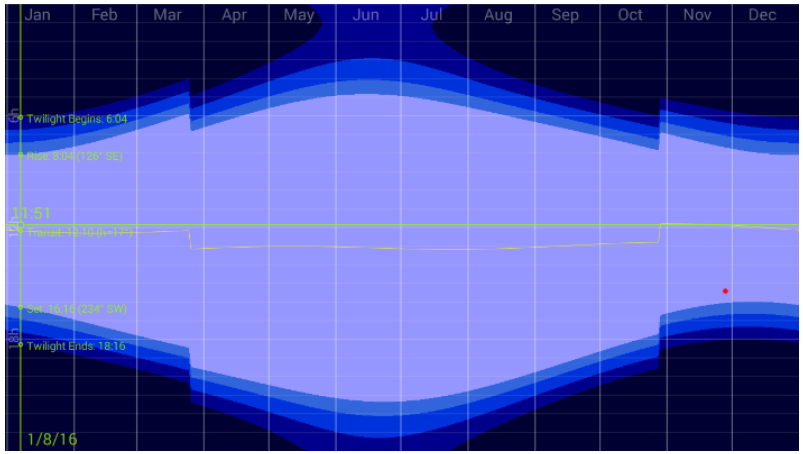
This curfew should be used in urban areas or where the skies are of not enough sufficient quality to be classed as intrinsically dark. Lights should still be extinguished when no longer required or at the end of business hours. Ideally, lights should be off as early as possible and for E3 zones, no later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

9.4.2 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

9.4.3 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.

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.

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.**

11 Examples – IDA Dark Sky Friendly Lighting

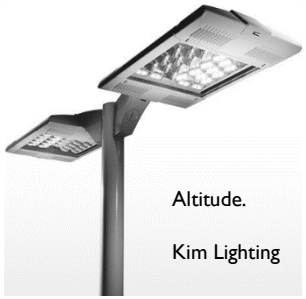
The IDA runs a Fixture Seal of Approval programme that certifies outdoor lighting fixtures as being Dark Sky Friendly, meaning that they minimise glare while reducing light trespass, sky glow and the amount of blue light in in the night time environment.

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

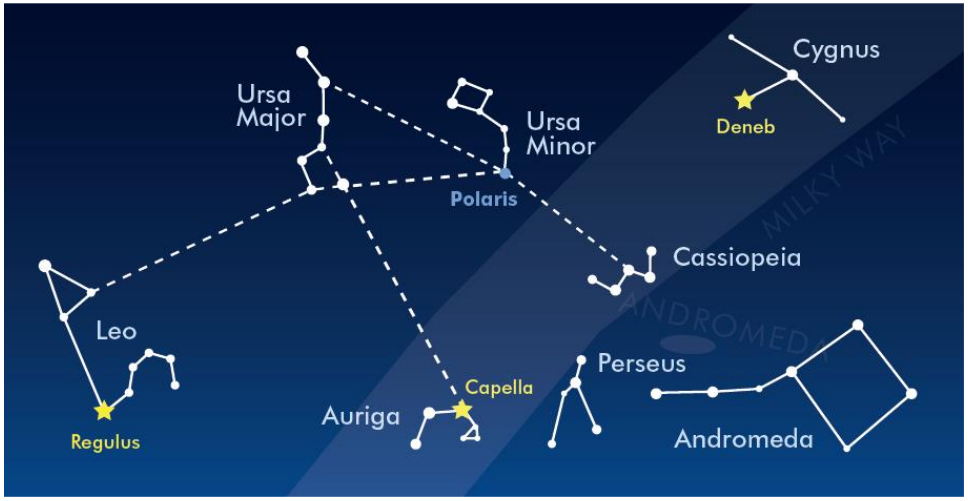
For ideas and examples http://www.darksky.org/fsa/fsa-products/

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

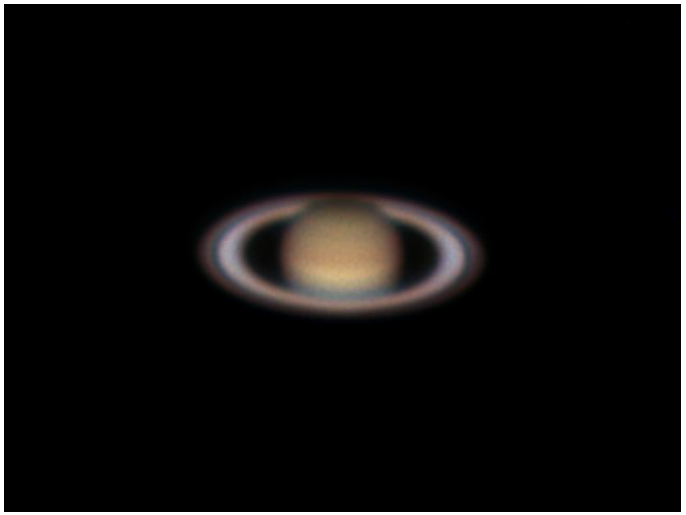
- Artificial Sports Lighting (2012)

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



EMBRACE THE DARKNESS