

AS/NZS 4282:2023



Australian/New Zealand Standard™

Control of the obtrusive effects of outdoor lighting



AS/NZS 4282:2023

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- Astronomical Society of Australia
- Auckland Transport
- Brisbane City Council
- CIE Australia
- Consumers Federation of Australia
- Department of Climate Change, Energy, the Environment and Water
- Energy Networks Australia
- Engineers Australia
- IES: The Lighting Society
- Institute of Public Works Engineering Australasia
- Lighting Council Australia
- Lighting Council New Zealand
- Municipal Association of Victoria
- Outdoor Media Association
- University of Sydney
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Australian/New Zealand Standard™

Control of the obtrusive effects of outdoor lighting

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Preface

This Standard was prepared by the Joint Standards Australia/New Zealand Committee LG-010, Obtrusive Effects of Outdoor Lighting, to supersede AS/NZS 4282:2019.

The objective of this document is to provide a basis for assessment of the potential obtrusiveness of the effects from an outdoor lighting system. However, it should be noted that the potentially obtrusive effects of the lighting will normally be only one of a number of environmental and ecological considerations that will need to be addressed during a development assessment. Conformance to this document, i.e. conformance to the limits for the various light technical parameters defined in this document, will therefore not necessarily be the sole basis for the approval of particular development proposals.

The following are significant changes between this edition and the previous edition:

- (a) The assessment of lighting of lit vertical surfaces including internally and externally illuminated signs, façades or objects has been modified.
- (b) The position of the calculation planes has been clarified, changed to better define the difference between current and future dwelling locations and also provide a buffer zone for environmentally sensitive areas.
- (c) This document does not apply to public lighting unless specified by the relevant authority. Limits have been included in [Section 4](#) of this edition when required. Thus, obtrusive light can be controlled in areas where it might be seen as a problem without the need to calculate the impact of every public lighting luminaire.
- (d) Environmental receivers are now considered under the Standard. This change recognizes the impact that artificial light at night can have on plants, animals and ecosystems. The limits identified in [Tables 3.2](#) to [3.4](#) apply to environmental receivers as well as human receivers. Conformity to this document will benefit environmental receivers through a reduction in spill light, but will not necessarily ameliorate impacts where protected species and communities are located on, or adjacent to the site.
- (e) The application of environmental zones has been clarified; it considers the ambient environment for the lighting system and/or each affected property as appropriate.
- (f) The assessment of sports venues illuminated for TV coverage has been modified.
- (g) The veiling luminance [Equation 3.2](#) has been changed.

Formally recognized sensitive locations, such as Siding Spring Observatory (Australia) and Aoraki Mackenzie International Dark Sky Reserve (New Zealand) may have requirements in addition to this document. This document does not address all the requirements that may be necessary for the lighting system to facilitate specific activities for which it is designed. Reference should be made to the appropriate Standard, such as AS/NZS 1158 series for the lighting for roads and public spaces, AS/NZS 1680.5 for outdoor workplace lighting and the AS 2560 series for sports lighting.

Where environmental impacts are likely, reference should be made to the following documents as applicable:

UN Environment Programme Convention on the Conservation of Migratory Species of Wild Animals. Light Pollution Guidelines: UNEP/CMS/Resolution 13.5/Annex.

National Light Pollution Guidelines for Wildlife: Including marine turtles, seabirds and migratory shorebirds.

NOTE The United Nations document is based on the Australian document.

The lighting system may also be subject to approvals of other authorities such as aviation, road safety, and environmental approvals, that are additional to the requirements of this document.

The terms “normative” and “informative” have been used in this document to define the application of the appendix to which they apply. A “normative” appendix is an integral part of a Standard, whereas an “informative” appendix is only for information and guidance.

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Introduction

This document provides methods and limits to control the obtrusiveness of outdoor lighting that may be spilling from a lighting system.

With any outdoor lighting system, it is not always possible to contain all light within the boundaries of the property on which it is installed. Some light may spill outside the property boundaries, either directly or by reflection. The determination of when the spill light becomes obtrusive to others is difficult since both physiological and psychological effects are involved. Irrespective, spill light should be limited where possible within the limits of the lighting function.

Government plays an important role in controlling the obtrusive effects of outdoor lighting through the approvals process, and in resolving neighbourhood disputes involving residents who experience discomfort or annoyance from nearby outdoor lighting systems. Government authorities may apply restrictions on the frequency of use and hours of operation of outdoor lighting, and on the levels of light spilled beyond the boundaries of the subject site.

Several aspects of potential obtrusiveness are considered, including the light falling on surrounding properties, the brightness of luminaires in the field of view of nearby residents, the glare to users of adjacent transport systems, the effects on astronomical observations and the impact on environmentally sensitive areas. For the control of these effects, limiting values of the light technical parameters have been developed taking account of the following:

- (a) The level of lighting consistent with the development zoning approved for the area.
- (b) The times that the proposed lighting is to operate.
- (c) The type of lighting technology available to light the task.
- (d) The use of readily available and easily understood technical data on the lighting systems that can easily be verified at the design and assessment stages.

These criteria have been utilized to ensure that the document is both credible to the interested parties and pragmatic in application.

Limiting values of illuminance at windows and of the intensity of bright light sources, necessary to satisfy the large majority of people as being at all times unobtrusive, are rather low. Furthermore, these values can easily be exceeded with conventional lighting practice, especially if the area of activity being lit is large and the required light level is relatively high.

There are potentially conflicting requirements for dark-hours activity and the maintenance of amenity and environmental integrity, therefore, two sets of limiting values are given dependent on the levels of lighting already in the area. One, with higher values, is for application outside the curfew time set by local government and the other, with lower values, is for application during the curfew period. Most outdoor sports lighting systems likely to be subject to this document are expected to operate only outside the curfew period.

The less restrictive values are predicated on dark time activity taking place while giving passive recipients of spill light relief from it being excessively obtrusive. The limiting values are based on the use of conventional lighting technology but with good practice being used in the selection of appropriate lighting levels, luminaires and aiming practices.

The more restrictive values, applying during the curfew period, are predicated on the maintenance of amenity and environmental integrity being the dominant considerations. The spill light at these times should be such that it will not be obtrusive to the large majority of recipients. To achieve this goal the need for the proposed lighting and its operation during the curfew period should be considered in the first instance. If the lighting is required to be operational during the curfew period, then careful attention needs to be given to the limitation of spill light. The type of luminaires (i.e. light distribution) and their specific locations and aiming angles, and the need for the fitting of louvres, baffles or shields needs careful evaluation.

Although public lighting is not within the scope of this document, light technical parameter limits have been included where the relevant authority considers that the extent and level of obtrusive light should be limited. The limits recognize that such lighting is provided to facilitate safety and security for the public at large.

The limits identified in this document have not been derived to address specific species or ecological community needs and so conformance with this document may not be sufficient to meet environmental regulation.

Australian/New Zealand Standard

Control of the obtrusive effects of outdoor lighting

Section 1 Scope and general

1.1 Scope

The objective of this document is to provide a common basis for assessment of the potential obtrusiveness of the effects from the lighting of developments that involve the provision of outdoor lighting. It includes limits for the relevant light technical parameters to control these effects. As the obtrusive effects of outdoor lighting are best controlled by appropriate design, this document is primarily applicable to new systems. This document specifically refers to the potentially adverse effects of outdoor lighting on nearby residents (e.g. of dwellings such as houses, hotels, hospitals), transport system users (e.g. pilots, water craft operators, train drivers, motorists, cyclists), transport signalling systems (e.g. air, marine, rail), astronomical observations and environmentally sensitive areas.

The document does not apply to the following:

- (a) Lighting for entertainment and festivals that is designed for a performance or an event that operates outside of curfew hours, and for a regularly occurring event that operates for an interval of not more than 30 min each night, excluding sports lighting.
- (b) Emergency warning, way finding lights/marker lights, navigation lights, all traffic signals, traffic signage and vehicle headlights, including working lights mounted on moving vehicles and plant.
- (c) Lighting for aviation safety.
- (d) Flags that are required to be lit at night by government protocol, see [Appendix D](#).

This document does not apply to the following unless specified by the relevant authority:

- (i) Public lighting, as defined in [1.3.24](#). (see [Section 4](#)).
- (ii) Temporary lighting other than that stated in item (a), operating for less than one month,

This document does not apply to the following unless the lighting scheme impacts environmentally sensitive areas, or observatories:

- (A) Lighting chains and other small lighting systems and devices, for example budlighting, fairy lights, festoon lighting, where the individual lights emit less than 30 lm and has a total luminous flux of less than 20 000 lm that operates in the non-curfew period.
- (B) The upward light limits for lighting of approved public artworks.
- (C) The upward light limits for lighting of the facades of classified heritage buildings and objects.

This document does not apply to temporary sports lighting, including that for televised coverage.

The above exemptions do not override regulatory and environmental legislation.

This document does not apply to impacts associated with the aesthetic or obtrusive daytime appearance of outdoor lighting systems, including their support structures.

While conformance with this document will afford general environmental benefit by reducing sky glow and light spill, the management of artificial light for the protection of specific entities protected by environmental legislation is beyond the scope of this document due to the diversity of impact pathways, species-specific behavioural and physiological responses of organisms and ecosystems to artificial light, and the potential for listed entities to be found in all environmental zones. As there are no agreed light thresholds at which it has been demonstrated that protected species will not be significantly impacted, biological monitoring would be required to demonstrate that the objectives of

environmental legislation had been met. Environmental impact assessment is beyond the scope of this document. Where protected entities are likely to be significantly impacted by artificial light, a risk-assessed and adaptive management approach should be undertaken to assess the impacts to protected species or ecological communities. Further guidance for environmental impact assessment is provided in [Appendix C](#).

This document is intended for reference by the following:

- (1) Relevant operators and authorities; such as building and infrastructure owners, industry plant operators, planning bodies, local government and transport control authorities etc, to assist in assessing and mitigating the potential obtrusiveness of both shielded and unshielded outdoor lighting systems.
- (2) Specifiers, designers, and installers of outdoor lighting systems, as an aid to producing lighting systems that control obtrusive effects to limits defined in this document.

NOTE [Appendix B](#) provides guidance on the documentation that may be required by planning bodies, in order to facilitate assessment of a proposed lighting scheme.

1.2 Normative references

The following documents are referred to the text in such a way that some or all of their content constitutes requirements of this document.

NOTE Documents for informative purposes are listed in the Bibliography.

AS ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

AS/NZS 1158.1.1, *Lighting for roads and public spaces, Part 1.1: Vehicular Traffic (Category V) lighting-Performance and design requirements*

AS/NZS 1158.2, *Lighting for roads and public spaces, Part 2: Computer procedures for the calculation of light technical parameters for Category V and Category P lighting*

AS/NZS 1158.3.1, *Lighting for roads and public spaces, Part 3.1: Pedestrian Area (Category P) lighting-Performance and design requirements*

AS/NZS 1158.4, *Lighting for roads and public spaces, Part 4: Lighting of pedestrian crossings*

NZS ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

1.3 Terms and definitions

For the purpose of this document, the following terms and definitions apply.

1.3.1

affected property

property, with one or more relevant boundaries, where the obtrusive impact from the lighting system is being assessed; or, for environmental receivers; their habitat, or that part of their habitat in which the obtrusive impact from the lighting system is being assessed

1.3.2

beam angle

angle between two imaginary lines in a plane through the [optical beam axis](#), such that these lines pass through the centre of the front face of the device and through points at which the [luminous intensity](#) is 50 % of the [centre beam intensity](#)

Note 1 to entry: The beam angle is a full angle measure, not a half angle measure.

Note 2 to entry: The beam angle is expressed in degrees (°).

1.3.3**building façade**

external face of a building that is visible from a calculation plane or a road or of a building at or near an astronomical observing facility

1.3.4**car parks-outdoor****1.3.4.1****off-road car park**

area either on grade or on a structure that is on a separate land title to the road reserve and is designed for the parking of vehicles and includes defined entries, exits, and access roads

1.3.4.2**on-road car parking**

parking on the road reserve including parallel, angle and median parking

1.3.5**commercial area**

area that is zoned for commercial, industrial or shared commercial and residential purposes

1.3.6**competent person**

person who has acquired, through education, training, qualification, or experience, or a combination of these, the knowledge and skill enabling that person to perform the task required

1.3.7**control direction**

with respect to the luminaire, direction that has a declination at a given vertical angle below the horizon

Note 1 to entry: This is a representative direction, with respect to a luminaire's light distribution, that is used for the purpose of evaluating conformance to the maximum luminous intensities.

Note 2 to entry: See [Figure 3.3](#).

1.3.8**curfew**

time interval during which stricter requirements for the control of [obtrusive light](#) apply

Note 1 to entry: See [Clause 3.2.1](#).

1.3.9**dwelling**

building, or part thereof, in which people reside, especially during the hours of darkness

Note 1 to entry: For example, house, hotel, motel, hospital.

1.3.10**dynamic content**

where the luminous image, pattern, colour or direction of light changes over an interval of less than 60 seconds

1.3.11**environmentally sensitive area**

area of ecological value including, bushland, waterways and marine and coastal areas

Note 1 to entry: These areas may be in any environmental zone and include areas that are unlit and should remain dark to provide refuge for flora and fauna that require naturally dark environments. These may include green/black-belts through urban environments.

1.3.12**environmental zone**

categorisation of the relative ambient lighting and environmental conditions as relevant to the lighting system or affected property

1.3.13**environmental receiver**

any identified living species (plants, animals and other organisms) and their locations indicated, that may be impacted by the proposed lighting system

1.3.14**façade lighting**

light sources for external decorative purposes that are fixed to the façade, embedded in the building elements or immediately behind the glazing

1.3.15**floodlight**

specific type of luminaire that emits light within a restricted range of directions, i.e. a beam

1.3.16**glare**

condition of vision in which there is discomfort or a reduction in ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrasts in the field of vision

1.3.16.1**disability glare**

glare that impairs the visibility of objects without necessarily causing discomfort

1.3.16.2**discomfort glare**

glare that causes discomfort without necessarily impairing the visibility of objects

Note 1 to entry: Both disability and discomfort glare may be present concurrently.

1.3.17**habitable room**

room within a dwelling that is occupied by people for extended periods, especially at night

Note 1 to entry: For example, living room, bedroom and study but not bathroom or storage room.

1.3.18**lighting system**

lighting system comprises the light sources, luminaires or luminous signs, facades and artworks, that are part of the proposed, changed or existing installation that is being assessed

1.3.19**luminaire**

apparatus which distributes, filters or transforms the light transmitted from at least one source of optical radiation and which includes, except the sources themselves, all the parts necessary for fixing and protecting the sources and, where necessary, circuit auxiliaries together with the means for connecting them to the power supply

1.3.20**may**

indicates the existence of an option

1.3.21**obtrusive light**

[spill light](#) which, because of quantitative or directional attributes, gives rise to annoyance, discomfort, distraction, or a reduction in ability to see essential information such as transport signals

Note 1 to entry: Obtrusive light includes the impact on humans and environmental receivers.

1.3.22**outdoor lighting**

any exterior or interior lighting that emits directly into the outdoor environment

1.3.23**protected species and ecological communities**

species or ecological communities listed under the *Environment Protection and Biodiversity Act 1999* as threatened or migratory; or as a protected matter under Australian state or territory environmental legislation; or listed under New Zealand's *Conservation Act 1987*

1.3.24**public lighting**

lighting provided for the purposes of safety and security on public roads, cyclist paths, footpaths and pedestrian movement areas within public parks and gardens, including on-road car parking, but not including off-road car parks

Note 1 to entry: Requirements for public lighting are set out in the AS/NZS 1158 series.

1.3.25**public lighting zones**

categorisation of Public Lighting for the assessment of the impact on adjacent properties, where required by the relevant authority

1.3.26**recreational areas**

areas designated for active play, leisure or public assembly such as parks, picnic grounds, camp sites, golf courses, lakes, streams, and oceans, but excluding private residential areas and sports facilities with dedicated sports lighting

1.3.27**reference direction**

direction to which the luminous intensity distribution of a luminaire is referred

Conventionally, this may be the direction that is normal to the front glass (or luminous emitting surface), the maximum luminous intensity or, where there is no unique maximum, the direction of the centre of the light beam, see [Figure 3.3](#)

1.3.28**relevant authority**

organization or individual who has the legal responsibility to make a determination, approval or exemption for a specific aspect of the obtrusive assessment

1.3.29**relevant boundary**

any boundary of a residential property or environmentally sensitive area over which it is physically possible for spill light from the lighting system to pass and directly impact on—

- (a) a dwelling located on the affected property;
- (b) the potential site of a dwelling if there is no development on the affected property; or
- (c) an area designated as environmentally sensitive area

Note 1 to entry: The lighting system may be within the relevant property boundary.

1.3.30**shall**

indicates that a statement is mandatory

1.3.31**should**

indicates a recommendation

1.3.32**sign**

internally or externally illuminated signage (directional and/or advertising) including static and dynamic signage (e.g. digital billboards), whether mounted outdoors or mounted within a building and visible to an external observer

1.3.33**solid state lighting****SSL**

type of [lighting](#) that uses semiconductor [LEDs](#), organic LEDs (OLEDs), polymer LEDs (PLEDs) or laser diodes as [sources](#) of lighting

1.3.34**sky glow**

brightening of the night sky that results from the [reflection](#) of radiation (visible and non-visible), scattered from the constituents of the atmosphere (gas molecules, aerosols and particulate matter), in the direction of observation

1.3.34.1**man-made sky glow**

part of the [sky glow](#) that is attributable to man-made sources of radiation (e.g. outdoor lighting)

1.3.34.2**natural sky glow**

part of the [sky glow](#) that is attributable to radiation from celestial [sources](#) and luminescent processes in the Earth's upper atmosphere

1.3.35**spill light**

light emitted by a [lighting installation](#) that falls outside the boundaries of the property for which the [lighting installation](#) is designed

Note 1 to entry: Spill light may not necessarily be obtrusive.

1.3.36**threshold increment****TI**

measure of [disability glare](#) expressed as the percentage increase in [luminance contrast](#) threshold required between an object and its background for it to be seen equally well with a source of [glare](#) present

Note 1 to entry: Increasing values of threshold increment correspond to increasing [disability glare](#).

Note 2 to entry: The threshold increment has unit one.

1.3.37**tilt angle**

angle in the vertical plane from nadir (the downward vertical axis directly beneath) to the vector that the luminaire reference direction is aimed. The tilt and uplift angle may be the same, e.g. for a road luminaire, or a symmetrical beam floodlight

Note 1 to entry: Uplift is the angle of the reference surface of the luminaire (usually the light emitting surface or housing) with respect to the horizon. The uplift angle may be different to the tilt where the distribution of the luminaire is asymmetric. The uplift angle may be positive or negative. Refer to AS 2560.2 for more detail.

Note 2 to entry: See [Figure 3.3](#).

1.3.38**upward light ratio****1.3.38.1****upward light ratio (luminaire)****ULR_L**

ratio of the luminous flux of a luminaire that is emitted, at and above the horizontal, divided by the total luminaire flux when the luminaire is mounted in its designed position

1.3.38.2**upward light ratio (system)****ULR_S**

ratio of the luminous flux of all luminaires in the system that is emitted directly into the night sky, divided by the total flux of all the luminaires, when the luminaire(s) is (are) mounted in its designed position(s), and excluding reflected light from surfaces or obstructions

Note 1 to entry: This method allows the inclusion of the impact of obstructions such as baffles or awnings to be included.

1.4 Demonstration of conformity

Conformance to this document shall be demonstrated by the results of calculations and analysis of design methods with respect to the relevant Light Technical Parameters (LTPs) set out herein.

Measurement is not required for conformance.

Section 2 Potential obtrusive effects

2.1 General

This section provides guidance on effects that outdoor lighting may have on surrounding areas.

Outdoor lighting while intended for a specific purpose may have some adverse effect on persons and the environmental receivers. For example, some activities require the illumination of an object in a volume or space, and not just of a surface at ground level. Note that generally there will be a diffusion of light within the lit space resulting from the reflection from surfaces. The following examples illustrate this point:

- (a) Lighting for certain sports, e.g. tennis, baseball, cricket or golf driving ranges where it is essential to be able to see the movement of the ball in the space above the playing surface to an appropriate height.
- (b) Lighting a freight terminal where it is necessary to identify containers in multiple container stacks.
- (c) Security lighting at or adjacent to the property boundary.

NOTE 1 See [Appendix A](#) for guidance on the design and operation of lighting systems.

2.2 Influence of surrounding context

The obtrusive effects of the lighting system may be significantly influenced by the following factors:

- (a) The use of the area abutting or in close proximity to the proposed development.
- (b) The topography of the area surrounding the lighting system. Residential developments at a lower level than that of the lighting system are more likely to be subjected to a direct view of the luminaires.
- (c) Physical features such as adjacent buildings, trees and spectator stands, that may be effective in restricting light spill beyond the boundaries of the development.
- (d) The existing ambient lighting characteristics relative to the proposed lighting.
- (e) The location of the proposed development relative to—
 - (i) areas of special significance, e.g. areas having cultural, environmental, historical or scientific importance;
 - (ii) harbours, airports, heliports, waterways, roads or railway systems where spill light from the proposed development may interfere with the visibility of signalling or signage associated with them; or
 - (iii) community and scientific optical observatories where spill light from the proposed development may interfere with astronomical observations.

2.3 Specific effects

2.3.1 Effects on residents

Effects on residents generally involve a perceived reduction of amenity arising from light technical factors such as the following:

- (a) The illumination from spill light being obtrusive, particularly where the light enters habitable rooms. The illuminance on surfaces, particularly vertical surfaces, is an indicator of this effect.

- (b) The direct view of bright luminaires from normal viewing directions causing annoyance, distraction or even discomfort or disability glare. The luminous intensity of a luminaire, in a nominated direction, is an indicator of this effect.
- (c) Changes in luminance in the peripheral vision due to effects such as variable content in signage or trees moving across bright lights.

The tolerable levels of each of these light technical parameters will be influenced by the ambient lighting existing in the environment where the light technical parameters are being calculated.

There is some evidence that exposure to artificial light at night may have adverse impacts on human health. However, caution is needed in interpreting the specific influence of outdoor lighting on human health. The effects of outdoor lighting on human health are beyond the scope of this document, noting that conformity to this document will limit exposure of humans to outdoor lighting.

2.3.2 Effects on transport system users

One of the effects on transport system users (e.g. pilots, water craft operators, train drivers, motorists, cyclists) normally involves a reduction in the ability to see caused by disability glare from bright light sources. The contrast of other objects and the surrounds to the user will be lowered, rendering them less visible or even invisible, especially if the environment is intrinsically dark. The magnitude of the effect will depend on the level of lighting to which the user is adapted. The relevant indicator for transport system users is the threshold increment (*TI*).

2.3.3 Effects on transport signalling systems

Effects on transport signalling systems will normally involve a reduction in the visibility of the signals either by—

- (a) disability glare; or
- (b) visual clutter; where signals are viewed against a competing background of other lighting. The effect is exacerbated if background lighting is the same colour as the signal lighting or a mix of colours.

2.3.4 Effects on the night sky (sky glow)

Sky glow is a combination of man-made sky glow and natural sky glow, this document only addresses man-made sky glow.

Sky glow is the cumulative effect of each and every light source in a development, and hence its minimization is achieved by careful selection, placement and screening of all light sources.

The increase in man-made sky glow can have a wide range of detrimental effects.

NOTE Refer to CIE 126–1997 for guidance on minimizing sky glow.

2.3.4.1 Astronomy

Visibility of the night sky is important for astronomical observations both for science and for the general appreciation of the night sky.

Effects on astronomical observations will generally involve the modification of night sky viewing conditions by any or all of the following:

- (a) Lightening of the dark sky caused by the scattering of light from the installation, in the atmosphere, increasing sky glow.
- (b) The spectral characteristics of the sky glow, so that the light pollution is not readily filtered out by optical means at the telescope.

(c) Direct light from the installation falling on the observatory.

Where outdoor lighting systems are proposed in the vicinity of community or scientific optical observatories the limitations of spill light and luminous intensity of luminaires in recommended directions will mitigate the adverse effects of direct light falling on the optical surfaces of the telescope.

Sky glow may be mitigated by limiting the exterior lighting in the vicinity of the observatory, including the spectral distribution and optical distribution of the local road lighting. If this measure is to be implemented, close consultation will be needed between all the parties involved, i.e. observatory, local community and relevant authority.

NOTE A list of community and scientific optical observatories is available from the Astronomical Society of Australia (Designated Observatories Officer), c/o School of Physics, University of Sydney, NSW 2006 and the Royal Astronomical Society of New Zealand (rasnz.org.nz).

Where the proposed lighting is within the field of influence of a major optical observatory, the above points are even more pertinent. Additional limitations on spill light may be imposed over a considerable area surrounding the observatory as part of a long-term plan to maintain satisfactory night sky viewing conditions. Such plans should be based on guidelines set out by the International Commission on Illumination and the International Astronomical Union in CIE 001-1980.

2.3.4.2 Cultural impacts

Cultures around the world, including many First Nations traditions and knowledge systems, are based on the stars and other celestial objects, and the peoples' ability to observe and interpret the night sky.

The mitigation for the preservation of culture is similar to the controls for astronomy.

2.3.4.3 Impact on flora and fauna

The impact on flora and fauna is addressed more generally in [Clause 1.1](#). However, the increase in sky glow can have an overall impact on the navigation and feeding of fauna which can have consequential impacts on the overall environment. The skyglow impacts on flora and fauna can be caused by light emitted at a lower altitude and be localized to specific installations.

2.3.4.4 Impact of the spectral content of the light

The blue content of the light has an impact on the sky glow as it scatters more in the atmosphere than light at the red end of the spectrum.

Preference should be given to sources with a correlated colour temperature of 3 000 K or less unless there is a safety reason for using 4 000 K. For CCT in public lighting refer to SA/SNZ TS 1158.6.

While Spectral Power Distribution (SPD) provides a better indication of the blue content in the light source there are no criteria to specify a limit that can be applied. Sources with low blue content are preferred.

Removal of the blue content of light, while effective in reducing the impact on astronomy and the overall brightness of the sky, is not a universal solution. Care should be taken in general limitation of blue light as there are some animals that prefer blue light, and as the illumination levels reduce, human vision moves into the scotopic zone which primarily relies on blue light for visual performance.

NOTE Sports fields have high levels of human activity, task visibility is challenging, and they are often used during sunset. Sources of up to 5 700 K ("daylight") can satisfy end user preferences, and when combined with the principles described in [Clause A.2](#) by a competent lighting designer, other adverse effects can be substantially mitigated, e.g. sky glow/ULR, glare, and spill light.

2.3.5 Effects on the natural environment

Effects on the natural environment may include behavioural changes in animals, physiological changes in plants and animals and changes in the interactions between organisms. Light can affect all living species (including plants, animals and other organisms) in all habitat types (land, air and water).

These changes can occur at very low light levels, for example some species change their behaviour with the waxing and waning of the moon. The physiological responses of some species may also be affected by the spectral composition of the light, particularly at short wavelengths.

NOTE The most effective way to avoid impacts on environmentally sensitive areas is to minimize spill light and upward light. See [Appendix C](#) for further information on the impact of outdoor lighting on the flora and fauna.