Lighting and Green Spaces
- an Expert Panel Presentation on new research and challenges
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Outdoor lighting practice needs to be based on facts, not myths

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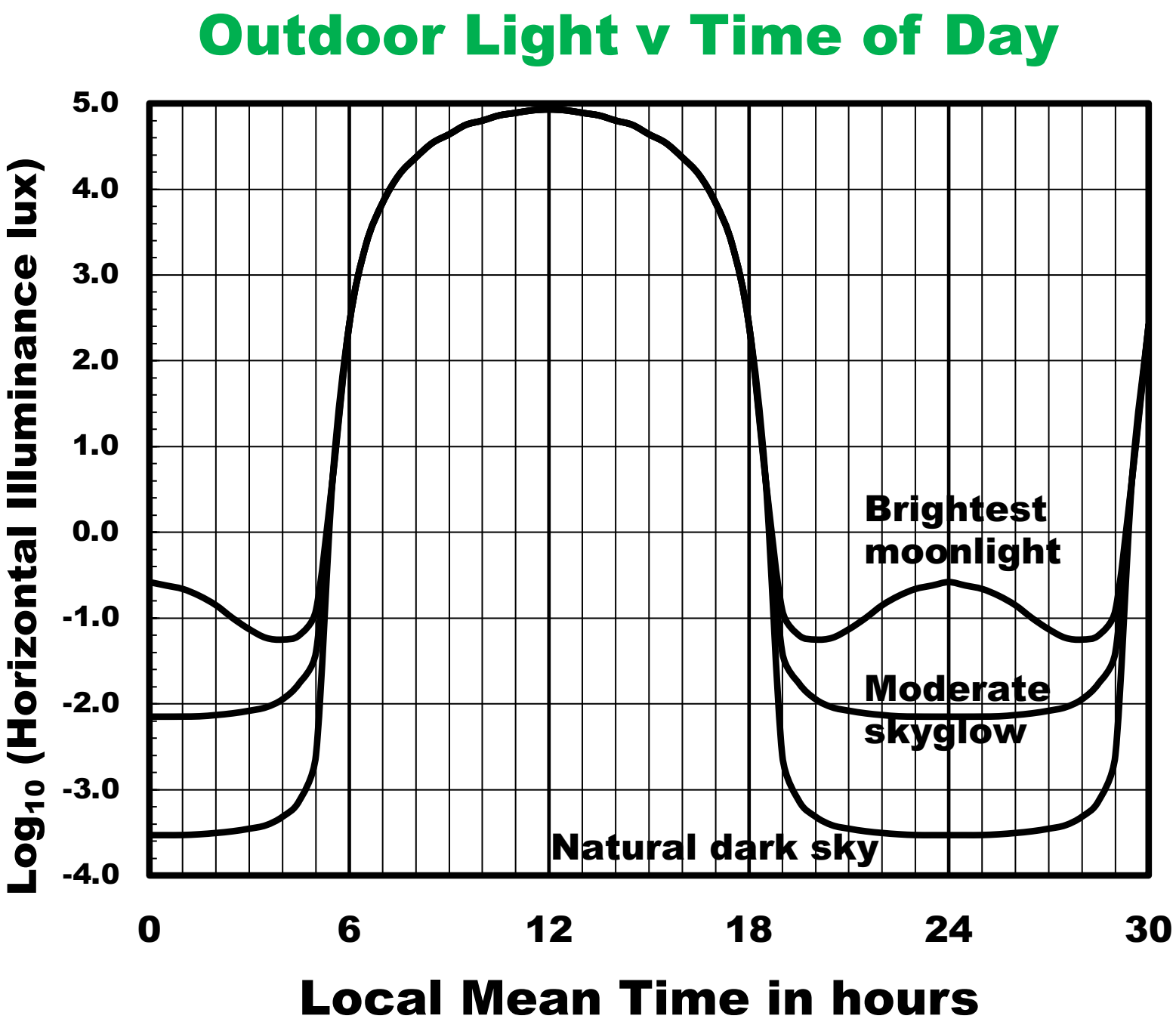
What myths?

Current lighting standards and practice are typically based on providing enough artificial light when it is needed for wayfinding, mobility safety, recreation, transport operations, domestic activities, shops, workplaces, and so on. Industry-recommended lighting ranges for such purposes are reasonably justifiable. However, many other aspects of conventional strategies for using artificial light at night (ALAN) are highly questionable.

ALAN is commonly supposed or implied to:

- **be a universal benefit with no deleterious effects on the physical environment;**
- **have no adverse effects on human health;**
- **have no ecological effects;**
- **deter and prevent crimes such as burglary, thefts, vandalism and assaults; and**
- **reduce road accidents.**

Solid scientific evidence suggests that each of these suppositions is untrue, but they are still being claimed by sections of the lighting industry and widely believed by the public. They are harmful myths.



Three possible forms of outdoor light curves are shown for an equinox day in Victoria. In summer the midday peak will be a little higher and daytime will be longer, and conversely in winter. *Natural and artificial skyglow at night does not change appreciably with the seasons.* Moonlight will usually be dimmer than shown and not present all night, but lunar light cycles can influence life stages in many species if not swamped by artificial light at night.

Upward Waste & Unused ALAN has Adverse Environmental Effects

’Light pollution’ or artificial skyglow is caused by light scatter in the atmosphere.

It degrades the wonderful natural spectacle of the starry night sky, imposing an aesthetic loss for everyone.

Especially when there are clouds, it increases the amount of ALAN at Earth’s surface, where it can disrupt biological processes.

It progressively blots out faint features of the night sky and thereby

- **hinders astronomical education and STEM encouragement,**
- **degrades or prevents amateur and professional astronomical observations, and**
- **interferes with the 50+ millennia of traditional propagation and perpetuation of the Australian Dreamtime stories that governed tribal life and survival (‘cultural genocide’ according to Hamacher).**

ALAN has Adverse Effects on Human Health

Blask D, Brainard G, Gibbons R, Lockley S, Stevens R, Motta M. (2012) Light pollution: adverse health effects of nighttime lighting. *AMA Report 4 of the Council on Science and Public Health (A-12)*. Chicago, IL: American Medical Association. http://www.ama-assn.org/ama/pub/about-ama/our-people/ama-councils/council-science-public-health/reports/2012-reports.page?

The blue-violet component of ALAN is a risk factor for some serious ill-health conditions such as breast and prostate cancers, obesity, dementia, heart disease, and type 2 diabetes. The Cain et al. (2020) results mentioned in the next slide strengthen this earlier conclusion.

[Here and below just one or two journal papers are cited from a choice, often of many thousands, on similar or related topics.]

Even Ordinary Domestic Lights at Night Can Affect Health

Cain SW, McGlashan EM, Vidafar P, Mustafovska J, Curran SPN, Wang X, Mohamed A, Kalavally V, Phillips AJK. (2020) Evening home lighting adversely impacts the circadian system and sleep. *Scientific Reports* (Nature), 10:19210. https://doi.org/101038/s41598-020-5622-4

Nearly half of the 59 homes examined had ALAN levels before bedtime bright enough to suppress melatonin by 50%. Energy-efficient home lighting had nearly double the suppressive effect of the incandescent lamps formerly used. Home lighting significantly affects sleep and circadian rhythms but the impact of lighting for a specific individual is highly unpredictable.

A fix? Use less light, and/or with less blue content, eg yellow-orange filtered LEDS, or wear yellow-orange blue blockers before bedtime.

ALAN Suppresses Melatonin in Many Vertebrate Species

Grubisic, Haim, Bhusal et al. (2019) discussed how ALAN affects melatonin, circadian rhythms and photoreceptor systems in fishes, amphibians, reptiles, birds, and mammals including humans. Melatonin suppression can take place at or less than 0.01 to 0.03 lux for fishes and rodents, and down to 6 lux for sensitive humans.

This is bad news for the health of these and probably many other species.

Grubisic M, Haim A, Bhusal P et al. (2019) Light pollution, circadian photoreception, and melatonin in vertebrates. *Sustainability*, 11(22), 6400. https://doi.org/10.3390/su11226400

ALAN Can Affect Insect Conservation and Biodiversity ('Insect Armageddon')

ALAN's disruptive effects add to others such as insecticides and habitat loss in causing global population losses in insects.

Wiley Online (2021) Special Issue: Impacts of artificial lighting at night on insect conservation. *Insect Conservation and Biodiversity*, 14(2): i-iii, 163-270. Impacts of artificial lighting at night on insect conservation: Insect Conservation and Diversity: Vol 14, No 2 (wiley.com) or https://onlinelibrary.wiley.com/toc/17524598/2021/14/2?s=03

Street Lighting Does Not Reduce Crime or Road Traffic Injuries

Steinbach R, Perkins C, Tompson L, Johnson S, Armstrong B, Green J, Grundy C, Wilkinson P. (2015) The effect of reduced street lighting on road casualties and crime in England and Wales: controlled interrupted time series analysis. *Journal of Epidemiology and Community Health*. doi:10.1136/jech-2015-206012. http://jech.bmj.com/content/early/2015/07/08/jech-2015-206012.full

Perkins C, Steinbach R, Tompson L. et al (2015) What is the effect of reduced street lighting on crime and road traffic injuries at night? A mixed-methods study. *Public Health Research*, 3(11). ISSN 2050-4381 (Print), -439X (Online). https://doi.org/10.3310/phr03110 or http://www.journalslibrary.nihr.ac.uk/phr

These studies both used a massive database of crime and road traffic injuries in 62 local government areas in England for up to 14 years after street lighting was reduced, removed or changed in colour for greenhouse gas reduction. Both found no significant changes. This is powerful evidence that previous studies with contrary findings are highly likely to have been affected by bias or confounding.

Fix? Consider reduction, curfew or removal of streetlighting!

Can Outdoor Lighting Increase Some Types of Crime?

Despite the results just discussed, serious crimes involving stalking, rape and murder are relatively so small that pooled crime data is unlikely to show that existing lighting practice may assist offenders by helping victim selection and giving feelings of increased safety to potential victims. The mechanism for the latter effect has just been published:

McGlashan EM, Poudel GR, Jamadar JD, Phillips AJK, Cain SW. (2021) Afraid of the dark: Light acutely suppresses activity in the human amygdala. *PLoS* [Public Library of Science] *ONE,* 16(6): e0252350. https://doi.org/10.1371/journal.pone.0252350

A Counterproductive ‘Safe’ Lighting Installation (1)

This shows the City of Melbourne’s Park Lights installed along a path lined by large trees at Fawkner Park. Most of the light is directed downwards where it is needed but the rest is emitted at and above the horizontal, adding to urban sky glow and unnecessary greenhouse gas emissions. The arrangement is highly advantageous for stalkers in allowing them to remain mostly hidden behind tree trunks during victim selection and following, and being able to see in both directions whether anyone else is present on the path. The lighting entices potential victims to use the path by reducing their fear and giving them a false sense of security.

A Counterproductive ‘Safe’ Lighting Installation (2)

Both photos courtesy Bea McNicholas

Again at Fawkner Park. Relatively bright paths are separated by much larger and darker areas. A person walking along a path will be visually adapted to the brighter light and would have difficulty in seeing someone in the darker areas. A stalker could attack a victim from behind on the path when there is no one else around and drag the victim into a darker area where there is still enough light for the offender to see the victim close up. Such circumstances have been common to several sexual assaults by stalkers in recent years elsewhere in Melbourne.

Fix? Don’t light up the whole park! Discourage solo walking in deserted spaces at night.

Lighting Strategies and Standards

The City of Melbourne is about to release its recently revised Public Lighting Strategy 2021. Where appropriate, it will now apply the current Australian/New Zealand Standard AS/NZS 4282: 2019 '*Control of the obtrusive effects of outdoor lighting*'. This Standard is broadly applicable to all outdoor light sources other than those used for road and pedestrian lighting but its primary purpose is to prevent excessive glare and outdoor lighting at astronomical observatories and heritage/scientific parks and gardens: stringent limits apply to illumination and upward waste light. Unfortunately, both the Strategy and the Standard still rely on the myths described in this presentation.

Although Melbourne Observatory was decommissioned in 1945, amateurs still use its operational heritage telescopes there. It has been used regularly for public astronomy (and STEM encouragement) since 1863. The Observatory is included in the Victorian Heritage Register and the National Heritage List, and is a strong prospect for World Heritage nomination. The Observatory site is managed by the Royal Botanic Gardens of Victoria (RBGV), which claims that its public onsite events do not have to comply with AS/NZS 4282. The following two slides show how badly the Observatory was affected by two of these events.

Obtrusive Lighting at Melbourne Observatory

Light pollution and glare from non-astronomical commercial events at night on the Observatory site can severely hinder or prevent observations with the telescopes. This picture shows the intense glare from a circus tent as seen in 2018 from the Astrograph dome.

More of the same

During the Fire Gardens event at the Observatory and Melbourne Gardens in 2018, showing obvious evidence of numerous breaches of AS 4282-1997.

AS/NZS 4282: 2019 is even more stringent.