S&T LIGHTING
Emotion & Precision

Report on Lighting Provisions for Private Pedestrian Access and Private Vehicle Access for Proposed Auckland Unitary Plan Change

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Auckland Council

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Signature 

Contents

Introduction

Context

The National Policy Statement on Urban Development ('NPSUD') requires Councils to remove all parking minimums by February 2022. As a result, Auckland will have more developments that rely solely on privately owned pedestrian access. Auckland Councils Urban Design Unit are already seeing a number of these across Auckland with varying quality in terms of width, gradient, visibility and overlooking, landscape treatment and lighting. These developments typically provide for a 1.5-2 metre wide footpath down the boundary, which is the only access to the dwellings. Some of the pedestrian access provide lighting (either sensor lights mounted on the buildings or low-level bollard lighting).

The Auckland Unitary Plan (AUP) does not manage privately owned pedestrian access and in respect of lighting, only requires lighting where there are 10 or more carparks, as per the standard below:

E27.6.3.7. Lighting

(1) Lighting is required where there are 10 or more parking spaces which are likely to be used during the hours of darkness. The parking and manoeuvring areas and associated pedestrian routes must be adequately lit during use in a manner that complies with the rules in Section E24 Lighting.

Council is therefore considering a plan change because of the NPSUD, that will consider introducing minimum standards for privately owned pedestrian access, including minimum legal and formed widths, gradient, safety including passive surveillance and lighting.

Auckland Councils Urban Design Unit are also seeing a number of private vehicle access across Auckland with varying quality in terms of lighting. Council is therefore also considering minimum lighting standards for private vehicle access to ensure adequate lighting is provided for the safety of pedestrians who use these vehicle access.

Council propose that the lighting standard would ideally specify the minimum lighting levels to be achieved rather than just specifying "adequate lighting" like the existing standard, to ensure safe access for all users and to create greater certainty in interpreting and administering the AUP. The objective is to also avoid issues at monitoring stage where Council staff are not left debating which level of lighting should be achieved.

Stephenson & Turner as appropriately experienced and qualified lighting engineers were engaged by Auckland Councils Urban Design Unit to prepare a report with recommendations which would be used to inform their RMA Section 32 analysis.

Scope of Review

The scope of our review:

- Recommendation as to the minimum level of lighting that should be achieved for privately owned pedestrian access.
- Recommendation as to the minimum level of lighting that should be achieved for privately owned access.
- Any NZ or best practice standards/examples that support these recommendations.
- Recommendations on the most appropriate type(s) of lighting (e.g. column lights, bollards, sensor lights etc) to comply with our recommendations, with cognisance of space constraints within the pedestrian access and access and long term maintenance.
- Confirmation that the recommendations will also be able to achieve compliance with E24 Lighting.

Executive Summary

The AUP has no requirement for the provision of outdoor lighting for any residential properties other than Section E27 which mandates any site with more than 10 carparks requires adequate lighting for manoeuvring and to associated pedestrian paths.

This has resulted in Auckland Council needing to impose lighting conditions when considering a resource consent to ensure an appropriate lighting result is provided.

Auckland Council undertook consultation with Emergency Service Providers and their feedback highlighted the need for good signage, lighting and wayfinding for their responder's safety and speed of access/response in emergencies.

For guidance on appropriate lighting provisions to ensure an appropriate lighting result is provided we referred to the Auckland Design Manual and Auckland Transport's Design Manual.

The Auckland Design Manual provides some best practice recommendations on the use of lighting to make pedestrian access safer at night, but this advice is non-statutory.

Auckland Transports Street Lighting Engineering Design Code refers to AS/NZS 1158.3.1 for lighting performance recommendations and requirements, for pedestrian pathways the minimum design standard subcategory shall be PP3. The use of 4m high lighting columns is recommended wherever practical within narrow walkways to limit spill light.

We propose that in line with New Zealand best practice for outdoor lighting appropriate lighting can be defined through lighting provisions that require the lighting to comply with AS/NZS 1138.3.1 and to minimum lighting subcategories (design lighting levels) from this standard. We recommend the following minimum lighting subcategories:

(i) *PR2 minimum for driveways and access.*

(ii) PC2 is the minimum for car parking.

(iii) PP3 minimum for paths.

(iv) PA3 minimum for connecting elements, steps, stairways and ramps.

Often several different lighting solutions are required to provide the appropriate lighting performance. For pedestrian access 4m high lighting columns are recommended, followed by fence or building mounted lighting @1.8m or higher where these can be appropriately located.

Also building mounted lighting over entries is recommended to assist wayfinding/identification, unlocking doors and identification of visitors.

For vehicle access 4m to 6m high lighting columns are recommended, with columns located outside of driveways and footpaths, ideally they are installed within service strips or berms and a minimum of 0.7m back from road or driveway curbs. Bollard lighting is not recommended as its low light source height does not provide the recommended vertical illumination at 1.5m for good face recognition and can be glary to drivers and pedestrians impair their vision.

With the quality of night time views of the sky becoming a focus of many communities, to mitigate skyglow from pedestrian access lighting we recommend that light fittings when installed should not project any light at or above the height of their light source and all light emitted from light fittings should have a correlated colour temperature of 3000K (Kelvin) or less.

Section E24 does not control the effects of a sites lighting on any lawfully established dwellings within that site's boundary. Therefore any lighting provisions for private pedestrian access lighting should address the control of adverse effects of spill and glare to windows of the site / developments dwellings.

The lighting provisions should require automatic control of the lighting so that it is on when dark and for the lighting to be supplied from a common supply which cannot be disabled by residents.

Lighting provisions should also require the lighting to be maintained in accordance with AS/NZS1158.3.1.

Compliance of the installed lighting scheme as required by AS/NZS 1138.3.1 should be required as a condition of resource consent.

Proposed lighting standards to be included in the proposed plan change are provided at the end of this report.

Examples of Private Housing Developments

We carried out a review of a range of recently consented multi-unit housing developments with private pedestrian and vehicle access. We have included a range of development examples to provide context to the need to provide appropriate lighting and the range of configurations that are typically encountered.

Shared pedestrian and vehicle access

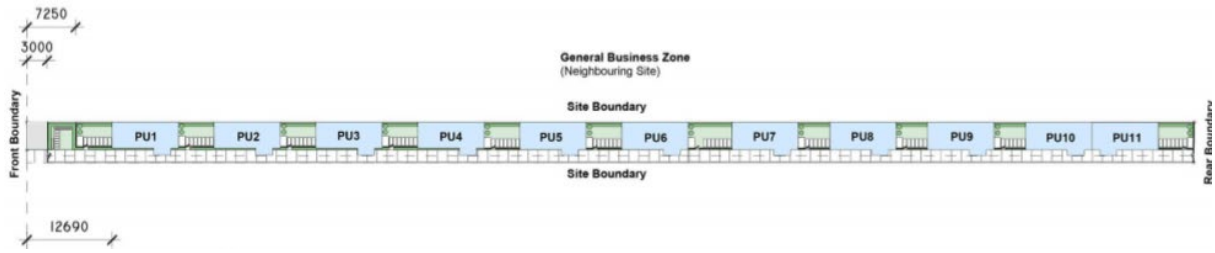
Separated pedestrian and vehicle access





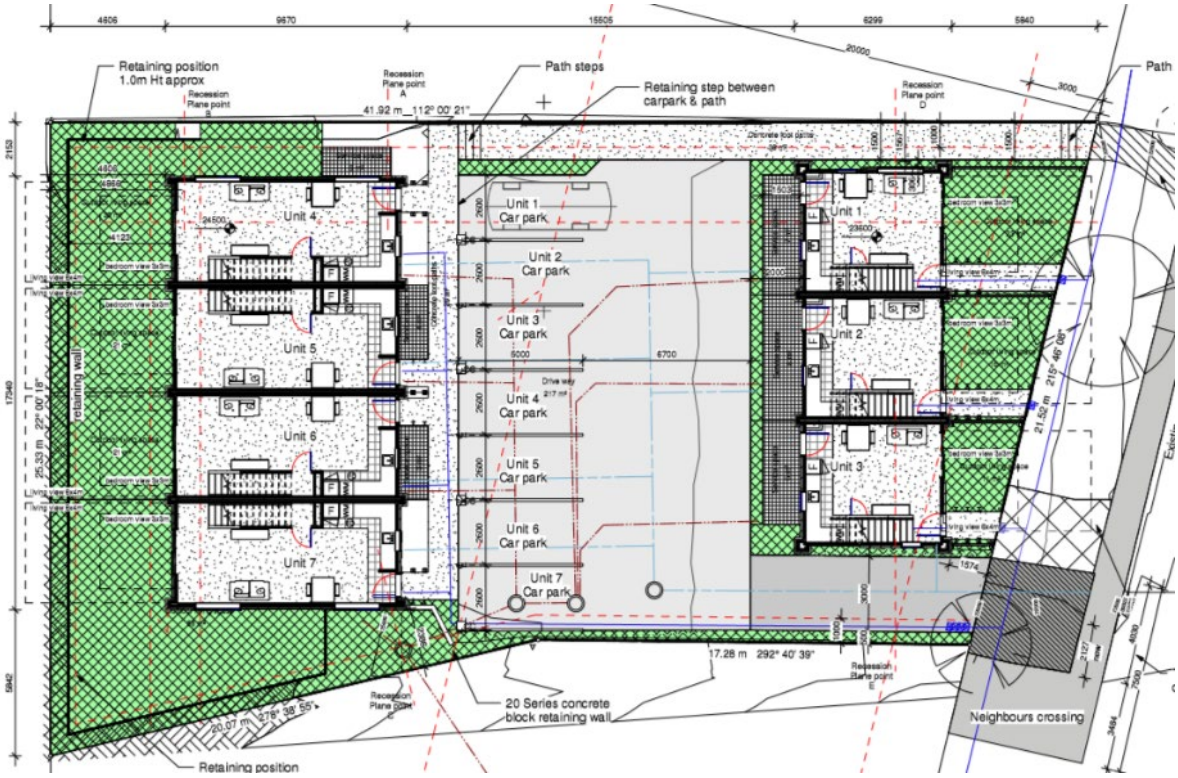
Pedestrian only access

Pedestrian only access, gated entry, units off both sides of path

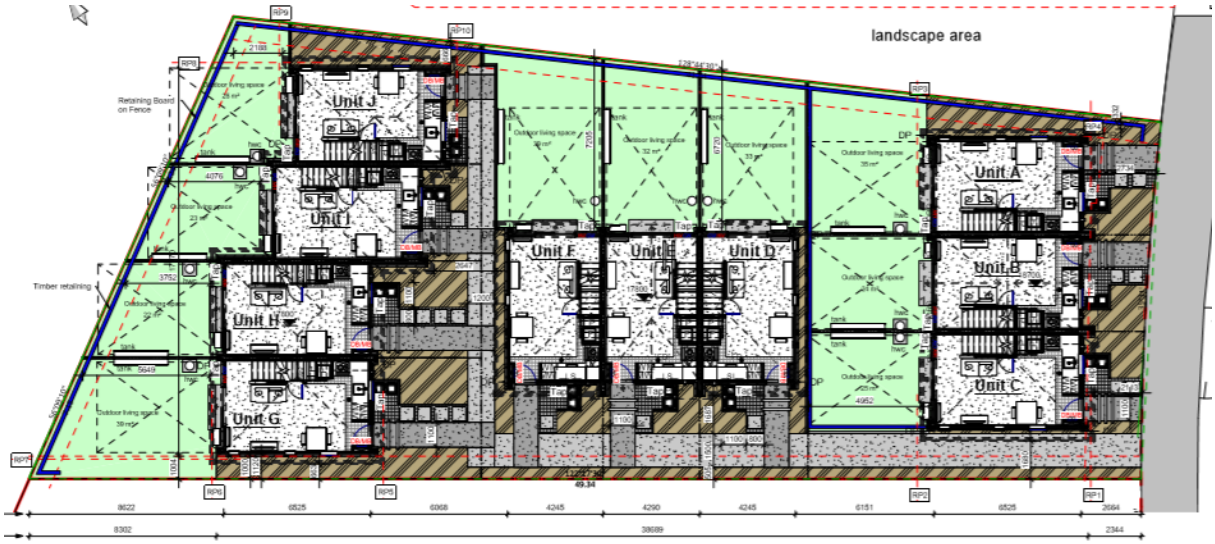


Pedestrian only access, 1.7m wide pedestrian path, 140m length serving 11 Units with end courtyards entry/exit each end.

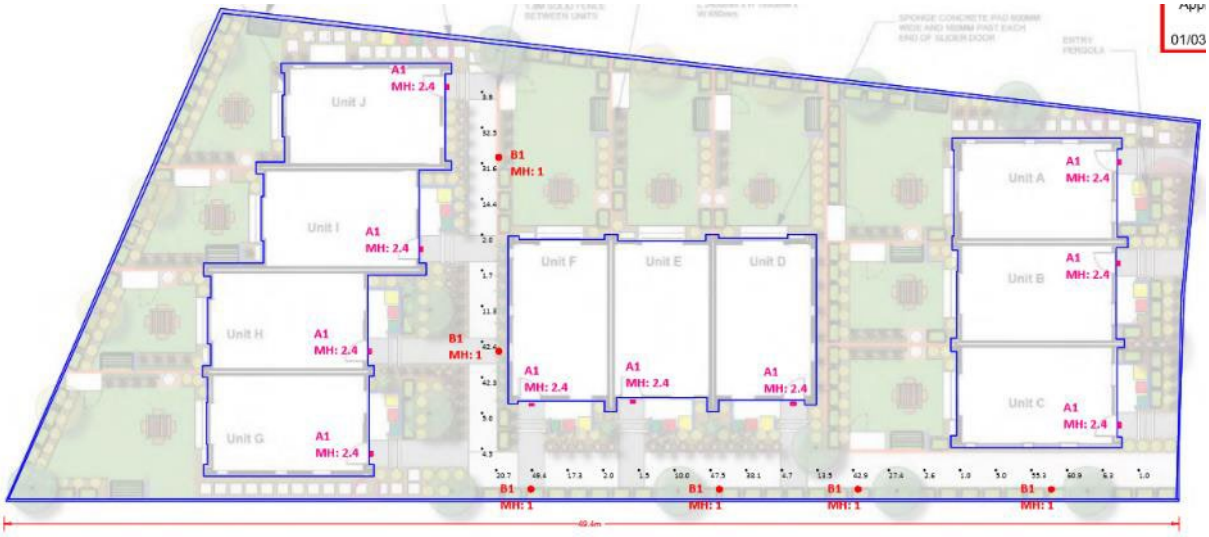
Pedestrian only access, 1.5m wide pedestrian path, 45m length serving 7 Units with front courtyards. Path has steps and ramps, boundary retaining walls and dead-end single entry/exit



Pedestrian path 1.5m wide with steps, driveway to forecourt with 7 carparks, 7 Units with front entry off forecourt



3 Units with direct access off street, 7 rear units, 1.5m pedestrian only access to middle 3 units, 1.2m pedestrian only access to 4 rear units, “L” shaped access path with dead-end single entry/exit, units entry through front courtyards



Lighting layout for previous development, 1m bollards alongside path, 2.4m building wall lights over each unit main entry door, PP4 category lighting performance

Emergency Service Provider Feedback

Auckland Council undertook consultation with Emergency Service Providers to gain an understanding of the issues that multi block units presented to them, their feedback highlighted the need for good signage, lighting and wayfinding for their staff safety and speed of access/response in emergencies. Key feedback relating to lighting included:

- New Zealand Fire - Lighting and wayfinding and unit numbering is critical, as a house fire can become fatal within three minutes.
- St Johns Ambulance - Poor or insufficient lighting can make it difficult for St Johns to find the correct property. Clear wayfinding signage is essential especially for multi block units up a pedestrian path. Unclear numbering will increase the time for emergency services to get to the patient and will increase risk. There is a greater risk of injuries to emergency response staff when access is limited, surfaces are uneven, slippery, narrow or poorly lit.
- New Zealand Police - Lack of or inadequate lighting can make it difficult for Police to find the correct property. Clear wayfinding signage is essential especially for multi block units up a pedestrian path. Unclear numbering will increase the time for emergency services to get to the patient and will increase risk. There is a safety risk for emergency response staff if the area is poorly lit.

Also any lighting columns adjacent vehicle access or parking should be located in positions that do not impact on emergency vehicle maneuvering, such as turning around.

Existing AUP lighting provisions

We carried out an analysis of the effectiveness and appropriateness of current AUP lighting provisions in the provision of lighting for public safety and conclude that there is no requirement for the provision of outdoor lighting for any residential properties other than Section E27 which mandates any site with more than 10 carparks requires adequate lighting for manoeuvring and to associated pedestrian paths.

Auckland Unitary Plan (AUP)

The Auckland Unitary Plan (AUP) applies across Auckland.

Section E24 Lighting

Section E24 covers artificial lighting and provides standards that protect adjoining properties from adverse effects of spill and glare. It does not provide any requirements for the provision of artificial lighting.

Its lighting standards are based on controlling the adverse effects on adjoining properties with these properties being on or across the boundary, with limits defined for effects at the boundary and/or at the windows of lawfully established dwellings over the boundary. As such it does not control the effects of a sites lighting on any lawfully established dwellings within that site's boundaries.

Section E24 Objectives and Policies in addition to limiting the effects of outdoor lighting also address the need for outdoor lighting to enable outdoor activities and the security and safety of people and property

E24.1. Background

Artificial lighting enables work, recreation and entertainment activities to occur beyond normal daylight hours. It also provides additional safety and security to sites and associated activities. However, unless used with care, it can adversely affect adjoining properties through light spill and glare. If screening or aiming of light is poorly controlled this can result in light pollution causing adverse changes to the view of the night sky.

The provisions for artificial light provide for adequate lighting to support activities and enable safety and security for participants, while minimising potential adverse effects.

E24.2. Objectives [rcp/dp]

(1) *Artificial lighting enables outdoor activities and the security and safety of people and property.*

(2) *The adverse effects of outdoor lighting on the environment and safety of road users are limited.*

E24.3. Policies [rcp/dp]

(1) *Provide for appropriate levels of artificial lighting to enable the safe and efficient undertaking of outdoor activities, including night time working, recreation and entertainment.*

(2) *Control the intensity, location and direction of artificial lighting to avoid significant glare and light spill onto adjacent sites, maintain safety for road users and minimise the loss of night sky viewing.*

(3) *Use area or activity specific rules where the particular functional or operational needs of the area or activity make such rules appropriate.*

Therefore any lighting provisions for private access lighting should address the control of the adverse effects of spill and glare to windows of the site / developments dwellings. They should also provide lighting provisions that will ensure adequate outdoor lighting is provided for the safety and security of private access to multi-unit housing developments.

Section E27 Transport

Section E27 mandates any site with more than 10 carparks requires adequate lighting for manoeuvring and to associated pedestrian paths.

E27.6.3.7. Lighting

(1) Lighting is required where there are 10 or more parking spaces which are likely to be used during the hours of darkness. The parking and manoeuvring areas and associated pedestrian routes must be adequately lit during use in a manner that complies with the rules in Section E24 Lighting.

We understand that this current standard also presents difficulties in determining what "adequately lit" means. This has resulted in Auckland Council needing to impose lighting conditions when considering a resource consent to ensure an appropriate lighting result is provided.

The typical lighting condition imposed by Councils UDU is:

Lighting Plans

Prior to the lodgement of Building Consent, the consent holder shall provide a ***Lighting Plan and Certification/ Specifications*** *prepared by a qualified Lighting Engineer, to the Council. The purpose of this condition is to provide adequate lighting for the safety of people residing, working or visiting the premises and its immediate environs outside of daylight hours. The Lighting Plan shall:*

- *include all accessible areas of the premises where movement of people are expected. Such locations include, but are not limited to the shared driveway, building entrances, building frontage, outdoor or undercroft carpark, footpath or common access areas.*

- *include proposed locations, lux levels and types of lighting (i.e. manufacturer's specifications once a lighting style has been determined) and any light support structures required to control timing, level of lighting, or to minimise light spill, glare, and loss of night time viewing.*
- *Demonstrate compliance with the relevant standards in E24.6.1 Lighting of the Auckland Unitary Plan (Operative in Part).*
- *Demonstrate compliance with the AS/NZS 1158 P requirements and clearly specify what P Category the lighting design will achieve. The selection criteria for the chosen lighting category should also be presented (i.e. pedestrian/cycle activity, risk of crime etc,).*
- *Include an executive summary of the above information in plain English that outlines the relevant requirements to their application and their design response to them.*

The finalised design details certified by the qualified Lighting Engineer shall be established prior to the development hereby consented being first occupied, and thereafter retained and maintained, to the satisfaction of the Council.

Advice Note: The purpose of this condition is to ensure that adequate lighting is provided to frequently used areas within the proposed development for the safety of users. Adequate lighting is the amount of lighting at eye level for a person with average eyesight so they can identify any potential threat approaching them from at least a 15-metre distance.

Therefore, the current AUP lighting provisions do not require the owner to provide outdoor lighting to private pedestrian access and private vehicle access when a site has less than 10 carparks.

Auckland Design Manual

We reviewed the Auckland Councils *Auckland Design Manual* (ADM), to identify any relevant guidance on the requirements for the lighting of private pedestrian access and vehicle access. While this information is non-statutory it does recommend the use of lighting to make a place safer at night and provides relevant guidance on best practice lighting that is applicable to pedestrian access. Relevant guidance included:

Section *Designing for Safety, Best practice for lighting* relevant guidance includes:

a) *The use of good lighting throughout an environment lets people see further and more clearly, especially in the dark. Better visibility increases the sense of safety in the space by allowing people to keep an eye on each other, giving them the confidence to participate in activities for longer*.

b) When considering lighting for pedestrians and cyclists, priorities routes that have:

- *The most users*
- *The best connections to main streets*

- *The shortest distance*
- *The most visibility throughout the site*
- *Incorporate other safe design principles.*

c) It provides guidance on the selection of light temperature, but it's recommendations are now contrary to latest lighting opinions on this subject. Refer to our comments in our section on *Light Correlated Colour Temperature*.

d) Lighting brightness is measured in lux levels. Selecting appropriate brightness depends on what the light will be illuminating. The more activities that are expected to take place in the environment, the higher the lux level should be. AS/NZS 1158 outlines the standards for pedestrian and vehicle lighting levels.

e) When choosing the height at which lights are placed, consider creating conditions where optimal visibility is experienced at pedestrian eye level, which is roughly 1.5m. Be aware of any shadows created and how they may affect the lighting on objects and people.

f) General lighting controls:

- *Provide adequate lighting in public spaces so people can identify another person from at least 15 metres distance.*
- *Minimise hazards to pedestrian and cyclists by adequately lighting the spatial features such as bins, planters, street furniture and changes in grade of the path.*
- *Choose lighting equipment that is vandal resistant in terms of material, design and location.*
- *Avoid over-lighting, glare and upwards spill lighting.*
- *Light all recesses, entrances and egress points of areas should be well lit, as should the areas around these. All potential night-time concealment spots need to be lit where access to them cannot be secured.*
- *Provide complementary lighting to facilitate progressive transition of the light in the areas that have an abrupt change from high light to low light.*

Transport Design Manual - Street Lighting

We reviewed Auckland Transport (AT) *Transport Design Manual Engineering Design Code Street Lighting Version 1*, to identify any relevant guidance on the requirements for the lighting of private pedestrian access and vehicle access. This engineering design codes purpose is *to provide a guide for everyone involved in the management and design of public lighting installations on Auckland Transport (AT) routes or associated infrastructure. Its application will ensure consistent standards are maintained.* Relevant guidance to the lighting on pedestrian and vehicle access includes:

Section *01 Introduction,* relevant guidance includes:

a) Principles of street lighting, *Public lighting is there to provide a safe environment for pedestrians and vehicles and to discourage illegal acts. At the same time, care must be taken to minimise spill light onto neighbouring properties and upward light (sky glow).*

b) Design approval, *The landscape design must be supplied when the lighting design is submitted for approval to demonstrate that the two designs are compatible and result in an efficient lighting design.*

Section *02 Applicable standards,* relevant guidance includes:

a) AT controlled public lighting must be designed and installed in accordance with all applicable standards with all current amendments, including:

- *AS/NZS 1158 – Lighting for Roads, and Public Spaces*
- *AS/NZS 3000 – Australia/New Zealand Wiring Rules*
- *AS/NZS 4282 – Control of the obtrusive effects of outdoor lighting*

Section *03 Lighting design,* relevant guidance includes:

a) The AS/NZS 1158.3.1 standards should be used to determine the appropriate lighting classification and sub-category.

b) Pedestrian access ways must be lit to the appropriate P category as set out in the current version of AS/NZS 1158.3.1 Table 2.2 of that document defines the criteria for determining the lighting subcategory.

c) The minimum category shall be PP3.

d) Luminaires must be column top mounted at a height suitable to allow access by ladder.

e) The use of 4m high lighting columns is recommended wherever practical within narrow walkways to limit spill light.

f) Verandas/canopies, refer to the AUP for lighting requirements.

g) Private access, refer to AUP Section E27.6.3.7 (lighting for 10 or more parking spaces).

h) Design, the minimum design standard for pedestrian pathways / cycleways shall be PP3. This typically relates to dedicated pedestrian, cycleway and shared use pathways.

i) The lighting design must optimize the design spacing between luminaire positions by considering the combination of the mounting height, luminaire type, lumen output and luminaire wattage.

j) Light spill, the lighting design must minimise glare and light spill on neighbouring properties and the environment. In accordance with AS/NZS 4282:2019 (Control of the obtrusive effects of outdoor lighting).

Luminaires must be installed with zero tilt relative to the road surface.

k) *The placement of lighting columns should always be coordinated with trees to provide an acceptable urban landscape.*

l) *Where new trees are proposed, lighting columns should be located first to provide the correct lighting levels in accordance with AS/NZS 1158. Only then should trees be located to create the daytime aesthetic3.*

m) *Trees should be positioned such that the expected future dripline, when the tree is mature, will provide a minimum clearance of 2 metres from the lighting column. The expected future dripline of the trees when mature must be shown on the lighting design layout. Consider the potential impact of shadows from road lighting when the trees are mature.*

n) *Also consider the use of 6m columns in treed subdivisions. This will result in additional lights, but will better contribute light onto the road from under the tree canopy and limit spill light.*

Section *04 Lighting columns,* relevant guidance includes:

a) Minimum setbacks, *Columns must be placed at least 1m from the side of a driveway.*

b) Tolerances, *Kerb setback no less than 0.7m*

c) Footpaths, *Street lighting columns should be clear of footpaths. Where this is not possible, place them towards the back edge of the footpath. Maintain a clear 1.5m minimum footpath space.*

Section *05 Luminaires,* relevant guidance includes:

a) In-ground uplights, *In-ground uplights must not present a trip tripping or slip hazard. Internal anti-glare attachments must be positioned to limit upward light.*

b) Bollard luminaires, *The use of bollard luminaires must be pre-approved by Auckland Transport. The construction and finishes of bollard luminaires must be consistent with the requirements for columns and luminaires. In addition these lights must:*

- *Have a maximum luminous intensity in any normal viewing direction not exceeding 500cd.*
- *Have an optic to control the light distribution.*
- *Have a concrete foundation to the manufacturer's recommendations.*

c) Light source, *All new or replacement luminaires must be LED luminaires.*

Section *06 Road lighting in specific areas,* relevant guidance includes:

a) 6.2 Safety and security lighting, *A principle of Crime Prevention Through Environmental Design (CPTED), is that lighting can reduce the risk of crime and improve safety levels on local roads and public spaces. See also AS/NZS 1158.3.1.*

Kainga Ora Guide to Driveway Safety for Property Owners

We reviewed the Kainga Ora *Guide to driveway safety for property owners*, to identify any relevant guidance on the requirements for the lighting of private pedestrian access. The guides purpose is *to provide property owners with general guidance on making driveways safer to reduce risk of young children being run over. Where feasible and where budgets allow, the guide also includes recommendations for driveways safer for other pedestrians and vehicles.* Relevant guidance to the lighting of pedestrian access includes:

> *Consider the principles of Crime Prevention Through Environmental Design (CPTED), for example proving exterior lighting and visual surveillance from dwellings and common places.*
>
> *Consider how to provide access and turnaround space for service and emergency vehicles.*

Design Tips included

> *Pedestrian access routes should consider safety issues such as using non-slip surfaces and night-time lighting, and using the principles of Crime Prevention Through Environmental Design (CPTED).*

Best Practice Examples

The Whangarei District Plan is an example of implementing compliance with AS/NZS1158 series of standards as a means to ensure that appropriate artificial light is provided to maintain security and support the safe use of areas after dark.

Whangarei District Plan – Lighting (NL)

The 2019 changes to the Whangarei District Plan introduced Chapter NL Lighting[1] which provides the following relevant references to the provision of artificial light to maintain security and support the safe use of areas after dark. It requires lighting to comply with AS/NZS1158 series of standards and requires the lighting to be calculated in accordance with the methods described in the AS/NZS1158 series of standards, or alternative method of compliance certified by in a statement by a suitably qualified and experienced professional:

Within the Overview:

> *Artificial lighting enables a variety of activities to occur beyond daylight hours.*
>
> *Artificial light is also important to maintain security and support the safe use of areas after dark.*
>
> *The artificial lighting provisions of this chapter both manage and require artificial lighting, in order to support the health and safety of people.*

Within the Objectives:

> *Artificial lighting is provided to enable activities to occur outside of daylight hours and to support the health, safety and security of people, communities, and their property.*

[1] https://www.wdc.govt.nz/files/assets/public/documents/services/property/planning/plan-changes/pc-urban-and-services/1-notified-chapters/nl-lighting.pdf

Within the Rules:

Rule NL-R2.5, Any artificial lighting is a Permitted Activity, where it meets the Requirements NL-REQ1.

Rule NL-R7, Artificial lighting within any subdivision is a Controlled Activity, where it is provided for all streets, walkways, cycleways and roads created by the subdivision and if it complies with AS/NZS1158 series of standards.

NL-R7	Any Subdivision	
	Activity Status: C Where: 1. Artificial lighting is provided for all streets, walkways, cycleways and roads created by the subdivision. 2. The artificial lighting complies with the AS/NZS158 series of standards as listed in REF.1 Referenced Documents at REF.1.2 a. Matters of control: 1. Amenity and character of the surrounding environment. 2. Traffic and pedestrian safety.	Activity Status when compliance not achieved: RD Matters of discretion: 1. The effects of artificial lighting and glare on the amenity values and the character of the zone or surrounding environment. 2. The effects of lighting on traffic and pedestrian safety.

Within the Requirements:

REQ1.3 lighting for pedestrian areas shall be calculated in accordance with the methods described in the AS/NZS1158 series of standards, or alternative method of compliance certified by in a statement by a suitably qualified and experienced professional.

NL-REQ1	Lighting Measurement
	1. Unless specified otherwise, lighting shall be measured by calculation with a proprietary lighting design program which details the direct, horizontal and vertical plane illuminance with a maintenance factor set at 1.0 at any point and height of an adjacent property boundary. 2. The light intensity shall be measured by calculation with a proprietary lighting design program at a height of 1.5 metres at any point on the adjacent property boundary. 3. Road lighting and lighting for parks, reserves, publicly accessible/used areas and pedestrian areas shall be calculated in accordance with the methods described in the AS/NZS 1158 series of standards as listed in REF.1 Referenced Documents at REF.1.2 a. or alternative method of compliance certified in a statement by a suitably qualified and experienced professional (e.g. Chartered Professional Engineer or Independently Qualified Person). 4. For illuminated signage, the maximum sign brightness shall be measured by calculation or certified statement by a suitably qualified and experienced professional (e.g. Chartered Professional Engineer or Independently Qualified Person). *Note: Measurement of the final installation may be required in order to ensure compliance.*

Australian / New Zealand Standard AS/NZS 1158.3.1:2020

In carrying out this review and providing lighting provision recommendations we have considered the requirements provided in Australian / New Zealand Standard AS/NZS 1158.3.1:2020 Lighting for roads and public spaces, Part 3.1: Pedestrian area (Category P) lighting – Performance and design requirements.

This is a combined Australian / New Zealand standard recently updated in 2020 and therefore can be considered to very relevant to today's requirements and lighting technologies which include LED lighting.

This standard is widely used and referenced by regulatory authorities and lighting designers throughout Australasia when designing lighting for roads, pathways and public spaces.

The "Foreword" to this standard states that *This Standard sets our performance and design requirements for Category P lighting schemes having regard to the safe movement of pedestrians, degree of activity (of pedestrians and vehicles), the fear of crime and the need to enhance the amenity of the locality.*

Category P lighting is acknowledged to be an effective counter measure to the fear of crime.

For each lighting subcategory described in this Standard, the light technical parameters (LTP's) and their prescribed values are both necessary and sufficient for the particular application. Conformance to this Standard will be achieved by meeting all the required values of the LTPs for the designated subcategory.

Relevant guidance from this standard includes:

a) Lighting subcategories for roads in local areas.

b) Lighting subcategories for pedestrian and cyclist paths.

c) Lighting subcategories for connecting elements.

Fear of Crime

AS/NZS1158.3.1:2020 uses the *Fear of Crime* criterion so that the level of lighting may be selected in order to reduce the fear of crime and to promote a feeling of safety.

If a community has a fear or heightened perception of crime (which may or may not be justified) it may lead to a greater fear of becoming a victim of crime. This reduces the quality of life for individuals and also leads to changes in lifestyle, including not going out at night.

Need to Enhance Amenity

AS/NZS1158.3.1:2020 uses the *Need to Enhance Amenity* criterion so that the level of lighting may be selected where a higher degree of amenity is desired, e.g., in a new housing development or in a refurbishment of a civic area.

Lighting Subcategory for Pedestrian and Cyclist Paths

To determine the lighting requirements for pedestrian paths that form part of private pedestrian access in multi-unit developments reference can be made to AS/NZS1158.3.1:2020 Table 2.2 which provides the selection criteria for determining the lighting subcategory for *pathways and cyclist paths*.

TABLE 2.2

LIGHTING SUBCATEGORIES FOR PEDESTRIAN AND CYCLIST PATHS

1	2	3	4	5
Type of pathway		Selection criteria[a,b,c]		Applicable lighting subcategory
General description	Basic operating characteristics	Pedestrian/ cycle activity	Fear of crime	
Pedestrian or cycle orientated pathway, e.g. footpaths, including those along local roads[d] and arterial roads[e], walkways, lanes, park paths, cyclist paths	Pedestrian and or cycle traffic only	N/A	High	PP1[c]
		High	Medium	PP2[c]
		Medium	Medium	PP3
		Medium	Low	PP4
		Low	Low	PP5

[a] The selection criteria of Columns 3 to 4 should be separately evaluated. The highest level of any of the selection criteria that is deemed appropriate for the pathway will determine the applicable lighting subcategory.

[b] See Appendix A for guidance on choosing the applicable level of each selection criteria for the environment and purpose of a lighting scheme.

[c] Where there are vertical surfaces of high reflectance (e.g. light coloured walls bordering on an alleyway) alongside the pathway, the next lower lighting subcategory may be selected.

[d] Where the footpath is along a local road and subcategory PP1 or PP2 is selected, the light technical parameters for that subcategory should only apply to the formed footpath.

[e] Footpaths associated with arterial roads are deemed not to require separate lighting provided that—

(a) the road is lit to at least the applicable level of Category V lighting conforming to AS/NZS 1158.1.1; and

(b) the footpath is unshaded, e.g. there are no substantially continuous building awnings, trees (refer to AS/NZS 1158.1.2) and the footpath is contiguous with the roadway.

For a private pedestrian access path, the *Pedestrian/cycle activity* could be considered to be *Low* if serving up to 10 houses and *Medium* if serving more than this.

For a private pedestrian access path, *Fear of crime* should be considered to be *Medium* as you want residents to have a good sense of being safe and this will also provide good lighting conditions desired for emergency service providers.

AS/NZS1158.3.1:2020 Table 3.4 provides the lighting technical parameters for path pedestrian and cyclist paths.

TABLE 3.4

VALUES OF LIGHT TECHNICAL PARAMETERS FOR PATHWAYS AND CYCLIST PATHS

1	2	3	4	5
Lighting subcategory	Light technical parameters (LTP)			
	Average horizontal illuminance[a,b] ($\bar{E}_h$) lx	Point horizontal illuminance[a,b,d] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})	Point vertical illuminance[a,b] (E_{Pv}) lx
PP1	10	2	5	1
PP2	7	1	5	0.3
PP3	3	0.5	5	0.1
PP4	1.5	0.25	5	0.05[e]
PP5	0.85	0.14	5	0.02[e]

[a] These values are maintained. See Clause 3.2 pertaining to lumen derating values for non-white light sources.

[b] Conformance is achieved by being greater than or equal to the applicable table value.

[c] Conformance is achieved by being less than or equal to the applicable table value.

[d] Conformance of 50% of E_{ph} shall also be demonstrated over an area of 5 m either side of the pathway—where a verge exists—or up to any structure/fence/property boundary that forms the edge of the pathway, unless deemed otherwise by the relevant authorities (see Clause 3.1.3.5).

[e] For luminaires with mounting heights of 1.5 m or less, the E_{Pv} values need not be applied.

NOTES:

1 Validation of the values in Columns 2 to 5 is by calculation, not field measurement. This is particularly relevant to small values in Columns 2, 3 and 5, which will typically be difficult to validate by field measurements.

2 See Section 4 for the design methods and requirements for use in assessing conformance to the specified light technical parameters.

We recommend a minimum of *PP3* for private pedestrian paths. This aligns with AT's minimum requirements for pathway lighting.

Lighting Subcategory for Connecting Elements

To determine the lighting requirements where the access path includes steps, stairways or ramps these are *connecting elements* reference can be made to AS/NZS1158.3.1:2020 Table 2.4 provides the selection criteria for determining the lighting subcategory for *connecting elements*.

TABLE 2.4

LIGHTING SUBCATEGORIES FOR CONNECTING ELEMENTS

Type of area	Applicable lighting subcategory
Subways, including associated ramps or stairways	PE1
Steps and stairways, ramps, footbridges, pedestrian ways	PE2
Ramps and footbridges associated with low use pathways (e.g. in parks and reserves)	PE3

NOTE: Subways are listed as a separate subcategory because of a fear of crime.

For a private pedestrian access path, any steps, stairways or ramps are to be lit to lighting subcategory *PE2*.

AS/NZS1158.3.1:2020 Table 3.6 provides the lighting technical parameters for connecting elements.

TABLE 3.6

VALUES OF LIGHT TECHNICAL PARAMETERS FOR CONNECTING ELEMENTS

1	2	3	4	5
Lighting subcategory	Light technical parameters (LTP)			
	Average horizontal illuminance[a,b,d] ($\bar{E}_h$) lx	Point horizontal illuminance[a,b] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})	Point vertical illuminance[a,b] (E_{Pv}) lx
PE1	35	17.5	8	17.5
PE2	Same as for highest lighting subcategory applying to areas that abut the connecting element but, where forming part of a road or pathway, to be not less than subcategory PA3 in Table 3.5.			
PE3	Same as for highest lighting subcategory applying to areas that abut the connecting element but, where forming part of a road or pathway, to be not less than subcategory PP3 in Table 3.4.			

[a] These values are maintained.

[b] Conformance is achieved by being greater than or equal to the applicable table value.

[c] Conformance is achieved by being less than or equal to the applicable value.

[d] For steps, the requirements assume that the noses of the treads are clearly delineated by a contrasting stripe or other equally effective means. If this does not apply, the illuminance should be at least twice the value specified.

NOTES:

1 It is recommended that the walls of subways be finished in a light colour to facilitate inter-reflection of light within the space. Such inter-reflected light may be taken into account in the achievement of the specified light technical parameters.

2 See Section 4 for the design methods and requirements for use in assessing conformance to the specified light technical parameters.

The lighting technical parameters for lighting subcategory *PE2* are to be the same as the highest lighting subcategory applying to areas that abut the connecting element but, where forming part of a pathway, to be not less than lighting subcategory *PA3* in Table 3.5.

TABLE 3.5

VALUES OF LIGHT TECHNICAL PARAMETERS FOR PUBLIC ACTIVITY AREAS (EXCLUDING CAR PARKS)

1	2	3	4	5
	Light technical parameters (LTP)			
Lighting subcategory	Average horizontal illuminance[a,b] ($\bar{E}_h$) lx	Point horizontal illuminance[a,b] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E1})	Point vertical illuminance[a,b,d] (E_{Pv}) lx
PA1	21	7	8	7
PA2	14	4	8	4
PA3	7	2	8	2

[a] These values are maintained.

[b] Conformance is achieved by being greater than or equal to the applicable table value.

[c] Conformance is achieved by being less than or equal to the applicable value.

We recommend a minimum of *PA3* for connecting elements, steps, stairways and ramps.

Lighting Subcategory for Roads in Local Areas

To determine the lighting requirements for private vehicle access and where pedestrian access is adjacent or included (shared access) within driveways/access in multi-unit developments reference can be made to AS/NZS1158.3.1:2020 Table 2.1 which provides the selection criteria for determining the lighting subcategory for *roads in local areas*.

TABLE 2.1

LIGHTING SUBCATEGORIES FOR ROAD RESERVES IN LOCAL AREAS

1	2	3	4	5	6
Type of road or pathway		Selection criteria[a,b]			Applicable lighting subcategory[c,d]
General description	Basic operating characteristics	Pedestrian/ cycle activity	Fear of crime	Need to enhance amenity	
Collector roads or non-arterial roads which collect and distribute traffic in an area, as well as serving abutting properties	Mixed vehicle and pedestrian traffic	N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3[f] or PR4[f]
		Low	Low	Low	PR5
Local roads or streets used primarily for access to abutting properties, including residential, commercial and industrial precincts		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3[f] or PR4[f]
		Low	Low	Low	PR5
		N/A	N/A	N/A	PR6[e]
Common area, forecourts of cluster housing		N/A	High	N/A	PR1
		High	Medium	High	PR2
		Medium	Low	Medium	PR3[f] or PR4[f]
		Low	Low	Low	PR5

[a] The selection criteria of Columns 3 to 5 should be separately evaluated. The highest level of any of the selection criteria that is deemed appropriate for the road will determine the applicable lighting subcategory.

[b] See Appendix A for guidance on choosing the applicable level of each selection criteria for the environment and purpose of a lighting scheme.

[c] All lighting subcategories apply across the whole of the road reserve width, including the footpath.

[d] Where there is a significant fear of crime or where required by the relevant authority, then, for enhanced lighting of the formed pathways, see Table 2.2.

[e] Use of subcategory PR6 shall be discretionary.

Generally, subcategory PR6 is only applied to the replacement of existing luminaires installed on existing electricity distribution poles or for the initial application of a lighting scheme where the cost to re-configure these poles limits or precludes conformance to subcategory PR4 and PR5 respectively.

NOTE: It is also appropriate to use one subcategory lower to take advantage of the cost reductions available when utilizing electricity distribution poles rather than dedicated lighting columns, i.e. if the desired subcategory is PR3, PR4 or PR5 and if electricity distribution poles are used then levels PR4, PR5 or PR6 respectively, may be used.

However, it is recognized that, for some authorities, there may be some specific lighting tasks where subcategory PR5 could be deemed to be excessive in terms of providing adequate level of service and meeting with community expectations. In this case subcategory PR6 may be used.

[f] Category PR3 is generally used in Australia and Category PR4 is generally used in New Zealand.

For a private driveway/access, the *Pedestrian/cycle activity* could be considered to be *Low* if serving up to 9 parking spaces or dwellings, *Medium* if serving 10-19 parking spaces or dwellings and *High* when serving 20 or more.

For a private driveway/access, *Fear of crime* should be considered to be *Medium* as you want residents to have a good sense of being safe and this will also provide good lighting conditions desired for emergency service providers.

For a private driveway/access, *Need to Enhance Amenity* we consider to be *Medium* as it is important for occupants of multi-unit residential developments to have good amenity.

AS/NZS1158.3.1:2020 Table 3.3 provides the lighting technical parameters for roads in local areas.

TABLE 3.3

VALUES OF LIGHT TECHNICAL PARAMETERS FOR ROADS IN LOCAL AREAS

1	2	3	4
Lighting subcategory	Light technical parameters (LTP)		
	Average horizontal illuminance[a,b] ($\bar{E}_h$) lx	Point horizontal illuminance[a,b] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})
PR1	7	2	8
PR2	3.5	0.7	8
PR3[e]	1.75	0.3	8
PR4[d,e]	1.3	0.22	8
PR5[d,e]	0.85	0.14	10
PR6[d]	0.7	0.07	10

[a] These values are maintained.

[b] Conformance is achieved by being greater than or equal to the applicable table value.

[c] Conformance is achieved by being less than or equal to the applicable table value.

[d] See Clause 3.2 pertaining to lumen derating values for non-white light sources.

[e] When the luminaires are to be supported on existing electricity reticulation poles, the subcategories PR3, PR4 and PR5 may be reduced to the next lower subcategory PR4, PR5 and PR6 respectively.

NOTES:

1 Validation of the values in Columns 2 to 4 is by calculation, not field measurement. This is particularly relevant to small values in Columns 2, and 3, which will typically be difficult to validate by field measurements.

2 See Section 4 for the design methods and requirements for use in assessing conformance to the specified light technical parameters.

3 Where there is a significant fear of crime or where required by the relevant authority then for enhanced lighting of the formed pathways, see Table 3.4.

4 The requirements for minimum obtrusive light specified in Clause 3.1.3 apply.

We recommend a minimum of *PR2* where a pedestrian footpath is adjacent to or included within a vehicle access.

We recommend a minimum of *PR5* where vehicle access is serving up to 4-9 parking spaces or dwellings, PR4 where serving 10-19 parking spaces or dwellings and PR2 where serving 20 or more.

Lighting Subcategory for Outdoor Carparks

To determine the lighting requirements for outdoor carparks in multi-unit developments through which pedestrian and vehicle access is made reference can be made to AS/NZS1158.3.1:2020 Table 2.5 which provides the selection criteria for determining the lighting subcategory for *outdoor carparks*.

TABLE 2.5

LIGHTING SUBCATEGORIES FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)

1	2	3	4
Type of area	Selection criteria[a,c]		
	Night time vehicle and/or pedestrian movements	Fear of crime	Applicable lighting subcategory[b]
Parking spaces, aisles and circulation roadways	High	High	PC1
	Medium	Medium	PC2
	Low	Low	PC3
Designated parking spaces specifically intended for people with disabilities	N/A	N/A	PCD
For any designated areas for pedestrians to cross	N/A	N/A	PCX

[a] The selection criteria of Columns 2 to 4 should be separately evaluated. The highest level of any of the selection criteria that is deemed appropriate for the area type will determine the applicable lighting subcategory.

[b] Providing a lighting scheme that meets the requirements of more than one subcategory by the use of switching is permitted.

[c] Consider the use of adaptive lighting controls for variable night time utilization.

For a private carpark, the *Pedestrian/cycle activity* could be considered to be *Low* if serving up to 4-9 parking spaces, *Medium* if serving 10-19 parking spaces and *High* when serving 20 or more parking spaces.

For a private carpark, *Fear of crime* should be considered to be *Medium* as you want residents to have a good sense of being safe and this will also provide good lighting conditions desired for emergency service providers.

AS/NZS1158.3.1:2020 Table 3.7 provides the lighting technical parameters for outdoor carparks.

TABLE 3.7

VALUES OF LIGHT TECHNICAL PARAMETERS FOR OUTDOOR CAR PARKS (INCLUDING ROOF-TOP CAR PARKS)

1	2	3	4	5
Lighting subcategory	Light technical parameters (LTP)			
	Average horizontal illuminance[a,b] ($\bar{E}_h$) lx	Point horizontal illuminance[a,b] (E_{Ph}) lx	Illuminance (horizontal) uniformity[c] Cat. P (U_{E2})	Point vertical illuminance[a,b] (E_{Pv}) lx
PC1	14	3	8	3
PC2	7	1.5	8	1
PC3	3.5	0.7	8	—
PCD[d]	—	≥14 and ≥($\bar{E}_h$)[d]	—	—
PCX[e]	21	5	8	—

[a] These values are maintained.

[b] Conformance is achieved by being greater than or equal to the applicable table value.

[c] Conformance is achieved by being less than or equal to the applicable table value.

[d] E_{Ph} shall be determined for each PCD area in the car park and, in each case, it shall be greater than the value stated and greater than the average for the overall car park.

[e] This level shall be used for any marked areas for pedestrians to cross.

NOTES:

1 See Section 4 for the design methods and requirements for use in assessing conformance to the specified light technical parameters.

Conformance to the light technical parameters in Table 3.7 is based on an open, unoccupied car park, i.e. free of vehicles.

2 Where raised obstructions are present, e.g. to limit vehicle movement in parking areas, these obstructions present potential hazards for pedestrians. Such obstructions should therefore be of such a material, or so finished, as to provide a high visual contrast with the paved surface.

3 See Table 3.6 for the requirements that apply to connecting elements, including steps and ramps within car parks.

4 The luminaires should be positioned to highlight physical obstructions or other similar hazards to pedestrian and vehicular traffic.

5 Lighting performance requirements for indoor car parks are specified in AS/NZS 1680.2.1.

We recommend a minimum of *PC2* for outdoor carparks in multi-unit developments as pedestrian and vehicle access is often through these carparks.

Basis of Conformance

AS/NZS1158.3.1 includes requirements for verifying compliance of both the design and the installed lighting solutions and therefore if the access lighting is to comply with this Standard there may be no need to include conformance requirements in the lighting provisions, you could stipulate that compliance of the design required by AS/NZS1138.3.1. is included in the Resource Consent application. Similarly, compliance of the installed lighting scheme could be included as a condition of the Resource Consent.

AS/NZS1158.3.1 section ***3.6.1 Conformance of the design*** sets out the criteria for proving design conformance, which includes defined documentation.

> *The design of the lighting scheme shall be deemed to conform to this Standard if, when created in accordance with Section 4, it satisfies the applicable light technical parameters of Tables 3.3 to 3.7 when considered together with the applied maintenance factor and the documentation listed in Appendix C is provided.*

AS/NZS1158.3.1 section ***3.6.2 Conformance of the installed lighting scheme****,* sets out the criteria for proving the installed lighting scheme.

> *After installation of a lighting scheme conforming to Clause 3.6.1, the installation shall be deemed to continue to conform to this Standard if-*
>
> *(a) An audit of the installation shows that it accurately replicates the final design (i.e. 'as built' verification);*
>
> *(b) The final design documentation includes any change to the original design made or agreed to by the designer in response to circumstances arising during installation and these changes do not cause non-conformance of the design with the requirements of Clause 3.6; and*
>
> *(c) Either-*
>
> *(i) The maintenance regime referred to in Appendix C, Item (k) is implemented; or*
>
> *(ii) An alternative maintenance regime is implemented that can be demonstrated to provide a maintenance factor equal to or better than the design value.*
>
> *Conformance of the installed lighting scheme to the LTPs shall be based on calculation according to AS/NZS1158.2, not by site measurement.*

Documentation Required for Demonstrating Conformance to This Standard

AS/NZS1158.3.1:2020 Appendix C specifies the documentation required for demonstrating conformance to this standard.

APPENDIX C

DOCUMENTATION REQUIRED FOR DEMONSTRATING CONFORMANCE TO THIS STANDARD

(Normative)

The following documentation shall be prepared in order to demonstrate conformance to the requirements of this Standard (see Clause 3.6):

(a) A statement shall be prepared by a competent person that either—

  (i) states that the design meets both the design brief and all requirements of this Standard and shall include details of any conforming increases in maximum spacing in accordance with Clause 4.1.2 that have been utilized in the design process; or

  (ii) identifies and justifies any aspects of the design that do not conform with either the design brief, or this Standard, or both.

(b) The essential details of all elements of the road or public space to be lit.

(c) The selected lighting subcategory and the off-peak lighting subcategories in an adaptive lighting scheme.

(d) Details of the lighting arrangement and geometry, e.g. spacing, mounting height, overhang, tilt angle.

(e) Details of the lighting columns, e.g. location (including offset), type, height, material and finish.

(f) Details of the luminaires and light sources to be used, e.g. luminaire identification details, light source type, rating and luminous flux.

(g) A scaled plan showing significant road or public space features (e.g. kerbs, property boundaries) and the proposed lighting scheme (e.g. pole locations).

(h) For each of the road elements or public spaces involved, the design method used and the values of the light technical parameters obtained, compared to the limiting values given in Tables 3.3 to 3.7.

(i) The origin of the photometric data for the luminaires and light sources.

(j) The name and source of the computer program used and a statement of its conformance to AS/NZS 1158.2.

(k) The maintenance factor used in the design and the basis for that maintenance factor, including the following:

  (i) Luminaire ingress protection rating specified.

  (ii) Luminaire cleaning cycle specified.

  (iii) Light source replacement strategy specified.

  (iv) Maximum lumen depreciation allowable.

  (v) Light source mortality allowable.

(l) If required, the provision of power density indicator (PDI) and annual energy consumption indicator (AECI) calculated values for the lighting scheme.

Lighting Solutions

The following is a review of possible lighting solutions and their advantages and disadvantages for lighting private pedestrian access. Often several different lighting solutions are required to provide the required lighting performance. This is often where a lighting solution fails because the design has been restricted to one lighting product / solution.

The provision of this lighting could complement or enhance the visual amenity of the illuminated route or area by the aesthetics of the installation.

Bollard Lighting

Bollard lighting is generally considered to occur at heights of 500mm – 1200mm, above these heights we would consider such lighting to be column lighting. Bollard lighting provides best lighting results when located along the edge of the pedestrian path.

They should not be installed within the path as they then become a hazard to pedestrians and are more prone to accidental damage.

Not suitable where face vertical illumination is required, i.e. category, PP3, PA3, PC2 or higher. For example, to meet PP3 there is a vertical lighting parameter (@1.5m face height) to be met, for a bollard to meet this criterion it would need to be a minimum of 1.5m high or it would need to project light upwards above the horizontal which is not permitted by proposed lighting provision (e) (All light fittings when installed shall not project any light at or above the height of their light source.) and can be a safety hazard if it was too bright in the direction of a pedestrian eyes, causing glare that affected their vision.

Proposals stating that bollard lighting is meeting higher subcategories, such as PP2, are unlikely and possibly only due to reliance on highly reflective surfaces, which may not be maintained in the long term, being conditional at that point in time only.

Advantages

- Generally good for way finding particularly when located in landscaping on the edge of a path, it is clear to the user where the path runs.

- Can be a good solution for lighting steps, changes in path level or path obstacles.
- Good control of spill light, with no direct light into bedroom windows due to the low height of the light source and projected light. A solid boundary fence would provide total screening of spill light and views of the light source.
- All light projected below the horizontal from the light source (except for a few poor bollard designs that don't shield light above the height of the light source), therefore good skyglow mitigation.
- Wiring is readily concealed as it is run underground between bollards.

Disadvantages

- If lighting category PP3, PP2 or PP1 is required, then there is a vertical lighting parameter (@1.5m face height) to be met, which a bollard solution will not meet.
- Can be an obstacle for furniture removals, particularly when mounted on the edge of path.
- They require robust construction and installation, otherwise susceptible to being damaged both accidently (often by furniture removals) or intentionally.
- Often don't provide sufficient lighting of faces to facilitate recognition of a path user, particularly at a distance.
- Some bollards can be glary which can impair night vision and result in trips or falls.
- Not a good solution when located adjacent carparking, as their light is blocked from reaching the path by parked cars.
- When used in vehicle access they can be glary to drivers and impair driver vision.
- The depth of their in-ground foundations can restrict where underground services can be run, particularly when there is only a narrow zone for services to run down an access.

Column Lighting

Column lighting generally requires the least number of light fittings.

Columns should not be installed within the path as they then become a hazard to pedestrians and are more prone to accidental damage.

Good solution where face vertical illumination is required, i.e. category, PP3, PA3, PC2 or higher.

For lighting private pedestrian access, the use of 4m high lighting columns is recommended wherever practical as they are suited to lighting narrower paths and their light fittings can be accessed via a ladder. Light fittings on 3m high columns are more susceptible to damage both intentional and accidental.

For lighting private vehicle access, the use of 6m high lighting columns can be a more economical solution as it can provide greater column spacings, light fittings with back spill light shields may be required to mitigate spill light effects behind the columns. Columns should be located a minimum of 0.7m (ideally 1m) from the road kerb to avoid damage from

vehicles and high sided trucks. Ideally columns should be installed within the service strip noting that typical column foundations are of 0.3m diameter and 0.9 to 2m depth depending on column heights and ground conditions.

Advantages

- Generally good for way finding due to their height and hence visibility, particularly when located to flag entries, exits and changes in direction.
- Can be a good solution for lighting wider areas such as vehicle access and carparking, as light spread can be significant and is not significantly obstructed by parked vehicles.
- Good vertical lighting particularly of faces to facilitate recognition of a path user, particularly at a distance.
- Good for lighting category PP3, PA3, PC2 or higher, where there is a vertical lighting parameter (@1.5m face height) to be meet.
- All light projected below the horizontal from the light source (assuming appropriate column top light fitting selection), therefore good skyglow mitigation.
- Wiring is readily concealed as it is run underground between columns.

Disadvantages

- Generally higher cost solution due to cost of columns and their installation.
- The AUP considers a light column greater than 7m in height to be a “building” and therefore building height, yards and height to boundary rules apply and therefore if staying within permitted activity standards for these they place restrictions on choice of column heights and locations. Column heights of 3 to 8m are common. However for the purposes of lighting pedestrian access a column height of 4m is likely to be sufficient and would not trigger any additional reasons for resource consent. Similarly for lighting vehicle access a column height of 6m is likely to be sufficient.
- Can be an obstacle for furniture removals, particularly when mounted on edge of path.
- The height of the light source can result in spill light and glare to dwelling windows and over fences to neighbouring dwellings. Controlling the amount of back (rear) spill light can be difficult.
- Not generally suited to lighting narrow paths (2m and less width) as too much light is projected beyond the path into windows. Lower column height of 4m or less often required to mitigate this spill light. Reducing column height can increase the number of columns required.
- They require robust construction and installation, otherwise susceptible to being damaged both accidently (often by furniture removals and vehicles) or intentionally.
- Safety in design issues if columns are greater than 4m height, from maintenance access perspective.

- The depth of their in-ground foundations can restrict where underground services can be run, particularly when there is only a narrow zone for services to run down an access. Therefore a wider services strip of minimum 1m width is recommended.

Building Lighting

Building lighting solutions can include wall mounted lights (@eye level and above), low level wall lights or lights mounted to entry canopies.

When mounted @ 1.8m or higher they can be good for lighting category PP3, PA3, PC2 or higher, where there is a vertical lighting parameter (@1.5m face height) to be met.

Advantages

- Providing a light over the dwelling entry (wall or canopy over) provides good flag lighting of each dwelling point of entry and provides good lighting of house identification, door lock and visitors.
- Good for lighting category PP3, PA3, PC2 or higher, where there is a vertical lighting parameter (@1.5m face height) to be met.
- Simple wiring with wiring run within wall during construction.
- Electricity supply generally taken from each unit. No shared electricity costs to be managed.
- Not an obstruction for furniture removals.
- Less likely to be damaged by accident as they are installed at heights generally above 2000mm.

Disadvantages

- If building lighting is served off each individual house, occupants can turn off the light and therefore their light does not contribute to path lighting.
- Replacement of non-operating light fitting would generally be up to the individual owner who may choose to do nothing.
- Requires consideration of fencing or planting that may block its light from reaching a section of path or driveway.
- Light selection is important, its brightness or spill light could annoy other dwelling occupants.

Fence / Wall Lighting

Fence or wall lighting can often be a cost-effective solution where the fence or wall is located close to the path or driveway. The main challenge is how the wiring is run to each light, best practice is for the wiring to be concealed and have adequate mechanical protection (often a PVC conduit).

Wall recessed lights are less vulnerable to damage and do not obstruct furniture removals.

They can be mounted at a low, medium or high level, each offering its own advantages or disadvantages.

When mounted @ 1.8m or higher they can be good for lighting category PP3, PA3, PC2 or higher, where there is a vertical lighting parameter (@1.5m face height) to be met.

Lights that only project light below the horizontal are good for mitigating skyglow.

Advantages

- Generally good for way finding due to the number and spacing and particularly when on fence or wall located on the edge of path it is clear to the user where the path runs.
- Can be a good solution for lighting steps, changes in path level or path obstacles.
- When mounted on a boundary fence there is no spill light or glare to neighbouring dwellings.
- When mounted at low level, no direct light into bedroom windows.

Disadvantages

- Some can be glary if they are too bright which can impair night vision and result in trips or falls.
- The brightness of some wall lights can be obtrusive to neighbours, light fittings with concealed light sources and back light shields that reduce the light flare onto the wall can mitigate this concern.
- To light wider spaces such as carparks and driveways, often requires higher light fitting positions and brighter light fittings.

Feature / Uplighting

Feature lighting often involves the lighting of vertical surfaces (walls, fences or plants/trees). Uplighting from in garden or inground light fittings can enhance the prestige of a property and add nighttime interest.

With the adaption of LED lighting there is more use of continuous strips of LED lighting



Advantages

- Good visual guidance as it gives you immediate perception of the extents of the path.
- Good control of spill light, with no direct light into bedroom windows and light readily screened by fences.

Disadvantages

- Uplighting close to a path can be glary which can impair night vision and result in trips or falls.
- Feature lighting only, not likely to provide the lighting levels required on paths, driveways or carparking.
- Uplighting contributes to skyglow.

Furniture Lighting

Furniture lighting is the incorporation of lighting into landscape elements, for example the integration of a linear lighting source or strip of lighting into the side or underside of an outdoor bench or seating is often done. In general furniture lighting provides low level lighting with similar advantages and disadvantages to that of bollard lighting.

A series of benches or seats could be provided alongside the path with their lighting providing the required path lighting.

Advantages

- Generally good for way finding due to increased number normally required and their location often on edge of garden/path.
- Good control of spill light, with no direct light into bedroom windows and light readily screened by fences.

- Can work like bollards if placed at a regular spacing.
- Prestigious and attractive solution.

Disadvantages

- Poor illumination of faces for identification.
- May not provide the path and vehicle access lighting levels required.

Handrail Lighting

With the adoption of LED lighting, the integration of LED lighting into the underside of handrails is becoming a favoured lighting solution wherever you have a handrail. Often the wiring is also run within the handrail.

Has many of the same advantages and disadvantages of bollard lighting.

Advantages

- Very good wayfinding solution.
- Prestigious and attractive solution.

Disadvantages

- Can be expensive.
- Poor illumination of faces for identification.

Solar Lighting

The use of solar lights that are a self-contained light fitting with solar panel and battery that do not require an electricity source are the simplest installation and some of these light fittings are reasonably priced. But often the low-cost versions do not provide the reliability and performance throughout the hours of darkness and often struggle through winter when there is less sunlight to charge their batteries and the hours of darkness are long.

High quality solar lights with appropriate matching of battery and solar cell performance to the light source requirements coupled with sophisticated controllers can provide a satisfactory solution.

Long lasting batteries such as nickel metal hydrate are required, but even their performance drops over their life with a life of up to three years.

Regular cleaning of their solar panels is required as the accumulation of dirt and leaves reduces their performance.

Solar lighting is very reliant on being able to locate the solar panel in a location with good sunlight access and minimal shading. This is particularly difficult when the solar panel is a fixed part on the light fitting. Consideration of future potential developments and tree growth is required when locating solar light fittings and panels. They should not be placed within a covered area.

The light level sensors that are used to control when these lights are on can be unreliable and where their lights are installed in proximity to other artificial light sources these can cause them not to work.

Appropriate lighting provisions will be required to ensure the inferior low-cost solar lighting solution is not used to gain initial compliance only for the lighting performance to deteriorate within a short time. The exception are some commercial grade products but these require their solar panels (generally integral with light) to be located where they will get sufficient unshaded light. Proposals for such lighting will require clear written confirmation of their quality, performance, design, PV panel locations and maintenance plan shall be confirmed to have been assessed to ensure their optimal performance in meeting the above lighting subcategory performance levels throughout the hours of darkness and their longevity.

Advantages

- Lowest installation cost as no wiring or additional sensors required.
- Considered to be a sustainability solution.

Disadvantages

- Can be cheap, poor quality that after time are not providing the performance.
- Can struggle to perform throughout the night during winter.
- Require good access to sunlight and this access to be maintained for life of installation.

Overall Recommendations

Often several different lighting solutions are required to provide the appropriate lighting performance.

Bollards are not recommended as they do not provide satisfactory lighting of faces and can be glary.

4m high lighting columns are recommended for pedestrian access, 6m for vehicle access and parking followed by fence or building mounted lighting @1.8m or higher where these can be appropriately located.

Additionally building mounted lighting over entries is recommended to assist wayfinding/identification, unlocking doors and identification of visitors.

Further, to minimise concerns with glare issues in close and enclosed pedestrian environments (narrow pedestrian access pathways) from lighting which complies with higher subcategory ratings, the use of more lights of lower output may be a more suitable solution.

Other considerations

Skyglow

The quality of night time views of the sky is becoming a focus of many communities, but unfortunately in our populous areas there is too much outdoor lighting and light from windows and skylights to significantly improve the quality.

Skyglow contributes to the brightening of the sky which diminishes the brightness of views of the stars.

Selecting light fittings that do not project any light at or above the height of their light source help to mitigate skyglow contributions, so too do light fittings that emit less blue wavelength light. Blue wavelength light is known to produce more light scattering effects and hence more visible scattering of light (skyglow).

The lighting provisions could include the requirement to use light fittings that do not project any light at or above the height of their light source.

Light Correlated Colour Temperature

The effects blue light can have on human melatonin and circadian rhythm disruption have begun to be explored extensively in literature. However, there seems to be no definitive levels of the amount, duration and timing which would give evidence to this effect.

To alleviate public concerns that may exist with respect to the effects of blue light emitted by the outdoor lighting, the use of light fittings that emit light with a correlated colour temperature of 3000K or less can be expected to reduce the emitted blue wavelength light.

As noted above the reduction in blue wavelength light will also contribute to mitigating skyglow effects.

Therefore, we recommend including in the lighting provisions that the light emitted from light fittings shall have a correlated colour temperature of 3000K (Kelvin) or less.

Compliant light fittings are readily available.

Lighting Control

Access lighting should have automatic controls so that it is on when it is dark (daylight sensor control) or on when it is dark, and presence is detected (presence sensor control).

The provision of daylight control is the simplest and most reliable form of automatic control but can be wasteful of energy as the lights are on throughout the hours of darkness.

To assist with minimising skyglow, the International Dark Sky's Association recommends the use of presence sensors that limit the duration of illumination to less than five (5) minutes after activation.

The provision of presence control requires sufficient and appropriately located sensors to ensure presence is detected as soon as someone enters the path. Presence sensors vary in

quality and reliability, but this aspect is not something that lighting provisions can readily control. Presence control provides best energy efficiency and mitigation of skyglow with the lights on only when someone is present on the access.

But presence sensors do not assist with illuminating an environment before you enter, and don't provide passive observation (person looking out window can't observe without lights being on) so it can result in potential concealment, safety issues and reduction in wayfinding signalled by the lighting when on. In this regard, presence sensor activated lighting is not favoured within a residential development context, especially along pathways, for this CPTED reason. Some development lighting situations may merit their consideration but are very case by case sensitive and generally not the standard approach supported. A continual illumination of pedestrian paths in residential areas is generally recommended during evening hours to ensure adequate safety of users.

The switching of outdoor lights on and off by presence sensors can be disturbing to some occupants interrupting sleep, but if the levels of the spill light onto bedroom windows is minimised so will be the switching effects on sleep.

Our recommendation is that automatic daylight control of the lighting should be included in the lighting provisions and the use of presence sensor control is not always appropriate and therefore requires a CPTED assessment to determine if it is appropriate.

Lighting Electrical Supply

If the lighting of common access is from lights supplied from each unit in lieu of a common electrical supply there is a risk that occupants may switch off their outdoor lighting which results in inadequate lighting.

To eliminate this risk / situation all common access lighting should be on a common / body corporate / community electrical supply. There may be some resistance to this requirement as it can mean that a separate site electrical connection is required and the electricity costs shared across all site households. This can be readily managed via body corporate or residents society. Smaller housing developments that don't always have a body corporate or resident's society will need to establish one or implement appropriate property/site management policy.

Also, to avoid large/multiple power cables causing space issues, LED lighting uses a lot less energy and hence smaller cables and fewer circuits can support a lot more lights. Electricians and engineers can design this appropriately to avoid this concern and cable placement can go above or below other services if trenching is restricted.

Long Term Maintenance

As alluded to in other parts of our report, the long-term quality and performance of the lighting scheme will be dependent on the reliability and maintainability over the service life of the selected hardware components. Appropriate property/site management policy will be required.

AS/NZS1158.3.1 includes requirements which define an expectation and requirement with respect to the maintenance of the installation to maintain compliance with the Standard.

Accordingly a lighting provision requiring the lighting to be maintained in accordance with AS/NZS1158.3.1 should be included.

Recommendations for new lighting provisions

Throughout this report recommendations for the new lighting provisions have been made, these have been captured below:

1. We support the proposal to include lighting provisions in the AUP that will ensure that appropriate artificial outdoor lighting is provided to private pedestrian access and this includes shared driveways, access and car parking.
2. We believe it is best and accepted practice in Australasia to require such lighting to comply fully with the requirements of AS/NZS1158.3.1 and that compliance with this Standard will ensure appropriate lighting is provided. Also, it is a Standard that local lighting engineers and lighting suppliers are accustomed to complying with. Therefore, the lighting provision should require the lighting to comply with this Standard. Through referencing and relying on this standard the extent of required lighting provisions can be reduced.
3. To remove the current ambiguity and risk that exist when leaving it to the Owner/Applicant to determine what AS/NZS1158.3.1 lighting subcategory is appropriate we recommend the following minimums are included in the lighting provisions:
    a. *PR2* is the minimum for pedestrian access adjacent vehicle access.
    b. *PC2* is the minimum for car parking.
    c. *PP3* is the minimum for paths.
    d. *PA3* is the minimum for connecting elements, steps, stairways and ramps.
    e. *PR5* minimum for vehicle access for 4-9 parking spaces or dwellings.
    f. *PR4* minimum for vehicle access for 10-19 parking spaces or dwellings.
    g. *PR2* minimum for vehicle access for 20 or more parking spaces or dwellings.
4. Including the requirement for *Compliance of the design as required by AS/NZS1138.3.1. to be included in the Resource Consent application*. This will take the place of the current Lighting Conditions that are being placed on Resource Consents.
5. Similarly including the requirement for *Compliance of the installed lighting scheme as required by AS/NZS1138.3.1. as a Resource Consent compliance requirement*. In lieu of current Resource Consent Lighting Conditions.
6. Lighting provisions could be considered to ensure inferior quality and poorly designed and maintained solar lighting solutions are not used to gain initial compliance only for the lighting performance to deteriorate within a short time.
7. The lighting provisions should require the use of light fittings that do not project any light at or above the height of their light source.
8. The lighting provisions should require that the light emitted from light fittings shall have a correlated colour temperature of 3000K (Kelvin) or less.

9. The lighting provisions should require the spill light and glare from the lighting to comply with E24 Lighting requirements and these requirements are to include windows of all lawfully established dwellings within the site.
10. The lighting provisions should require automatic daylight control of the lighting so that it is on when dark. The use of presence sensor control is not always appropriate and therefore requires a CPTED assessment to determine if it is appropriate.
11. Lighting to be supplied from a common supply which cannot be disabled by residents.
12. Where solar lighting is proposed, such lighting will require clear written confirmation of their quality, performance, design, unshaded PV panel locations and maintenance plan.
13. Lighting provisions should require the lighting to be maintained in accordance with AS/NZS1158.3.1.

Lighting provisions

We propose the following lighting standards are included in the proposed plan change.

Lighting is required to pedestrian access and vehicle access serving dwellings which will be used during the hours of darkness. Lighting for pedestrian and vehicle areas shall be calculated in accordance with the methods described in the AS/NZS1158 series of standards, and certified in a statement by a suitably qualified and experienced professional. The lighting design shall demonstrate compliance with the following:

(a) Lighting shall comply fully with the requirements of AS/NZS1158.3.1.

(b) Lighting shall as a minimum provide the lighting subcategory performance determined in accordance with AS/NZS1158.3.1, but not less than the following minimums lighting subcategories:

(i) PR2 minimum for pedestrian access adjacent to vehicle access.

(ii) PC2 is the minimum for car parking.

(iii) PP3 minimum for paths.

(iv) PA3 minimum for connecting elements, steps, stairways and ramps.

(v) PR5 minimum for vehicle access for 4-9 parking spaces or dwellings.

(vi) PR4 minimum for vehicle access for 10-19 parking spaces or dwellings.

(vii) PR2 minimum for vehicle access for 20 or more parking spaces or dwellings.

(c) Detail compliance of the design as required by AS/NZS1138.3.1.

(d) All light fittings when installed shall not project any light at or above the height of their light source.

(e) All light emitted from light fittings shall have a correlated colour temperature of 3000K (Kelvin) or less.

(f) Spill light and glare from the lighting to comply with E24 Lighting requirements and these requirements shall include windows of all lawfully established dwellings within the site.

(g) The lighting is to have automatic daylight controls such that the lights are on from dusk to dawn, except that automatic presence detection may be included to ensure the lights are only on when presence is detected, maximum on time of 5 minutes but the use of presence sensor control is not always appropriate and therefore requires a CPTED assessment to determine if it is appropriate.

(h) Lighting to be supplied from a common supply which cannot be disabled by residents.

(i) Where solar lighting is proposed, such lighting will require clear written confirmation of their quality, performance, design, unshaded PV panel locations and maintenance plan.

(j) The lighting installation is to be maintained in accordance with AS/NZS1158.3.1.