

LIGHT POLLUTION
DETAILED BACKGROUND PAPER



**AUSTRALASIAN
DARK SKY
ALLIANCE**

Report prepared by

Australasian Dark Sky Alliance

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TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Background.....	1
1.2	Light Pollution.....	1
1.3	Impacts of Light Pollution	1
1.3.1	Energy waste and greenhouse gas emission.....	2
1.3.2	Public health impacts	2
1.3.3	Cultural Heritage and Indigenous Astronomy.....	2
1.3.4	Ecological impacts	2
1.3.5	Astronomy and Astrotourism.....	3
1.3.6	Crime and Safety	4
2	Legislation and Guidelines	4
2.1	National Light Pollution Guidelines for Wildlife	5
2.2	NSW Dark Sky Planning Guidelines	5
2.3	AS/NZ 4282	5
2.4	Key Threatening Process	6
2.5	National Pollutant Inventory	6
3	MANAGEMENT and EDUCATION	6
3.1	Best Practice Lighting Principles	6
3.2	Light Management and Planning.....	7
3.3	Dark Sky Place Designation.....	7
3.4	Research and Education	8
4	PROPOSED ACTIONS	8
5	BIBLIOGRAPHY	10

1 INTRODUCTION

1.1 Background

This detailed discussion paper has been prepared as an Attachment to a Briefing Note on Light Pollution prepared by ADSA and submitted to Minister Tony Zappia, MP to be presented in parliament on Monday 24 November at 4PM. The paper provides a brief description of light pollution, how it affects all of life on Earth, and the objectives of this discussion paper (**Section 1**). The current national and state legislation and guidance on managing and mitigating light pollution is outlined in **Section 2**. Ways to manage and mitigate light pollution (**Section 3**) and some suggested actions that can be taken by State and Federal governments to recognise and reduce light pollution (**Section 4**).

1.2 Light Pollution

Light pollution is the excessive or inappropriate use of artificial light at night (ALAN). Components of light pollution include:

- Glare – excessively bright lights that cause visual discomfort, e.g. bright LED car head lights or unshielded pole or wall mounted lights
- Sky glow – the brightening of the sky over towns and cities from scattered and reflected light, e.g. dome of light above major cities caused by ground-based street and commercial lighting
- Light trespass – light that falls outside of the area it is intended to be illuminated, e.g. lights shining into a window from a neighbour's house or streetlight.
- Clutter – bright, excessive and confusing grouping of lights, e.g. Times Square New York.

1.3 Impacts of Light Pollution

A growing body of evidence now links the brightening of the night sky directly to measurable negative impacts including:

- Substantial energy waste through increasing energy consumption and associated greenhouse gas emissions In the United States 35% of light is wasted by unshielded or poorly aimed lights, costing AUD\$4 billion a year in energy lost; 19 million tonnes of CO₂ is emitted each year to power wasted light.
- Public health impacts including sleep and metabolic disorders, increased rates of depression, obesity, heart disease and some cancers.
- Cultural heritage and Indigenous Astronomy through loss of visibility of the stars and planets that make up the night sky
- Ecological impacts on plants and animals including, the masking and disruption of natural light cycles; shifts in patterns of navigation and movement, reductions in reproduction and foraging. Each of these can affect the health and fitness of plants and animals and may lead to biodiversity declines.

- Reduction in the visibility of the stars and planets that make up the night sky, which directly affects Western and Indigenous Astronomy including loss of cultural connection
- Crime and Safety, light is frequently used to prevent crime and increase the sense of safety for people at night.

These impacts are discussed in more detail below

1.3.1 Energy waste and greenhouse gas emission

Excess or poorly directed light is wasted light that creates a financial and environmental burden. The energy required to generate the wasted light costs not only wastes money but also generates excess greenhouse gases through electricity production. In the United States 35% of light is wasted by unshielded or poorly aimed lights, costing AUD\$4 billion a year in energy lost and emitting an estimated 19 million tonnes of CO₂ each year to power the wasted lights.

1.3.2 Public health impacts

Exposure to artificial light at night can impact on human health by disrupting the circadian cycle which regulates sleep and guides day night cycles in hormone secretion (melatonin) and physiology. This is most evident in shift workers who have been found to be at risk of higher rates of breast and testicular cancer. The health consequences associated with exposure to light at night include increased risk of breast and prostate cancer, sleeplessness, depression, obesity, diabetes, heart disease, and eye strain in adults, and damage to retinal cells in young children.

Research findings recommend reducing exposure to light at night from bright white, blue rich lights and screens, using filters on electronic screen or tinted glasses to reduce blue light exposure and maintain a dark sleeping environment.

In 2007 the World Health Organisation International Agency for Research on Cancer (IARC) first recognised the potential cancer risks from exposure to light at night when they classified shift work that involves circadian disruption as "probably carcinogenic to humans". In 2016 the American Medical Association recognised the potential health effects of LED street lighting and recommended light management be implemented to reduce future impacts. An expert advice paper by the Royal Society of New Zealand in 2018 specifically addressed the health impacts of blue light on humans, in addition to the behavioural effects and retinal damage particularly in young children.

1.3.3 Cultural Heritage and Indigenous Astronomy

Humanity evolved under dark starlit skies, inspiring science, religion, philosophy, art and literature. Ancient Polynesian explorers have traditionally used the stars to navigate the oceans. Well before the evolution of western astronomy, Indigenous Australians have used the annual movement of stars to provide a narrative on social order, seasonal changes in food supplies, navigation, kinship and spirituality.

1.3.4 Ecological impacts

Life on Earth has evolved for 4.3 billion years under predictable cycles of light (day) and dark (night). These natural light cycles facilitate critical physiologies and behaviours including seasonal

reproduction, foraging, and migration, pollination, sleep and predator avoidance. With the introduction of light at night into the night these natural light cycles are disrupted and nights are brighter. Biological issues associated with the presence of artificial night lighting are increasingly documented.

The impact of ALAN on marine turtle hatchlings has been recognised for over 100 years. The DCCEEW [Recovery Plan for Marine Turtles in Australia](#) lists light pollution as a high-risk threat to marine turtles.

Impacts on plants and animals include:

- Disrupted Behaviours: Many species rely on natural darkness for foraging, breeding, and migrating but are attracted to and/or pulled off their usual navigational path by the presence of lights. For example juvenile shearwaters learning to fly are disoriented by artificial lights and frequently crash into street lights and die.
- Growth and Reproduction: Artificial light at night can interfere with seasonal cycles of light and dark used by plants (for growth, fruiting and flowering) and animals (for stimulation of seasonal reproductive hormones) leading to mistimed development and reproduction of offspring.
- Altered Ecosystem Dynamics: the loss or changes in the behaviour of moths attracted to (and often perishing in the presence of) night lighting can have a cascading effect on other species that depend on them as a food source or for pollination. This is also recognised for its longer term, widespread economic impacts on food security.
- Habitat Fragmentation: Artificial light can break up natural dark corridors that animals use to travel between feeding and breeding sites, isolating populations and limiting their ability to find food and mates.

1.3.5 Astronomy and Astrotourism

Skyglow impacts the view of the night sky; it reduces the ability of humans to see the stars and planets.

Australian astronomy research relies heavily on existing observatory sites, which despite the encroachment of increasing light pollution, continue to conduct world class research and instrumentation development. As light pollution grows it will impact on the ability of Australian astronomers to study a night sky unavailable in the northern hemisphere and prevent facilities such as the Space Surveillance Telescope in Exmouth WA from detecting incoming meteors, space junk, missiles etc.

Good lighting design principles are important considerations to manage skyglow to enable Astrotourism development which can be of benefit economically to the wider community by increasing visitor numbers and spending, and diversifying and increasing employment.

1.3.6 Crime and Safety

The perception that outdoor lighting improves traffic safety and reduces crime is common. Despite this belief there is no scientific evidence to support the idea that increased lighting leads to a decrease in road accidents, crime and safety. There are situations where well-designed outdoor lighting can improve night-time safety, such as properly shielded lights that prevent blinding an observer with glare and enhancing a person's visibility and awareness of their surroundings.

2 Legislation and Guidelines

The critical challenge in addressing light pollution is the lack of recognition under legislation, standards and codes. **Light is currently not explicitly recognised as a pollutant under any State or Federal legislation.** While no vehicle exists for light to be legislated as a pollutant under Federal legislation, it does at State level, and this should be promoted at all levels of government.

Countries leading the way in recognising and regulating light as a pollutant include Spain, Italy, Slovenia, France and Germany. The objective of the regulatory actions includes dark sky protections, energy savings and nature protection. Germany has specifically targeted the protection of insects from light pollution after documenting a 75% decline in insect biomass over 27 years in nature protected areas, with serious implications for the long-term survival of plants and trees. Furthermore, the loss of insects has implications for food security for crops that require insect pollination to reproduce.

Australia has a number of guidelines for addressing light pollution, i.e. the [National Light Pollution Guidelines](#), NSW [Dark Sky Planning Guidelines](#), and the [Australian Standard Control of the Obtrusive Effects of Outdoor Lighting \(AS/NZS 4282\)](#), however, none are legally binding and are not uniformly enforced.

Some State environmental regulation recognises electromagnetic radiation as a contaminant ([Queensland Environmental Protection Act, 1994, Chapter 1, Part 3, Division 2, Subdivision 2, Section 11 \(d\)](#)). Electromagnetic radiation includes visible light in addition to X-rays, gamma rays, radio wave and microwaves, however light is not treated as a contaminant in everyday practice.

In 2021 the WA Department of Planning, Lands and Heritage (DPLH) released a [Dark Sky and Astrotourism Position Statement](#) as a policy document designed to protect WAs night skies from light and dust pollution with the aim of promoting Astrotourism. This policy acknowledges light as a pollutant and promotes best practice light management, however the local councils this policy is targeting are not familiar with the policy, are not legally required to implement the policy and it is largely ignored.

Light pollution was recently recognised in the DCCEEW Discussion Paper on Implementing Australia's Strategy for Nature 2024 – 2030. The Paper highlighted Australia's global lead in developing the Guidelines and linked them to a specific Target, i.e. *Increase Australia's circularity rate and reduce pollution and its impacts on biodiversity by 2030*. While the recognition of light as a pollutant is commendable there still lacks any accountability as to who is responsible for regulating and managing light pollution.

2.1 National Light Pollution Guidelines for Wildlife

The national light pollution guidelines aim to reduce artificial light's impact on EPBC Act listed species with specific advice on how to protect marine turtles, migratory shorebirds, seabirds, bats, terrestrial mammals and ecological function. These guidelines provide a framework for assessing and managing light pollution impacts on protected wildlife and detailed guidance on how to manage and minimise ALAN.

In 2020, the Australian guidelines were endorsed and adopted by the Convention on Migratory Species (CMS), a subsidiary of the United Nations Environment Program (UNEP), and the 133 signatory parties.

These guidelines are frequently applied to major resource sector projects and increasingly to defence projects, assessed under the EPBC Act. They are less frequently applied to port and airport and other transport infrastructure, nor are they considered for street lighting, residential and commercial developments by local councils.

While the Guidelines are a useful starting point for managing light pollution they are targeted at EPBC Act listed species which are a very small subset of the total number of marine and terrestrial species that occur in Australia.

2.2 NSW Dark Sky Planning Guidelines

NSW established Dark Sky Planning Guidelines in 2016 (updated 2022) to protect and enhance the night sky environment in the vicinity of the Siding Springs Observatory. These guidelines focus on encouraging local councils and communities to adopt outdoor lighting that minimises light pollution and preserves natural darkness. They provide practical recommendations for lighting design, zoning regulations, and public education initiatives, aiming to create sustainable urban spaces while maintaining visibility for nighttime activities.

2.3 AS/NZ 4282

Australian Standard AS/NZ 4282 provides guidance for controlling the obtrusive effects of outdoor lighting, providing advice on managing light spill, glare and clutter. AS/NZ 4282 has a primary focus on human receptors, road users, astronomy values and transport signal systems. AS4282 is primarily used by councils to manage local projects. In Oct 2023 the Standard was amended to include consideration of environmental receivers.

Standards Australia are the peak non-government, not for profit Standards organisation. The AS4282 Standard is not legally enforceable, however it is typically applied as best practice and is often incorporated into laws and regulations making adherence to them mandatory. The Standard must be purchased (\$211.37, September 2025) and does not establish any upper limits on lighting. In the absence of legally binding, transparent and publicly available government legislation, the Standard acts as pseudo regulation and is the guidance used by Councils to avoid potential litigation.

2.4 Key Threatening Process

Consideration should be given to listing ALAN as a Key Threatening Process (KTP) under the EPBC Act since ALAN is a significant environmental pressure that threaten the survival, abundance, and evolutionary development of many native and threatened species.

There is clear evidence of the impact of ALAN on a wide range of insects, mammals, reptiles and avifauna, including marine turtles, migratory shorebird and seabirds, wallabies, bogong moths and pygmy possums etc. It is likely that Australia's unique cohort of nocturnal native mammals are already at risk from significant impact on reproduction, predation, migration and overall health by the growth of light pollution nationally.

2.5 National Pollutant Inventory

ALAN is a candidate for inclusion on the National Pollutant Inventory since it is an emission that originates from industrial, commercial, transport, and household sources across Australia. Inclusion on the NPI will help bring focus and attention on light as a pollutant, increase community understanding of light as a pollutant, track progress on how it is managed and mitigated, and inform environmental decision-making and industry practices.

Light is one of the easiest pollutants to manage, by turning a light switch off, or by the simple actions as outlined in **Section 3.1**.

3 MANAGEMENT and EDUCATION

3.1 Best Practice Lighting Principles

The best way to minimise light pollution is to manage the light. Principles recommended by ADSA and the National Light Pollution Guidelines include:

1. Start with natural darkness and only add light for a specific purpose; avoid over lighting.
2. Use adaptive/Smart light controls to manage the timing, intensity and colour of light; turn lights off late at night, reduce the intensity and colour of street lights late at night, use motion sensors to turn lights on only when people are present.
3. Use light only in the area it is needed; focus light onto the space or object that requires illumination, avoid light escaping beyond the boundary of a property or up into the sky.
4. Use low intensity lighting and keep it close to the ground; assess how high and how bright a light really needs to be and mount it as low as possible to the ground and use lowest intensity for safe movement.
5. Use non reflective, dark coloured surfaces near lighting fixtures; to prevent light reflecting up into the sky and contributing to sky glow.
6. Avoid white lights, use warm white or amber lighting with reduced blue wavelengths; as blue wavelengths have the greatest impact on wildlife, human health, sky glow and astronomy bright white LEDs that are rich in blue wavelengths should not be used.

3.2 Light Management and Planning

Any proposed development requiring regulatory approval, regardless of the size or cost, should consider its ALAN footprint. Councils particularly need to be cognisant of their responsibilities for management light from street lighting, commercial and urban sources. Currently one of the largest sources of ALAN are streetlights, yet there are no upper limits on how many, how bright nor where streetlights can be installed, moreover there is no consideration of the impact they have on EPBC Act listed species. Sports grounds are a major source of light pollution in urban areas (after street lighting) and historically the lighting of them has been poorly designed. A recent upgrade of the US Tennis Association Billie Jean King National Tennis Centre in Flushing Meadows New York was completed using Best Practice lighting design resulted in a dark sky friendly design that also satisfied tennis fans, TV producers and players without causing unnecessary sky glow.

An emerging source of light pollution in urban areas is electronic billboards, made possible by the development of LED and LCD technology. While AS4282 recognises these as a source of obtrusive outdoor lighting the Standard does not provide any best practice management guidance for these light sources.

As sports grounds are upgraded from legacy lighting to LEDs over the next decade it will be important to ensure that dark sky values are recognised by councils and regulators responsible for approvals, and that it is done using good lighting design principles.

The general advice provided by the National Light Pollution Guidelines for Wildlife can be applied more broadly and used by councils, regulators, industry, lighting designers, architects, lighting suppliers and the public to better understand and manage the lighting they are responsible for.

3.3 Dark Sky Place Designation

Dark Sky place certifications are important vehicles for educating the public about ALAN and providing communities with opportunities for increased Astro-tourist visitations. Dark Sky places protect the nighttime darkness through good lighting policy that includes stringent controls on ALAN. Dark sky places are protected for scientific, natural, education and nighttime heritage values. They support good quality sites for professional and amateur astronomical observing, the ability for the public to connect with and learn about the stars and protect the cultural values of indigenous Australians.

A Dark Sky place may be certified by third party organisations such as Dark Sky International or equivalent and are typically areas that can be identified by a recognised geographical boundary, managed by a recognised regulatory body who is legally responsible for the management of activities with the area.

Dark Sky places are increasingly popular with the growing area of Astrotourism as urban dwelling public seek to reconnect with the natural environment and the opportunity to see the stars. National Parks are natural destinations for Astrotourism and in the USA a growing number of National Park visitors participate in night sky recreation activities, with an estimated US\$5.8 billion expected to be spent between 2019 and 2029 in the Colorado Plateau alone.

Australia's National and Marine Parks have been identified as ideal places for dark sky certification due to their remoteness, low level of infrastructure development, existing management structures

and plans. A similar program in the US is operated by the US National Park Service which recognises the value of dark skies, protecting and restoring natural night skies and nocturnal environments in national parks as part of the natural resources and values protected under their Federal regulations.

3.4 Research and Education

While the understanding of the impacts of ALAN is growing, it has not yet been recognised as a pollutant in Australia in the same manner as pollutants that contaminate air, water and soils. This is in part due to the difficulties and complexities inherent in measuring, monitoring and modelling light. These limitations are a focus of research globally and tools to assist in better management of light are being explored. For example, ILLUMINA Light project is an online modelling tool for non-specialists that has been proposed by a collaboration of Spanish and French-Canadian academics and is being considered for grant funding by CMS.

Education is critical to the better understanding and management of light as a pollutant. Not only is it important that general public understand the problem, but also regulators (council, state and federal government), industry (developers and builders, engineers, lighting designers, architects), lighting suppliers (to develop and build less impactful light sources). Education will assist with the long-term understanding and acceptance of the impacts of ALAN and the need to better manage it.

4 PROPOSED ACTIONS

ADSA request the Federal Government consider the impacts of light, an emerging environmental, health and cultural pollutant, and act to recognise, educate, legislate and manage this emerging threat to Australia and Australians. We propose the following actions for implementation.

Human health

- Engage with the Department of Health to list light as a potential carcinogen (American Medical Association)

Legislation/guidance

- Have light pollution listed as a key threatening process under the EPBC Act
- Have light pollution added as a pollutant to the National Pollutant Inventory (NPI)
- Amend the conceptual framework of the NPI to include energy as a pollutant, explicitly recognise light, noise, radiation etc.
- Encourage State/Territory counterparts to explicitly recognise light as a pollutant under State/Territory Environmental legislation
- Require light pollution, impacts and management, be incorporated into Australian Standards and the National Construction Code.
- Mandate lighting accreditation and quality testing (e.g. formal recognition by Australasian National Association of Testing Authorities).

- Develop a pathway for all Australian National Parks to gain Dark Sky Place certification (via ADSA/Dark Sky International) to promote Astrotourism and encourage enjoyment of the night sky.

Management and Education

- Require all new developments under the EPBC Act are consistent with the National Light Pollution Guidelines for Wildlife
- Support and promote Indigenous Astronomy and recognise the cultural values of the night sky.
- Partner with peak industry bodies to incentivise Australian industry to produce better lighting fixtures for protection of wildlife, human health and dark sky values

Funding opportunities

- Provide funding to.
 - Develop information and training packages for and in partnership with industry and state governments for Australian Local Government Association on Best Practice Lighting Design and management
 - Sponsor an awards program to recognise good lighting design
 - Continue to the sponsorship of the biennial Valuing Darkness Symposium
 - Develop a tool that allows communities to monitor and manage light pollution, ie ILLUMINA Light

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