GUIDANCE NOTE 01/26

THE AVOIDANCE OF OBTRUSIVE LIGHT

Guidance Note

GN01/26

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The Avoidance of Obtrusive Light

This guidance note has been revised and supersedes GN01/21 to reflect, National Planning Policy Framework (NPPF) 2024 as well as industry comment regarding the assessment and definition of obtrusive lighting. It also now contains sample planning requirements for planners to apply with respect to application containing artificial light. This should be read alongside any Local Planning Policy or local guidance used by the Local Planning Authority relating to external lighting. This document draws upon the international guidance regarding obtrusive light as detailed in CIE 150; 2017 *Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations* [1].

Good lighting practice is the provision of the right light, at the right time, in the right place, controlled by the right system.

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

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

Upward Light from individual luminaires or complete lighting installations causes Sky glow, the brightening of the night sky.

Glare the uncomfortable brightness of a light source when viewed against a darker background.

Light spill the spilling of light beyond the boundary of the area being lit.

Light Intrusion ("Nuisance") [2] are all forms of obtrusive light which may cause nuisance to others, or adversely affect fauna & flora as well as waste money and energy.

[1] The copyright of the data detailed within this guide belongs to CIE, email ciecb@cie.co.at

This document should be used in conjunction with CIE 150:2017 and CIE 126:1997 and not as a replacement for the procedures contained therein.

These documents can be obtained from http://cie.co.at/publications and members of a National Committee of the CIE can purchase them with a discount of 66.7 %.

[2] The term light trespass has been used in the past and should no longer be referenced, trespass is to physically encroach on land and light can't do that, so the term nuisance or spill light should always be used.

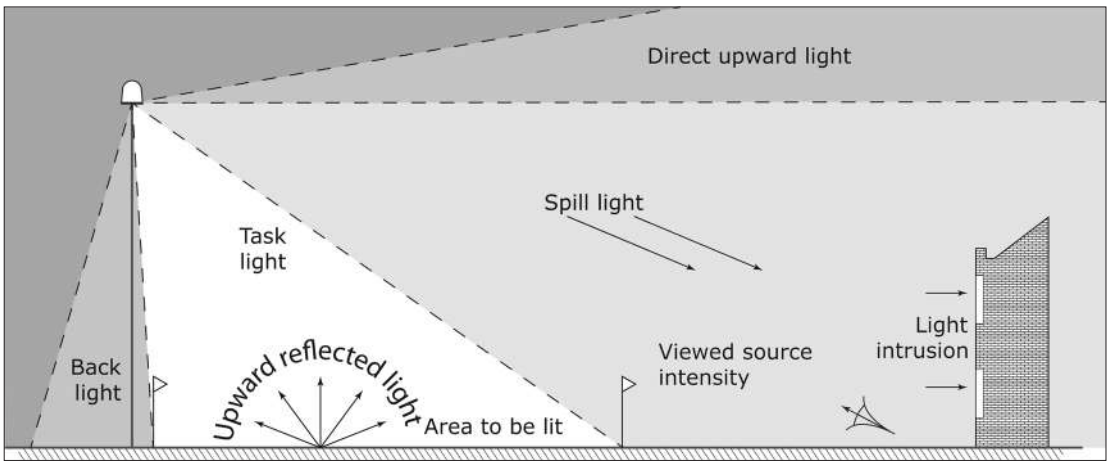


Figure 1: Types of obtrusive light

1. Considerations to be made

1.1 Think before you light. Is it necessary? What effect could it have on others? Has it the potential to cause a nuisance? How can you mitigate and manage any potential adverse effects from your lighting installation?

1.2 Effective management of light pollution requires both the protection of dark areas and the careful control of lighting in developed or urban locations. Without this dual approach, incremental increases in artificial lighting will continue to degrade environmental quality. Accordingly, developments in already lit areas must still demonstrate that lighting is necessary, proportionate and designed to minimise adverse effects.

1.3 There are published standards and guidance for the majority of lighting tasks adherence to which will help mitigate obtrusive lighting aspects. Organisations from which full details of these standards can be obtained are given later in this Guidance Note.

1.4 For the purpose of this Guidance Note the following two Commission Internationale De L'Eclairage (CIE) documents are specifically referenced which provide guidance to the mitigation of obtrusive light from exterior lighting installations.

- CIE 150: 2017 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations.
- CIE 126: 1997 Guidelines for Minimizing Sky Glow.

1.5 When considering any lighting installation then these two documents should be referenced and referred to.

1.6 Whilst this Guidance Note specifically considers the effects of external lighting installations the considerations within it can be relevant when considering modern office blocks and shop fronts where the main external facing structure is transparent and light from within the buildings could become a source of illumination to the exterior environment.

"Good Design Equals Good Lighting"

1.7 It cannot be stressed sufficiently that by employing a competent lighting designer with proved experience in the lighting application being considered will provide a suitable lighting installation where all obtrusive lighting aspects are mitigated [3].

1.8 Any lighting scheme consists of three basic elements: a light source, a luminaire (incorporating the optical control system) and a method of installation / mounting.

2. Light sources (Lamps / LEDs)

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

2.2 Most night-time visual tasks are only dependent on light radiated within the visual spectrum. It is therefore not necessary for light sources to emit either ultra-violet or infra-red radiation unless specifically designed to do so, the majority of light sources used in external lighting do not contain these wavelengths or where they are present their spectral power is very low.

2.3 Research indicates that light from the blue end of the spectrum could have significant adverse effects on fauna and flora. The lighting designer should consider the blue light spectral power of the light source and try to balance the needs of the task to be lit with any impact on fauna and flora within the environment.

2.4 It is noted that research concerning blue light and human circadian rhythms is being undertaken, as reported through the House of Lords Science and Technology committee report July 2023, these effects are still unclear and are perhaps more related to interior lighting that exterior. The management of obtrusive light will support any adverse health concerns.

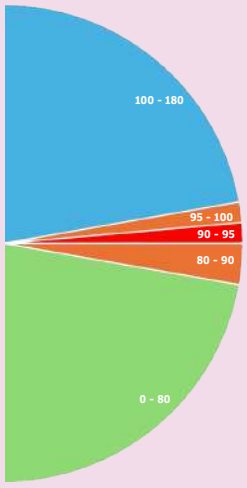
[3] Competency can be determined through membership of a professional lighting body supported by the appropriate qualifications and experience in the application of lighting required.

3. Luminaires

3.1 The choice of luminaire with the right optical distribution at the right mounting height is critical to minimising light spill and obtrusive light effects yet providing the right lighting performance on the task area.

3.2 Sky-glow is the general diffuse sheen that is visible in the direction of large cities, airports, and industrial complexes. It occurs from both natural and artificial light sources and does not depend exclusively on the lighting design. It also depends on the atmospheric conditions (humidity, aerosols, clouds, haze, atmospheric pollution, etc.). Light propagating into the atmosphere either directly from upward directed or incompletely shielded sources, or after reflection from the ground or other surfaces, is partially scattered back towards observers on the ground; the impact being shown in table 1.

Table 1: The effect on the ability to view the night sky at various angles



Indicative diagram

Angle of light emitted (degrees)	Sky glow effect
100 - 180	Critical area for skyglow experience from with urban and local areas but minimum impact to remote (rural) viewing areas.
95 - 100	Significant contributor to skyglow, especially in rural areas where it is mostly aerosol dependent, less likely to be obstructed.
90 - 95	Critical zone for skyglow at tens of km (in rural areas) where it is strongly dependent on aerosol scattering
80 - 90	Significant contributor to skyglow seen at a distance through reflection but reflected light is more likely to be obstructed by buildings, tress and topography [4].
0 - 80	Minimum, ideal light distribution

3.3 It is therefore important to consider the luminaire, its light distribution, how it is installed and how it is focussed or aimed.

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

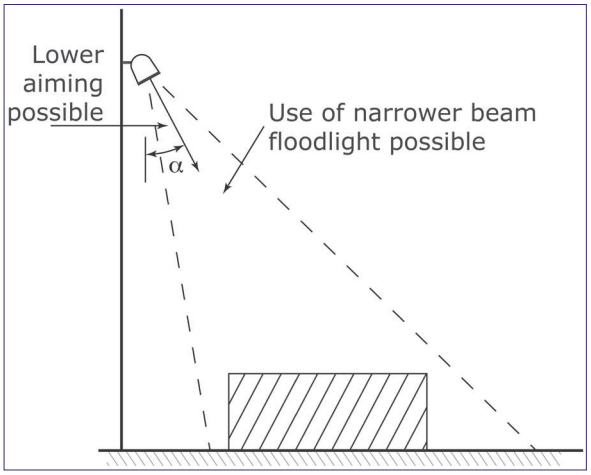
3.5 Appendices 1 and 2 to these notes gives more details of how to choose and if necessary, using louvers and shields modify luminaires.

[4] Reflected light is dependent upon climatic conditions and the natures of the many surfaces involved, their angle, reflectivity and moisture levels and is therefore very difficult to assess.

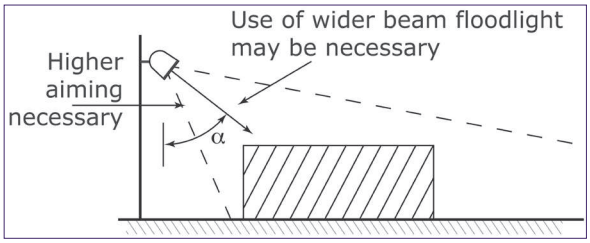
4. Installation

4.1 In most cases it will be beneficial to use as high a mounting height as possible, giving due regard to the daytime landscape appearance of the installation where columns / masts may be visible against the skyline.

4.2 It should be noted that a lower mounting height is perhaps not better as can be seen from figure 3 from CIE 150. Using a lower mounting height can create a higher level of light spill, glare and require additional lighting points. Higher mounting heights as shown in figure 2 from CIE 150 allow lower main beam angles, which can assist in reducing glare.



✓ *Figure 2: Higher mounting height – less spill light and glare*



✗ *Figure 3: Lower mounting height – more spill light and glare*

4.3 To minimise and sky glow effect and to keep glare to a minimum by ensuring that the main beam angle of all luminaires directed towards any potential observer is no greater than 70°. Luminaire optical distribution should always aim to ensure that the emitted light is below to horizontal as indicated in figures 4 and 5.

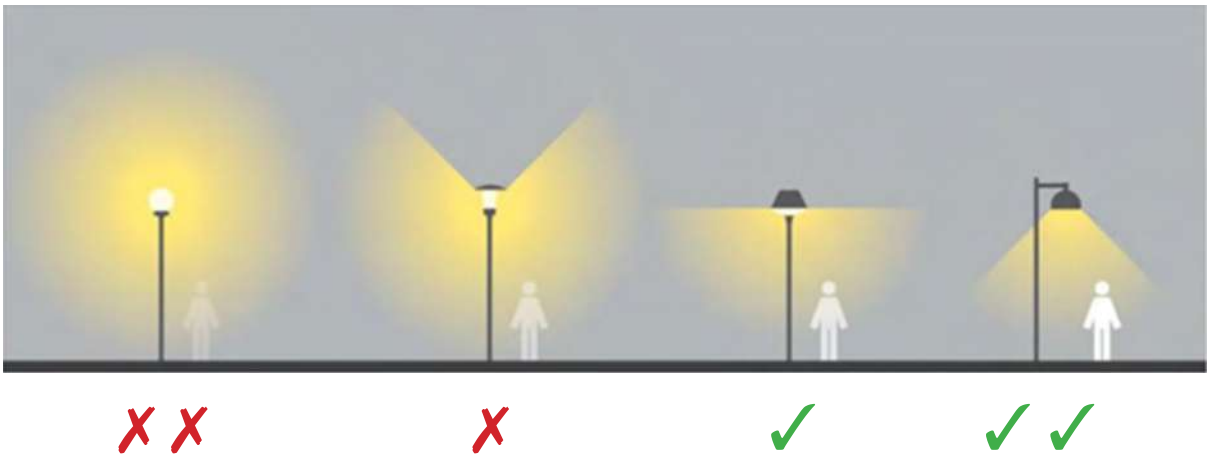


Figure 4: Luminaire aiming angles

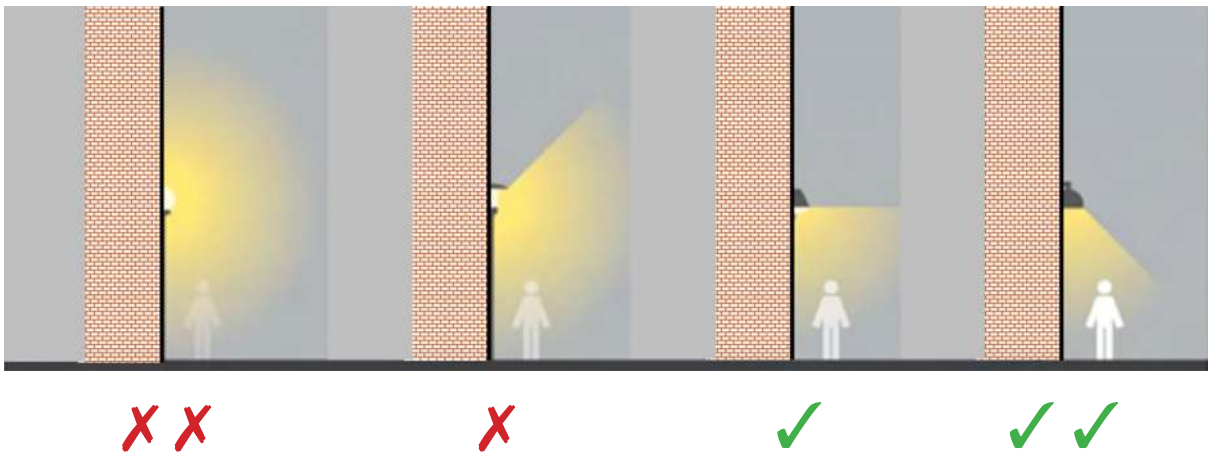


Figure 5: Bulkhead luminaire aiming angles

4.4 In areas with low ambient lighting levels, glare can be very obtrusive, and extra care should be taken when positioning and aiming lighting equipment. Regarding domestic security lighting the ILP produces an information leaflet GN09:2018 Domestic exterior lighting, getting it right! that is freely available from its website.

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

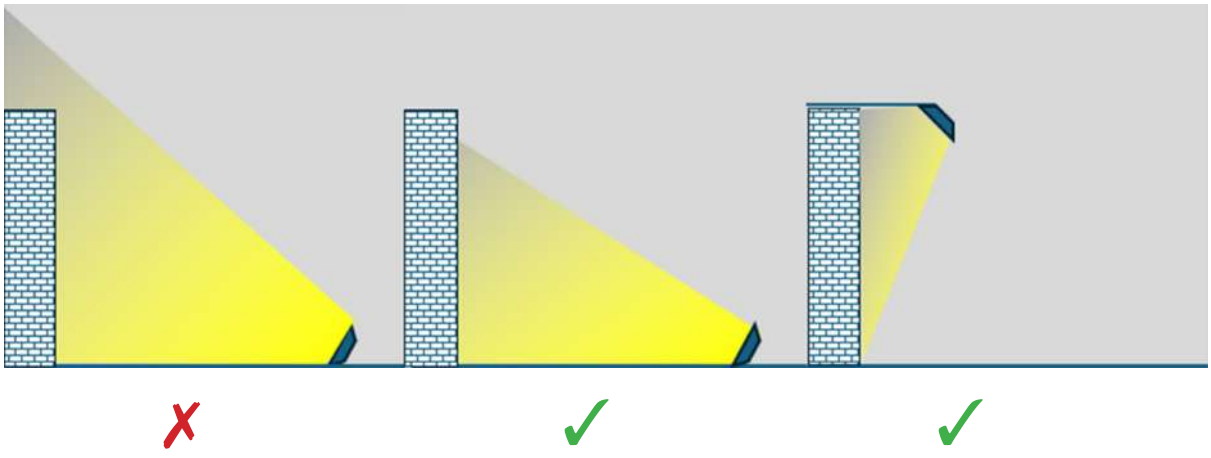


Figure 6: Façade illumination

4.6 For road and amenity lighting installations light near to and above the horizontal must be prevented to reduce glare and sky glow (Note the Upward Lighting Ratios (ULR's) advised in Tables 5 and 6). In rural areas the use of full horizontal cut off (G4 to 6) luminaires installed at 0° uplift will, in addition to reducing sky glow, also help to minimise visual intrusion within the open landscape. However, in some urban locations, luminaires fitted with a more decorative bowl and good optical control of light should be acceptable and may be more appropriate.

5. Clean Neighbourhoods and Environment Act (CNEA) 2005

5.0.1 The Clean Neighbourhoods and Environment Act (CNEA) 2005 gives Local Authorities and the Environment Agency within England and Wales additional powers to deal with a wide range of issues by classifying artificial light emitted from defined premises as a statutory nuisance.

5.0.2 The CNEA 2005 amended section 79(1) of the Environmental Protection Act 1990 to extend the statutory nuisance regime to include light nuisance stating the following.

> *'(fb) artificial light emitted from premises so as to be prejudicial to health or a nuisance'.*

5.0.3 Guidance produced on Sections 101 to 103 of the CNEA 2005 by DEFRA (DEFRA, April 2006) extends the duty on local authorities to ensure their areas are checked periodically for existing and potential sources of statutory nuisances including nuisances arising from artificial lighting. Local authorities must take reasonable steps to investigate complaints of such nuisances from artificial light. Once satisfied that a statutory nuisance exists or may occur or recur, local authorities must issue an abatement notice (in accordance with section 80(2) of the Environmental Protection Act 1990), requiring that the nuisance cease or be abated within a set timescale.

5.0.4 The CNEA contains several premises that are exempt for the legalisation. This means that a case of statutory nuisance cannot be brought against such premises. In such instances the complaint can look to raise a case of nuisance under Common Law.

5.0.5 Common law nuisance is a legal concept that addresses actions which unreasonably interfere with another person's use and enjoyment of their land or property.

5.0.6 A private nuisance is a tort action, meaning it's a civil claim. The claimant can seek an injunction to stop the nuisance and/or damages to compensate for their loss. The interference must be unreasonable to be considered a nuisance.

5.0.7 To establish a light nuisance under common law, the interfering light must be more than just an annoyance; it must significantly impact the affected property's use and enjoyment, potentially causing unreasonable interference or even health concerns.

5.1 Scotland

5.1.1 In Scotland Section 110 of the Public Health etc. (Scotland) Act 2008 was introduced as an amendment to the Environmental Protection Act 1990 to include artificial light. The approach is generally similar to England and Wales and covers artificial light from premises or a stationary object. Exemptions apply to light houses which are occupied on behalf of the Crown or a visiting force for naval, military or air force purposes or for the purposes of the department of the Secretary of State having responsibility for defence.

6. National Planning Policy Framework (NPPF)

6.1 The NPPF was introduced as a more concise and useable planning document to aid developers and designers in the design and construction of developments within the UK.

6.2 The National Planning Policy Framework 2024 makes little reference to lighting regarding the control of obtrusive light with paragraphs 198 and 200 making reference, which states:

> *'Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:…*
>
> *c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.'* (NPPF, Paragraph 198, 2024)

6.3 The NPPF includes the "agent of change" principle is set out in paragraph 200 of the NPPF, which requires that:

> "*Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."*

6.4 In essence this means that, for example if a development is proposed adjacent to an existing illuminated premises whose lighting could be considered as a nuisance to residents of the proposed development, that the applicant must design the development or look to other mitigations to ensure this does not occur. New residents should not effectively 'come to a nuisance'.

7. National Planning Policy

7.1 The national on-line planning guidance resource looks at when lighting pollution concerns should be considered.

7.2 The guidance provides a high-level overview for planners with links to a few appropriate documents to give planners an overview of the subject through seven discussion points as follows:

i. When is light pollution relevant to planning?

ii. What factors should be considered when assessing whether a development proposal might have implications for light pollution?

iii. What factors are relevant when considering where light shines?

iv. What factors are relevant when considering when light shines?

v. What factors are relevant when considering how much the light shines?

vi. What factors are relevant when considering possible ecological impact?

vii. What other information is available that could inform approaches to lighting and help reduce light pollution?

7.3 It is to be hoped that whilst the guide does not specifically require it that Planners will consider the application of artificial light and look to consult with lighting designers to aid them. The planners can then be advised on the planning conditions that might be applicable for each project and to review any submissions to determine if the planning conditions have been met.

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

8. Lighting Environmental Zones

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

Table 2: Lighting Environmental zones

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

Note 1 The environmental zone can be defined by using the relevant guidance however the designation of the environmental zone is ultimately the decision of the local authority in conjunction with a competent lighting professional.

Note 2 Where an area to be lit lies close to the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone (see adjacent zone considerations).

Note 3 Rural zones under protected designations should use a higher standard of policy.

Note 4 Zone E0 must always be surrounded by an E1 Zone.

Note 5 Zoning should be agreed with the local planning authority and due to local requirements a more stringent zone classification may be applied to protect special / specific areas.

Note 6 The previous edition of GN01 included the consideration of SQM (Sky Quality Meter) assessments, this has been removed in the update due to the rigorous assessment periods involved to determine a detailed assessment which can extend to over a year.

9. Adjacent Zone Considerations

9.1 As advised in note 1 to table 2 where an area to be lit lies within visual distance of the boundary between two zones then the obtrusive light values applicable to the most rigorous zone shall apply. Figure 5 demonstrates this, for an observer located within or at the boundary of a more rigorous zone (E(X-1)) compared to the adjacent less rigorous zone (E(X)) then when the observer faces the less rigorous zone they will only be exposed to obtrusive lighting level pertinent to the zone within which they are located.

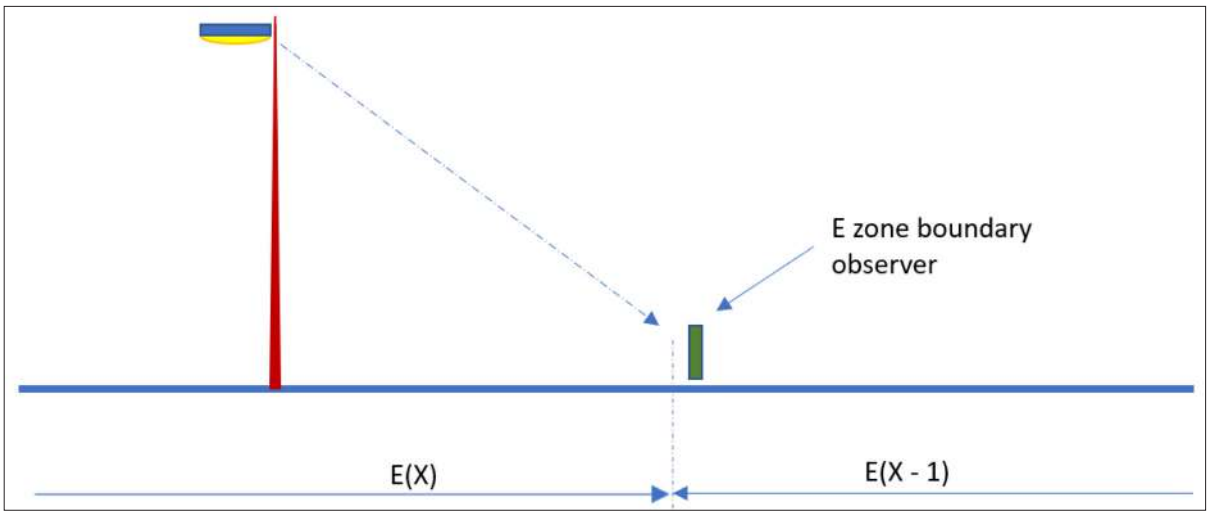


Figure 7: boundary zone considerations

10. Design Guidance

10.1 The following limitations based upon CIE 150 may be supplemented or replaced by a LPA's own planning guidance for exterior lighting installations. As lighting design is not as simple as it may seem, you are advised to consult and/or work with a competent professional lighting designer when considering any exterior lighting.

11. Recommended Maximum Values of Light Parameters for the Control of Obtrusive Light

11.1 Limitation of illumination on surrounding premises

11.1.1 Light intrusion / nuisance

Table 3 (CIE 150 table 2): Maximum values of vertical illuminance on premises

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

11.1.1.1 Limits apply to nearby premises or potential premises and specifically windows, the values are the summation of all proposed and existing lighting installations that contribute to light on the window.

11.1.1.2 It is essential that a base line position is established so the potential impact of any new scheme can be determined or the impact of existing lighting on a new development can be established.

11.1.1.3 To reduce the potential for adverse increases in obtrusive light for residential amenity receptors through light spill onto windows, increases in vertical illuminance should not exceed the baseline by more than 50%, or the Environmental Zone limit (whichever is lowest).

11.1.2 Spill light

11.1.2.1 Table 3 can also be considered for the management of spill light; however, designers must consider the task performance requirements of any adjacent lit areas and ensure that any spill light does not adversely affect these performance parameters as this could affect their safe use. This may result in a need to minimise spill and intrusive lighting values to less that might be expected for the Environmental Zone within which the installation lies.

* Curfew: The time after which stricter requirements (for the control of obtrusive light) will apply; often a condition of use of lighting applied the local planning department. Depending upon application curfew times often commence between 21:00 to 23:00 and may run until 07:00. However, exact curfew hours should be carefully applied to ensure the reduction of obtrusive light is prioritised within the immediate environment and towards sensitive human as well as fauna and flora receptors.

11.2 Limitation of bright luminaires in the field of view

11.2.1 The limits for the luminous intensity of bright luminaires are dependent on the viewing distance *d*, (between the observer and the bright luminaire(s)) and the projected area A_p, of the bright part of the luminaire in the direction of the observer.

11.2.2 Table 4 shows the maximum values for the luminous intensity of luminaires in designated directions where views of bright surfaces of luminaires are likely to be a nuisance to occupants of premises or, from positions where such views are likely to be maintained, i.e. not for momentary or short-term viewing is involved.

Table 4 (CIE 150 table 3): Limits for the luminous intensity of bright luminaires [5]

Light technical parameter	Application conditions	Luminaire group (projected area A_p in m²)					
		$0<A_p \leq 0.002$	$0.002<A_p \leq 0.01$	$0.01<A_p \leq 0.03$	$0.03<A_p \leq 0.13$	$0.13<A_p \leq 0.50$	$A_p > 0.5$
Maximum luminous intensity emitted by luminaire (*I* in cd)[5]	E0 Pre-curfew Post-curfew	 0 0	 0 0	 0 0	 0 0	 0 0	 0 0
	E1 Pre-curfew Post-curfew	 0.29 *d* 0	 0.63 *d* 0	 1.3 *d* 0	 2.5 *d* 0	 5.1 *d* 0	 2,500 0
	E2 Pre-curfew Post-curfew	 0.57 *d* 0.29 *d*	 1.3 *d* 0.63 *d*	 2.5 *d* 1.3 *d*	 5.0 *d* 2.5 *d*	 10 *d* 5.1 *d*	 7,500 500
	E3 Pre-curfew Post-curfew	 0.86 *d* 0.29 *d*	 1.9 *d* 0.63 *d*	 3.8 *d* 1.3 *d*	 7.5 *d* 2.5 *d*	 15 *d* 5.1 *d*	 10.000 1,000
	E4 Pre-curfew Post-curfew	 1.4 *d* 0.29 *d*	 3.1 *d* 0.63 *d*	 6.3 *d* 1.3 *d*	 13 *d* 2.5 *d*	 26 *d* 5.1 *d*	 25,000 2,500

Note 1 *d* is the distance between the observer and the glare source in metres

Note 2 A luminous intensity of 0 cd can only be realised by a luminaire with a complete cut-off in the designated directions

Note 3 A_p is the apparent surface of the light source seen from the observer position

Note 4 For further information refer to Annex C of CIE 150

Note 5 Upper limits for each zone shall be taken as those with column $A_p>0.5$

[5] Amended based upon the approach taken by NSVV Nederlandse Stichting Voor Verlichtingskunde (Dutch: Dutch Foundation for Illumination; The Netherlands) and to consider CIE150 Annex C Table C.2

11.2.3 Considerations to aid the application of Table 4 and the assessment process.

a) The assessment of Ap for observers can prove difficult and will vary for all observer positions and distances.

b) The above information is applicable for the consideration of a single luminaire but where two or more luminaires are located in close proximity to each other that to the observer they appear as a single light source then the assessment shall be undertaken based upon the combined bright surfaces of luminaires (Ap) in the direction of the observer or, from positions where such views are likely to be maintained.

c) In installations that involve mast lighting the luminaires will often be viewed against the night sky. The contrast between the background sky and the bright surface areas of the luminaires can be considerable. In such installations the curfew levels set for each environmental zone shall be applied with the exception that such installations within an E4 zone will be designed to suit the curfew requirements of an E3 zone.

11.2.4 Appendix 3 provides a supplementary guidance to aid the application and use of Table 4.

11.3 Limitation of the effects on transport systems

11.3.1 Limits apply where users of road networks are subject to a reduction in the ability to see essential information. CIE 150 2017; Table 4 gives values that are for relevant positions and for viewing directions in the path of travel.

11.3.2 This assessment does not just apply to road lighting installations but to any installation where luminaires positioning falls under the above definition i.e. luminaires visible from the road network.

11.3.3 For non-road lighting installations where Ti can't be established look to GN01 Table 4 source intensity limitations.

Table 5 (CIE 150; table 4): Maximum values of Threshold Increment and viewing direction in the path of travel

Light technical parameter	Road classification[1]			
	No road lighting	M6 / M5	M4 / M3	M2 / M1
Veiling luminance[2] (L_v)	0.037 cd/m²	0.23 cd/m²	0.40 cd/m²	0.84 cd/m²
Threshold Increment	15% based on adaption luminance of 0.1 cd/m²	15% based on adaption luminance of 1.0 cd/m²	15% based on adaption luminance of 2.0 cd/m²	15% based on adaption luminance of 5 cd/m²

Note 1 Road classifications as given in CIE 115:2010

Note 2 The veiling luminance values specified in this table are based upon on a permissible TI value of 15%

11.3.4 *Definitions:*

TI The measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare, the reduction in visibility caused by intense light sources in the field of view.

L_v The luminance that would need to be superimposed on a scene in object space to reduce the scene's contrast by an amount equal to the added retinal illuminance from scattered light on the scene's retinal image. It is most commonly used to describe the contrast-reducing effect of a glare source in the field of view.

11.4 Limitation of skyglow

Table 6 (CIE 150 table 5): Maximum values of upward light ratio (ULR) of luminaires

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

Note 1 This is the primary approach to limit skyglow and is suitable to compare different single luminaires and mitigate the contribution of each luminaire within an installation.

Note 2 This does not take into account the effect of light reflected upwards from ground that also contributes to skyglow.

Note 3 Research indicates that light sources with a high colour temperature / blue light emission spectrum can contribute to skyglow to a greater degree than those with a lower colour temperature.

Note 4 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 cumulative upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

Note 5 Protected and dark sky places may require zero ULR which may include E2 zones.

Table 7 (CIE 150 table 6): Maximum values of upward flux ratio of installation (of four or more luminaires)

Light technical parameter	Type of installation	Environmental zones				
		E0	E1	E2	E3	E4
Upward flux ratio (UFR) / %	Road	0	2	5	8	12
	Amenity	0[5]	0	6	12	35
	Sports	0[5]	0[5]	2	6	15

11.4.1 Table 7 allows the effect of both direct and reflected upward components of a whole installation to be considered. The factor being the upward flux ratio (UFR).

11.4.2 This should only be considered where an installation consists of four or more luminaires that form an installation with a defined performance requirement or specialised fauna growth lighting systems (such as those use to promote grass growth in sports stadia) and is in proximity to:

- Optical observatories
- Lies within dark (E1) zones which abuts a protected (E0) dark sky zone

Note 1 The effect of distance must be considered which is a factor of the artificial lighting installation size, a small lighting installation will have an effect on an optical observatory 30km away whereas a large lighting installation of many luminaires will have an effect from a greater distance up to 100km. Specific guidance is given in CIE 126 and CIE 150.

Note 2 All external surfaces will have varying reflectance's depending upon their condition and climatic conditions (wet, dry, frost etc,) as well as their varying angles so the level of uncertainly in any assessment may be considerable.

Note 3 In urban areas such light is more likely to be obstructed by buildings, trees and topography.

Note 4 Reflected light is dependent upon climatic conditions and the nature of the many surfaces involved, their angle, reflectivity and surface moisture levels and is therefore very difficult to assess.

Note 5 Such installations would not be expected within these lighting environmental zones.

11.4.3 Clauses 6.4.2 and 6.4.3 of CIE 150; 2017 describe the calculation methods for both ULP and UFR.

11.4.4 As discussed in Table 1 light emitted just above the horizontal in a zone between 80° and 110° is extra critical for sky glow in large open areas around

observatories. An additional measure in these areas limits the luminous intensities (I_{80} – I_{110}) as follows:

- Between 80° and 90° < 2.0 cd/ 1000lm
- Between 90° and 100° < 0.5 cd/1000lm
- Between 100° and 110° 0 cd (0.5% of total luminaire lumens for bollard luminaires)

Note All proposed luminaires must have been photometrically measured so that results can be verified for Gamma angles 0 to 180°.

11.5 Limitations of the effect of over-lit building facades and signs

11.5.1 Table 8 provides recommendations regarding luminance values that provide visibility in order that a balanced urban lighting master plan can be considered, and such lighting does not cause negative impacts such as a continuous increase in the lighting levels (ratcheting) between buildings and within areas and light pollution.

11.5.2 Illuminated advertising signage and digital displays should be assessed as advised in the Institutions Professional Lighting Guide (PLG) number 5 (PLG05) The brightness of illuminated advertisements including digital displays.

Table 8 (CIE 150 table 7): Maximum permitted values of average surface luminance

Light technical parameter	Application conditions	Environmental zones				
		E0	E1	E2	E3	E4
Building façade luminance (L_b)	Taken as the product of the design average illuminance and reflectance divided by π	< 0.1 cd/m²	< 0.1 cd/m²	5 cd/m²	10 cd/m²	25 cd/m²
Sign luminance (L_s)	Taken as the product of the design average illuminance and reflectance divided by π, or for self-luminous signs, its average luminance	< 0.1 cd/m²	50 cd/m²	400 cd/m²	800 cd/m²	1.000 cd/m²

Note The values apply to both pre- and post-curfew, except that in Zones 0 and 1 the values shall be zero post curfew. The values for signs do not apply to signs for traffic control purposes.

11.5.3 For illuminated advertising signs and digital media displays the requirements advised in PLG05 tables 10.4 Recommended maximum night-time permitted values of display luminance and 10.5 recommended maximum daytime permitted values of sign luminance shall be applied.

12. Relevant Publications and Standards

12.1 British Standards

BS 5489-1: Code of practice for the design of road lighting – Part 1 Lighting of roads and public amenity areas

BS EN 13201-2: Road lighting; Part 2: Performance requirements

BS EN 13201-3: Road lighting; Part 3: Calculation of performance

BS EN 13201-4: Road lighting; Part 4: Methods of measuring lighting performance

BS EN 12193: Light and lighting; Sports lighting

BS EN 12464-2: Lighting of work places; Outdoor work places

PD CEN TR 13201-1: Road lighting; Guidelines on selection of lighting classes

BS EN 12464-2: Light and lighting; Lighting of work places; Part 2 Outdoor work places.

12.2 CIE publications

001 Guidelines for minimizing urban skyglow near astronomical observatories

CIE 094-1993 Guide for flood lighting

CIE 112-1994 Glare evaluation system for use within outdoor sport and area lighting

CIE 115:2010 Lighting of roads for motor and pedestrian traffic

CIE 126:1997 Guidelines for Minimising Sky Glow

CIE 129:1998 Guide for lighting exterior working areas

CIE 136:2000 Guide to the lighting of urban areas

CIE 150:2017 Guide on the Limitation of the Effects of Obtrusive Light from Outdoor Lighting Installations

CIE 169:2005 Practical design guidelines for the lighting of sport events for colour

12.3 ILP publications

PLG 04 Guidance on undertaking environmental lighting impact assessments

PLG 05 The brightness of illuminated advertisements including digital displays

PLG 06 Guidance on seasonal decorations and lighting column attachments

GN09 Domestic Security Lighting: Getting it right!

12.4 SLL / CIBSE Publications

LG 01: The industrial environment

LG 04: Sports lighting

LG 06: The exterior environment

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

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13. Acknowledgements

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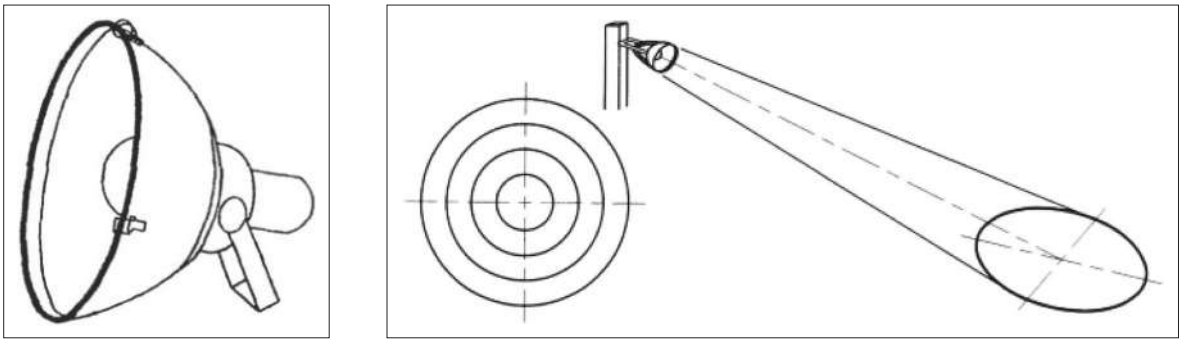
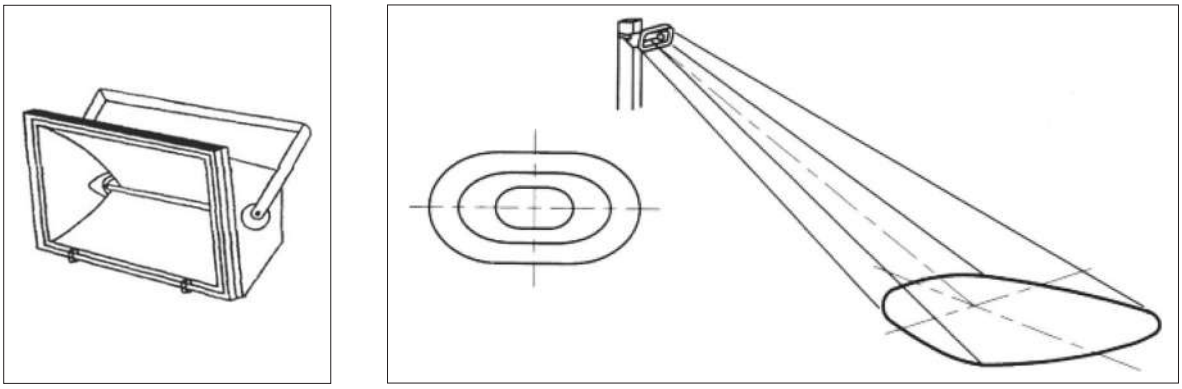
14. Appendix 1

14.1 Outdoor luminaire classification system

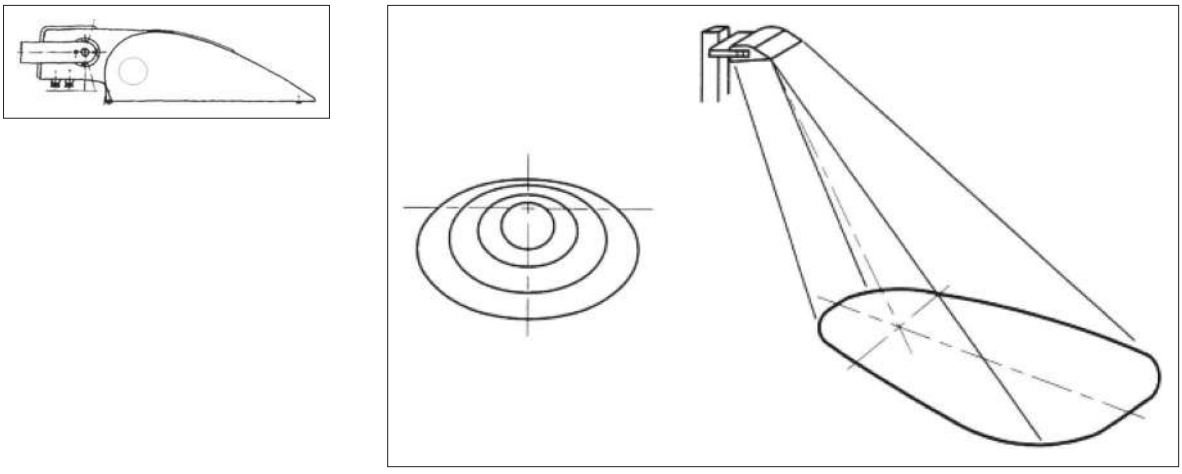
14.1.1 Based upon CIE 150:2017 and for the purpose of this and associated documents the following figures illustrate the luminaire classification (CIE 150:2017)



Type A flood light / projector producing a symmetrical beam



Type B flood light / projector producing a fan-shaped beam



Type C flood light / projector producing a double asymmetric distribution in the vertical plane

15. Appendix 2

15.1 Illustrations of luminaire accessories for limiting obtrusive light

Luminaire with cowl, hood & shield

With louvre

With cowl

16. Appendix 3

16.1 Sample planning requirements

16.1.1 The following is the core information that Planners should request when considering any application where external lighting is being proposed. It should be supplied by a competent lighting designer / professional in compliance with the Construction (Design and Management Regulations (CDM).

16.1.1.1 The lighting scheme submission shall include but not be limited to:

a) Details of adherence to best practice lighting standards for the tasks being lit.

b) Details of adherence to obtrusive lighting mitigation and controls to comply with:

(i) ILP Guidance note GN01/25 The reduction of obtrusive light, relevant to the lighting environmental zone.

(ii) ILP Professional Lighting Guide PLG05/ Brightness of illuminated advertisements including digital displays, relevant to the lighting environmental zone.

c) Purpose and functions of proposed lighting and the uses it supports e.g. for recreation facilities.

d) Lighting design details including:

(i) Plan(s) detailing all proposed artificial lighting, including but not limited to luminaire locations, mounting heights, tilts, aiming angles, luminaire light sources, specifications and control system details.

(ii) A illuminance (lux) plan(s) for the lit areas showing conformance with the required lighting standards for the task areas being illuminated.

(iii) Where required under the Standards, luminance (cd/m^2) calculations(s) for the lit areas showing conformance with the required lighting standards for the task areas being illuminated.

(iv) Curfew details of areas where the task lighting will be adapted, turned off or lighting levels reduced due to a change in task activity or event ending.

e) Lighting obtrusive / environmental impact design details (design maintenance factor set to unity (1.0)), pre- and post-curfew where a curfew is proposed, to include:

(i) Illuminance (lux) plan(s) for all the lit areas including spill light assessments, iso-contours at regular levels down to 0.5 lux, no maximum limit imposed.

(ii) Source intensity calculations for all existing (external to development) and potential sensitive receptors (within the development).

(iii) Vertical illuminance contour plan(s) for areas with sensitive receptors such as windows of premises, iso-contours at regular levels down to 0.5 lux.

(iv) Details of any proposed screening measures towards areas with sensitive receptors.

f) Details of how the lighting scheme will avoid / mitigate any potential biodiversity impacts arising from the installation or operation of the proposed lighting (in accordance with ILP GN08) with regard to priority habitats and sensitive species identified around the site, including light source colour temperature, colour rendering index, tuneable LED sources etc.

g) Details of all illuminated advertisements and digital media displays, evidencing compliance with ILP PL05 including luminance, curfews, optical control and for digital displays the images formats to be displayed.

16.1.1.2 The relevant Plot or area of Open Space shall not be Occupied until the approved lighting scheme in respect of it has been carried out in accordance with the approved details and the lighting forming part of the Plot or area of Open Space shall be retained as approved thereafter.

16.2 Discharging the planning consent

16.2.1 Once the lighting has been installed and commissioned, a lighting planning condition is normally discharged by demonstrating "asbuilt compliance".

16.2.2 This should be provided by the lighting designer, and it should include:

- Condition number and wording.
- A clear statement that the installed lighting complies with the condition.
- That a post lighting performance assessment / survey has been undertaken confirming all operational photometry performance parameters.
- Reference to approved drawings / documents (if applicable).
- Confirmation that no unauthorised changes to the design and operation of the installation have occurred, this includes aspects such as luminaire substitution, mounting arrangements, light performance control system etc.

16.3 Vehicle external lights

16.3.1 The subject of vehicle external lights (head, daytime running, side lights, rear and brake lights) comes up regularly in discussions regarding disability and discomfort glare to other road users. In addition, it occasionally is raised regarding obtrusive lighting considerations for observers within premises or impacts on sensitive ecology features.

16.3.2 Whilst the scope of this document is limited to fixed and permanent light sources, used for the purpose of lighting the night-time environment responsibly, it is important to explain the complexities around vehicle headlights. As vehicle headlights are a legal requirement in the UK, requirements for their performance is outside the scope of his document.

16.3.3 The vehicle-to-vehicle topic has become a global concern but shows little sign of early resolution as vehicle manufacturers further adopt LED technologies together with automatic control systems that, for example switch between high and main beam. Unless disabled the control of the lighting has effectively been removed from the driver. It might be expected that the optical distribution of all vehicle head lights should be the same, but research shows that this is not the case. The optical distribution of head lights varies greatly from make to make and model to model. In addition, from a light source perspective a wide range of colour temperatures are being used.

16.3.4 From the perspective of how we consider obtrusive light (artificial light affecting someone's enjoyment of their premise) vehicle head lights cannot be considered. Unless the vehicle is stationary, they are a mobile light source so the level of intensity, illuminance, glare on an observer is constantly changing and as a result any adverse effect or concern is more momentary than for a duration.

17. Appendix 4

17.1 Supplementary guidance

17.1.1 Limits for the luminous intensity of bright luminaires

17.1.1.1 The ILP's Guidance notes for the reduction of obtrusive light 2011 and CIE 150:2003 only advised of a single limiting luminaire intensity based upon an environmental zone and pre / post curfew assessment. This approach did not take into consideration the fact that intensity is a factor of illuminance at the observer multiplied by the square of the distance to the source. As we know the illuminance received is factor of the inverse square law as well as the size of the source.

17.1.1.2 GN01/20 superseded by GN01/21 as well as CIE 150:2017 now take this into consideration but with few exceptions lighting design software has had yet to catch up with the requirements.

17.1.1.3 The assessment of intensity as advised within it Table 4 has been developed to assist the competent professional lighting designer in making the considerations necessary. At this time and until software is available to assist the designer they must make their best professional judgement and undertake some manual assessments, calculations and reviews based upon software that is currently available to determine compliance or otherwise with intensity limits and values.

This should be considered as follows:

17.1.2 *Observer position (d)*

17.1.2.1 The closest observer position will be the most onerous, so for any given installation determine where the most realistic closest maintained observer position will be. This is where the luminous intensity will be greatest, and should therefore set the limiting assessment value.

17.1.3 *Determine the luminaire group (projected area A_p)*

17.1.3.1 As can be seen in Image 1, whilst all the luminaires are of the same size, their apparent projected area A_p is different for each one from a single observer position.

Image 1: Change in projected area based upon observer position

17.1.3.2 In general, for the same observer distance (d) a luminaire with a smaller A_p will cause the greater concern regarding luminous intensity.

17.1.3.3 Where the designer knows the expected A_p of the installed luminaire then this figure can be used to determine the luminaire group in Table 4. Where this factor is unknown then the bottom three rows of table 4 (amended below) are provided as an aid to gauging A^p and are based upon CIE 150:2017 Annex C. This approach groups ranges of luminaires by diameter, extracts a geometric mean diameter for each group and provides a corresponding A_p for application (if your luminaire is square then you will need to do a calculation based upon area), so this can be used to assign the luminaire group. Whilst this is for circular luminaires the designer will need to make their best professional judgement for all shapes of luminaires and the expected A_p towards each observer.

Table 4 (CIE 150 Table 3 (amended)), limits for the luminous intensity of bright luminaires[6]

Light technical parameter	Application conditions	Luminaire group (projected area A_p in m²)					
		$0<A_p \leq 0.002$	$0.002<A_p \leq 0.01$	$0.01<A_p \leq 0.03$	$0.03<A_p \leq 0.13$	$0.13<A_p \leq 0.50$	$A_p > 0.5$
Maximum luminous intensity emitted by luminaire (*I* in cd)[5]	E0 Pre-curfew Post-curfew	 0 0	 0 0	 0 0	 0 0	 0 0	 0 0
	E1 Pre-curfew Post-curfew	 0.29 *d* 0	 0.63 *d* 0	 1.3 *d* 0	 2.5 *d* 0	 5.1 *d* 0	 2,500 0
	E2 Pre-curfew Post-curfew	 0.57 *d* 0.29 *d*	 1.3 *d* 0.63 *d*	 2.5 *d* 1.3 *d*	 5.0 *d* 2.5 *d*	 10 *d* 5.1 *d*	 7,500 500
	E3 Pre-curfew Post-curfew	 0.86 *d* 0.29 *d*	 1.9 *d* 0.63 *d*	 3.8 *d* 1.3 *d*	 7.5 *d* 2.5 *d*	 15 *d* 5.1 *d*	 10.000 1,000
	E4 Pre-curfew Post-curfew	 1.4 *d* 0.29 *d*	 3.1 *d* 0.63 *d*	 6.3 *d* 1.3 *d*	 13 *d* 2.5 *d*	 26 *d* 5.1 *d*	 25,000 2,500
Aid to gauging A_p Luminaire diameter		**2 to 5 cm**	**5 to 10 cm**	**10 to 20 cm**	**30 to 40 cm**	**40 to 80 cm**	**>80 cm**
Geometric mean of diameter (cm)		3.2	7.1	14.1	26.3	56.6	>80
Corresponding A_p representative area (m²)		0.0008	0.004	0.016	0.063	0.251	>0.5

Note 1 *d* is the distance between the observer and the glare source in metres

Note 2 A luminous intensity of 0 cd can only be realised by a luminaire with a complete cut-off in the designated directions

[6] Amended based upon the approach taken by NSVV Nederlandse Stichting Voor Verlichtingskunde (Dutch: Dutch Foundation for Illumination; The Netherlands) and to consider CIE150 Annex C Table C.2

Note 3 A_p is the apparent surface of the light source seen from the observer position

Note 4 For further information refer to Annex C of CIE 150

Note 5 Upper limits for each zone shall be taken as those with column A_p>0.5

17.1.3.4 To aid this assessment, values of A_p corresponding to the geometric mean diameter of each circular luminaire group have been extracted from CIE 150 Annex C and included within Table 3. These areas can be considered for an assessment of likely A_p in the observer direction to calculate a maximum luminous intensity value.

17.1.4 *Determining the maximum luminous intensity emitted*

17.1.4.1 This is just a matter of looking down the Luminaire group and to the appropriate environmental zone and determining the calculation required for pre and post curfew levels. This will advise the designer / assessor of the maximum permitted luminous intensity for that observer position and luminaire.

17.1.4.2 Existing software can then be used based upon observer position and the value of intensity advised by the programme manually compared to the limited value determined from Table 4.

17.1.4.3 The additional notes b) multiple luminaires and c) luminaires viewed against the night sky within GN01/20 for the consideration of the limitation of bright luminaires in the field of view should also be considered.

17.1.5 Example: 15cm luminaire

17.1.5.1 We are working in an E2 zone, the luminaire has a diameter of 15cm and the realistic expected maintained nearest observer position is 100m away.

17.1.5.2 Based upon Table 4, this advises that the geometric mean of diameter is 14.1cm, and the corresponding representative A_p is 0.016. This places it within the luminaire group $0.01 < A_p \leq 0.03$ m^2 grouping. Reading down this column to E2, the pre-curfew maximum luminous intensity calculation is 2.5d where d from our case is 100m.

17.1.5.3 The limiting intensity to the identified observer is therefore 2.5 x 100 = 250 cd

17.1.6 Example: 44cm luminaire

17.1.6.1 We are working in an E3 zone, the luminaire has a diameter of 44 cm and the realistic expected maintained nearest observer is 80m away.

17.1.6.2 Based upon Table 4, this advises that the geometric mean of diameter is 56.6cm, and the corresponding representative A_p is 0.251. This places it within the luminaire group $0.13 < A_p \leq 0.50$ m^2 grouping. Reading down this column to E3, the pre-curfew maximum luminous intensity calculation is 15d where d from our case is 80m.

17.1.6.3 The limiting intensity to the identified observer is therefore 15 x 80 = 1,200 cd

17.1.7 Assessment

17.1.7.1 In both cases these are the values the competent lighting designer needs to use within the assessment calculations. If the lighting design software is CIE 150:2017 compliant it will do this, however this may require the designer to make manual assessments between intensity values advised through existing software, and the limitation required for each observer, and adjust their design until it is compliant.