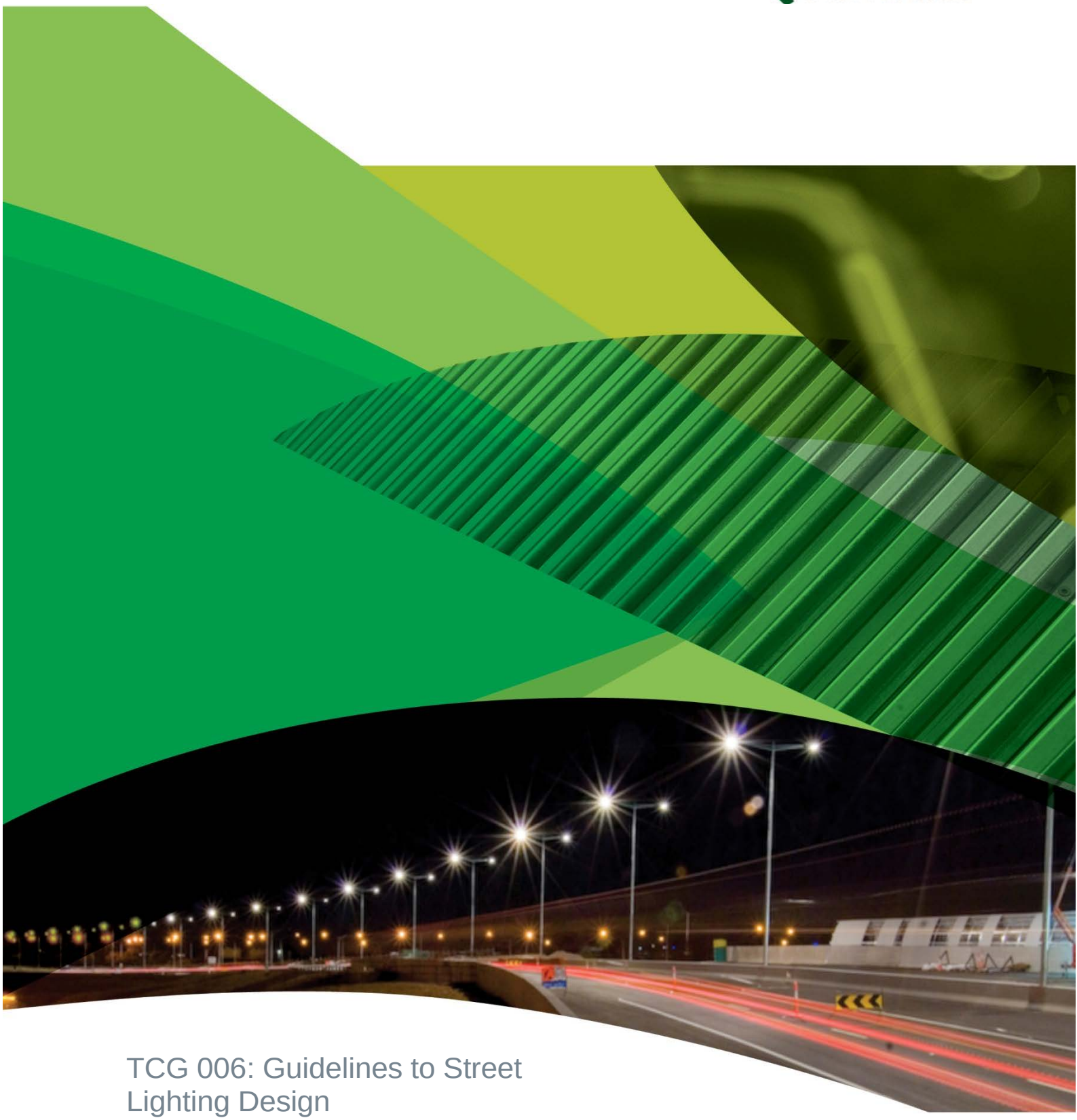

TCG 006: Guidelines to Street Lighting Design

JANUARY 2016 - Rev B

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Revision History

Version	Revision	Date	Author	Description
2016		Jan 2016	SJS	Initial release
2016	B	Dec 2018	SJS	Maximum TI of 15% added (clause 2.1 (e))

1. Introduction

1.1 Purpose and standard

This document provides guidance on the design of new road lighting schemes for freeways and arterial roads. As far as possible, schemes shall be designed in accordance with this guideline and with the associated standards and documents listed within.

This document shall be read in conjunction with:

- VicRoads *Lighting of Declared Roads Policy*
- AS/NZS 1158 Lighting of Roads and Public Spaces
- Austroads Guide to Road Design, Part 6B: Roadside Environment [2009]
- VicRoads Standard Specification 3100: Street Lighting
- Other documents listed in the references in Section 1.2 below.

1.2 References

VicRoads *Lighting of Declared Roads Policy*

AS/NZS 1158, “Lighting for roads and public spaces”

VicRoads Supplement to AS/NZS 1158

AS/NZS 1170.2, “Minimum design loads on structures - Wind loads”

AS/NZS 3000, “Electrical Installations” known as the “Wiring Rules”

AS/NZS 3008.1.1, “Electrical Installations - Selection of cables – Cables for alternating voltages up to and including 0.6/1 kV – Typical Australian installation conditions”

AS/NZS 3100, “Approval and test specification – General requirements for electrical equipment”

Austroads Guide to Road Design, Part 6B: Roadside Environment

Australian Bridge Design Code

VicRoads ITS standard drawings

VicRoads Standard Specifications For Roadworks And Bridgeworks and associated standard drawings

VicRoads Standard Specification 3100: Street Lighting

VicRoads Standard Specification 730: traffic Signal Installation

VicRoads Standards Specification 731: Road Lighting Specification

VicRoads TCS001, Specification for the Supply of Joint Use Poles, Joint Use Mast Arms, Mast Arms, and Rigid Street Lighting Poles

VicRoads TCS014, Specification for the Supply of Frangible Street Lighting Poles

VicRoads TCS043, Specification for the Supply of Electrical Distribution Cabinet

VicRoads TCS050, Specification for the Fabrication and Supply of Street Lighting Brackets

VicRoads TCS 065: Specification LED Road Lighting Luminaires

Distribution Company (VESI) standards and guidelines

Essential Services Commission, *Public Lighting Code*

1.3 Definition

For the purposes of this guideline, the following definitions apply:

“Arterial road” means a road (other than a freeway or freeway ramp) that has been declared to be an arterial road under Section 14 of the *Road Management Act 2004*.

“Distribution Company” has the same meaning as "Distribution Company" in the *Electricity Industry Act 2000*, No. 68/2000.

“Freeway” means a State road declared a freeway, including associated ramps.

“Municipal roads” includes all roads that are not declared (i.e. are the responsibility of municipal councils).

“VESI” means the Victorian Electricity Supply Industry.

1.4 Ownership of assets

There are two types of road lighting:

- Lights owned and operated by VicRoads; and
- Lights owned and operated by the relevant electricity Distribution Company.

VicRoads-owned lights must:

- be wired in accordance with AS/NZS 3000 Electrical Installations (known as the Australian/New Zealand Wiring Rules)
- be on dedicated street lighting poles with straight brackets
- have a separate meter box to record electricity consumption and a single point of supply
- have a PE (photo electric) cell in the distribution box.

Distributor-operated lights:

- must be wired in accordance with VESI (Victorian Electricity Supply Industry) standard
- are non-metered
- may be mounted on electricity distribution poles or dedicated street lighting poles with curved brackets

- are fed directly from distribution cables
- are controlled by a PE (photo electric) cell at each luminaire.

It is important to note that the ownership arrangements do not determine the ongoing funding responsibilities. On arterial roads (outside freeway declaration boundaries), both VicRoads-owned and Distributor-operated lighting schemes are cost-shared between VicRoads and the relevant councils.

Except with the written authorisation of VicRoads, no Design Consultant or person engaged by or on behalf of VicRoads shall sign any document or make any agreement with any party that gives or transfers ownership of any VicRoads operated road lighting asset or component from VicRoads to any other party.

New road lighting on arterial roads shall be installed as **distributor-operated**.

Within the same location, a combination of VicRoads-owned and distributor-operated lights should be avoided.

1.5 Responsibilities and funding

Responsibilities for operation, maintenance and replacement of road lighting assets are set out in Schedule 7A of the *Road Management Act 2004.*

VicRoads is responsible for the full cost of freeway lighting.

For lighting on arterial roads, ongoing operation and maintenance costs are shared between VicRoads and the municipal council. Further detail on cost sharing is provided in Section 1.5.2.

The following provides guidance on key stakeholders and their responsibilities for lighting.

VicRoads is responsible for:

- installation and operation of lighting on freeways (refer to Section 1.5.1)
- installation and operation of VicRoads-owned lighting on arterial roads
- funding of 60% of the operation and maintenance of arterial road lights
- promoting the use of frangible lighting poles in road lighting schemes as a safety measure.

Municipal Councils are responsible for:

- funding installation of lighting on arterial roads (where appropriate)
- funding of 40% of the operation and maintenance of arterial road lights
- installation and operation of road lighting on municipal roads.

Electricity Distributors are responsible for:

- safe connection of electricity
- installation, operation, maintenance and replacement of distributor-operated schemes.

The maintenance service standards for distributor operated schemes are set out in the Essential Services Commission 'Public Lighting Code (2005)'.

Electricity Retailers are responsible for:

- billing of accounts for electricity usage for VicRoads-owned schemes
- billing of accounts by tariff for distributor-operated schemes.

1.5.1 Freeway lighting responsibilities

VicRoads pays the full cost of installation, operation and maintenance of all road lighting within the limits of the freeway declaration, apart from pathway lighting.

VicRoads may fund the full cost of installation of new or upgraded lighting schemes outside the limit of the freeway declaration at interchanges or freeway terminals that it considers necessary and appropriate, but, unless there is an agreement to the contrary –

- the operation and maintenance of lighting outside the freeway declaration on arterial roads is cost-shared by VicRoads and the relevant council; and
- the operation and maintenance of lighting outside the freeway declaration on municipal roads and pathways is fully funded by the relevant council.

1.5.2 Arterial road lighting responsibilities

Schedule 7A of the *Road Management Act 2004* requires that operating costs for lighting on arterial roads be cost-shared between VicRoads and the relevant municipal council. VicRoads funds 60% and the council funds 40%.

The operating cost for road lighting includes electricity supply, maintenance, repair and replacement, but does not include installation costs.

Cost-sharing applies to all road lighting on arterial roads, except service roads, regardless of ownership and lighting standard. Lights on service roads are fully funded by council.

Generally, the initiating party for the road lighting will fund the installation costs. However, VicRoads can agree to share the installation costs of new lights where the proposal provides benefits for through traffic, footpath pedestrian traffic, security and the amenity of adjacent land use. In such cases, a share of 60% VicRoads and 40% council may be applied.

1.5.3 Developer-funded lighting

Where lights are installed on an arterial road as part of a new development, the developer shall pay:

- All costs associated with the installation of the lights to full operation.
- Reimbursement in advance, of VicRoads share for 10 years ongoing operating costs in accordance with VicRoads guidelines. VicRoads share is to be 60%. Developers should pay the remaining 40% to the relevant council.

When providing advice or imposing conditions on planning permits, VicRoads should only recommend that lighting be provided at the locations listed in Section 4.1.

Where road lighting provided by developers on arterial roads is to be distributor-operated, it shall be designed by a consultant prequalified with both VicRoads and the relevant electricity distributor and installed in accordance with the electricity distributor's requirements by an accredited or recognised contractor.

Where road lighting provided by developers on arterial roads is to be VicRoads-owned, it shall be designed by a consultant pre-qualified with VicRoads to category TLD (Freeway/Arterial Lighting Design) and installed by a contractor pre-qualified with VicRoads to category STCE (Traffic Control Equipment).

1.6 Acceptance

1.6.1 Use of pre-qualified design consultants

All designs for VicRoads owned road lighting installations shall be completed by design consultants that are suitably pre-qualified by VicRoads under the category - Freeway / Arterial Lighting Design (TLD).

All designs for Distributor-owned public lighting installations on arterial roads shall be undertaken by design consultants accredited with both VicRoads under the Category - Freeway / Arterial Lighting Design (TLD) and the relevant Distribution Company.

1.6.2 Basis for design

All designs for VicRoads-owned sections of road lighting shall be based on the use of products type-approved by VicRoads.

All designs for Distributor-owned sections of public lighting shall be in accordance with the relevant Distribution Company's standards and regulations. The Design Consultant is responsible for determining the appropriate Distribution Company requirements.

Future maintenance requirements and/or constraints should be considered when designing public lighting schemes.

2. Lighting design

2.1 General

Lighting on declared freeways and arterial roads shall comply with the principles laid down in the VicRoads *Lighting of Declared Roads Policy*.

Generally, VicRoads may apply one of the following levels of lighting to freeways or arterial roads:

- No lighting. Based on road safety, VicRoads may decide to provide no lighting in the short and medium term. In this instance, particular attention should be given to other forms of delineation.
- "Flag" lighting. At appropriate intersections the provision of a small number of luminaires may be provided to indicate the presence and location of the intersection without providing lighting to any particular level. This is in accordance with AS/NZS 1158.1.1.
- Full lighting in accordance with AS/NZS 1158.

The following requirements apply to lighting designs:

a) Unless otherwise specified, all road lighting design shall be in accordance with the references listed in Section 1.2 of this guideline. In the event of conflict between this guideline and the various documents referred to in Section 1.2 this guideline shall take precedence.

b) Unless otherwise specified, lighting on freeways and arterial roads shall be designed in accordance with **Category V3** of AS/NZS 1158. The following exceptions may be considered:
   - Category V1 or V2 lighting in areas with very high pedestrian numbers at night.
   - Category V5 lighting for isolated rural intersections.

c) Where continuous lighting along a road or freeway is specified, lighting should be installed in the central median rather than on both sides of the carriageway where the median width is equal to or greater than 1.4m. Exceptions to this requirement include lighting installed on concrete barriers or where minimal ramp lighting is specified for freeway interchanges.

d) All new lighting schemes shall be based on VicRoads Type Approved LED luminaires.

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e) The maximum allowable Threshold Integrity (TI) for all freeway and arterial road lighting designs using LED luminaires shall be 15%.

f) Unless otherwise specified, lighting design including mounting height should be based on the Table 1 (Clause 2.12.3).

f) Pole / luminaire locations shall be determined based on best traffic engineering practice, and where possible shall be sited to:
   - give maximum sense of direction to drivers

- provide a smooth visual guide to the road alignment
- minimise the likelihood of being struck by a vehicle.

g) Joint use signal poles shall be used wherever possible to minimise the number of poles at intersections.

h) Lighting schemes should be designed so that boundaries between VicRoads-owned and Distributor-operated lighting schemes are clear and easily identified.

2.2 LED Luminaires

New **VicRoads-owned** lighting schemes (such as on a freeway) should be based on LED luminaires. Designers should discuss this with the VicRoads ITS Group.

New **Distributor-operated** lighting schemes shall also be LED luminaires, if the Distributor has an approved LED product and there is an agreed tariff arrangement in place.

The standards and guidelines for LED lighting are not as well developed as for HPS lighting. It is therefore incumbent on the designer to ensure the design meets lighting levels and safety requirements equivalent to a design for HPS luminaires.

The requirements for LED luminaires are detailed in VicRoads specification TCS 065 for LED Road Lighting Luminaires. Standard LED luminaire used by VicRoads are:

- **L1** – the LED replacement for a 150W HPS
- **L2** – the LED replacement for a 250W HPS
- **L4** – the LED replacement for a 400W HPS

2.3 Lighting Spillage

The Design Consultant shall take all reasonable steps to ensure that light spillage is minimised.

Where light spillage is likely to be an issue, such as areas where residential properties have windows close to the property line, the Design Consultant shall notify VicRoads. In these locations, the Design Consultant may be requested to undertake designs based on the use of full cut off luminaires and/or lower mounting heights.

2.4 Roundabouts

Roundabouts shall be lit.

Where a central pole arrangement is used, generally the bracket length should be 0.5 metres (i.e., 2 x 0.5m, 3 x 0.5m, or 4 x 0.5m brackets as appropriate for the numbers of luminaires required). However, longer brackets may be used for double outreaches.

2.5 Pedestrian facilities

2.5.1 Pedestrian (zebra) crossings

Pedestrian (zebra) crossings shall be lit in accordance with AS/NZS 1158.4, except as noted below.

Luminaires shall be located in advance of the pedestrian (zebra) crossing where possible.

Supplementary floodlighting of pedestrian (zebra) crossings is not required for left turn slip lanes at signalised intersections provided the intersection is fully lit.

2.5.2 Pedestrian operated signals

Pedestrian operated signals shall be lit.

Where practicable, luminaires should be positioned on a Joint Use Pole (JUP) in advance of the pedestrian crossing.

Where pedestrian operated signals are installed on a road with no route lighting and the posted speed limit is 60km/h to 70km/h, one (1) span of approach / departure lighting (or for a minimum of 50m) shall be provided to Category V3 standard.

Where the posted speed limit is greater than 70km/h, two (2) spans of approach / departure lighting (or for a minimum of 100m) shall be provided to Category V3 standard.

2.5.3 Pedestrian crosswalks at signalised intersections

Where possible, signalised pedestrian crosswalks at signalised intersections shall be lit by providing a luminaire on a joint use signal pole in advance of the crosswalk.

2.5.4 Pedestrian tunnels

In areas of high pedestrian activity, where pedestrian tunnels are connecting elements to train stations, schools etc., lighting shall be designed in accordance with AS/NZS 1158.3.1.

In areas of low pedestrian activity, the minimum horizontal point illuminance for pedestrian tunnels shall not be less than 10 lux throughout.

Vandal proof luminaires shall be used. Where possible, these are to be mounted in the centre of the roof of the pedestrian tunnel.

2.5.5 Pedestrian overpasses

Where pedestrian overpasses are required to be lit, lighting shall be provided to meet the requirements of AS/NZS 1158.3.1, Category P3, unless otherwise specified.

2.6 Airports / airfields

For lighting installations in the vicinity of airports and airfields, agreement to the proposed lighting scheme shall be obtained from the Civil Aviation Safety Authority (CASA) and all other relevant authorities.

Where the lighting scheme will be in the vicinity of aircraft flight paths, full cut-off luminaires shall be used and mounting heights shall conform to any constraints required by CASA. Where practicable, this should be achieved using standard poles or at least minimising the number of different pole heights.

2.7 Underpasses and short tunnels

Underpasses and short tunnels shall be lit in accordance with AS/NZS 1158.5.

Unless lighting during daylight hours (i.e. tunnel lighting) is required, underpasses should only be lit where route lighting is to be provided on either side.

Where underpass lighting is not to be provided at the time of construction, provision for lighting at a future date shall be made.

Under structure lighting shall be mounted at soffit level and positioned symmetrically above and along the outer edges of the carriageway (i.e. road shoulders). For underpasses where lighting is required and soffit levels (clearances) are 10m or less, 150W HPS luminaires (or equivalent LED) should be used. Where soffit levels are less than 8.5m, full cut-off luminaires shall be used.

If an underpass is part of a Distributor-operated scheme, then the underpass lighting should be designed to VESI standard and accommodate structural support for distributor standard fittings and lanterns.

2.8 Railway crossings

Railway level crossings in urban areas shall be lit to a minimum of Category V3 standard, and should be designed in a similar way to intersections.

Adjacent to railways, impact absorbing poles shall be used. The dynamic clearances specified in Section 2.14.1 shall also be achieved between the impact absorbing pole and the railway tracks.

2.9 Rest area and car parks

Where rest areas or car parks are required to be lit, lighting shall be provided in accordance with AS/NZS 1158.3.1 (Category P) lighting.

Generally, rural rest areas are only lit in the vicinity of toilet blocks and picnic areas.

2.10 Changes in carriageway width

Converging changes in carriageway width (i.e. merge areas) shall be designed in accordance with AS/NZS 1158.

Diverging changes in carriageway width should be lit. However, where this results in a significantly reduced efficiency (i.e. span lengths are reduced below 75% of the maximum that could otherwise be achieved or additional poles are required), the requirements of AS/NZS 1158 shall not apply at the commencement of the divergence.

2.11 Median openings

Unless otherwise specified, Category V luminaires shall be located over both carriageways within 10m of a median opening.

Where isolated lighting only is to be provided at median openings, the median opening shall be lit using 150W HPS (equivalent LED) luminaires.

Wide median treatments shall not be lit using a central pole arrangement.

2.12 Luminaires

2.12.1 Luminaire overhang

Generally, designs shall include bracket lengths to cater for a minimum positive luminaire overhang into the adjacent road carriageway of approximately 1m. However, where it is demonstrated that the number of poles can be reduced, negative overhang of up to 2m may be used. This may occur in medians where either a single row of poles instead of a double row of poles is achievable or when lighting narrow carriageways.

In cases where negative overhang is to be adopted in wide medians, outreach bracket lengths shall be maximised to reduce the amount of negative overhang.

2.12.2 Luminaire orientation

Unless otherwise specified, for all Light Technical Parameter calculations, luminaires shall:

- be oriented at 90 degrees to the road carriageway
- have an upcast angle of 5 degrees
- have a spin angle of 0 degrees.

2.12.3 Mounting height and output

Table 1 below gives appropriate luminaire mounting heights. The value shown for the standard mounting height shall be adopted wherever possible.

Mounting heights greater than 12.5m on arterial roads and 15m on freeways shall only be used with the approval of VicRoads.

Table 1: Minimum Luminaire Characteristics

A	B #	C
Luminaire Type	Minimum Lamp Output (lumens)	Luminaire Mounting Height (m)
L1 LED (replacement for 150W HPS)	14,500 (HPS)	8.0 Absolute min 8.5 min 10.0 standard 12.5 max
L2 LED (replacement for 250W HPS)	28,000 (HPS)	10.0 Absolute min 11.0 min 12.5 standard 15.0 max
L4 LED (replacement for 400W HPS)	48,000 (HPS)	15.0 min 15.0 standard ** 18.0 standard *** 20.0 max

Notes:
This information is for information only and not relevant to LED
** Standard mounting height on 13.5m slip-base poles.
*** Standard mounting height on median mounted rigid poles between barrier sections.

2.13 Poles

Frangible poles shall be used within the road reserve wherever possible. Exceptions to this are included in Section 2.13.5.

Lighting poles shall not be placed immediately in front of a crash barrier and shall have appropriate clearance from barriers when placed behind.

Unless otherwise approved by VicRoads, standard pole heights (i.e. 8.5m, 11.0m and 13.5m) shall be used.

When lighting poles are located between sections of concrete barrier, steel cover plates, that match the profile of the concrete barrier and the lighting pole, shall be used to cover the resulting gap between concrete barrier sections. The steel cover plate shall be designed to prevent the collection of debris and allow drainage of water at the bottom.

2.13.1 Poles - set back zones on the outside of carriageways

Frangible lighting poles shall not be located within:

- 0.7m of the road carriageway in speed zones less than or equal to 60km/h.
- 1.5m of the road carriageway in speed zones greater than 60km/h and equal to or less than 80km/h.
- 3.0m of the road carriageway in speed zones greater than 80km/h. However, adjacent to a sealed shoulder that is 3m or more in width, the set back zone for frangible poles may be reduced to 1.5m from the road pavement.

Lighting poles shall not be placed within road shoulders.

Poles shall be set back as far as is practicable from the edge of the carriageway whilst retaining necessary overhang.

> *Note: for the purpose of this clause, the edge of the road carriageway is defined as either the back of the kerb or the outer edge of a sealed or unsealed shoulder.*

2.13.2 Poles - set back zones in medians

Frangible lighting poles should not be located in medians less than 1.4m in width (i.e. 0.7m setback distance), unless the lighting is part of a concrete crash barrier system.

In speed environments where speed is less than 80km/h and lighting cannot be installed on the outside of the carriageway, frangible poles may be located in medians as narrow as 1.2m in width.

In speed environments where speed is greater than or equal to 80km/h, frangible lighting poles should not be located in medians less than 2.0m in width.

The longitudinal distance from the nose of a median or splitter island to a lighting pole should not be less than 8m, or 5m in extenuating circumstances. However, this may be reduced to 3m for gaps in medians for U-Turn slots and accesses to minor roads.

2.13.3 Frangible pole selection - mid blocks

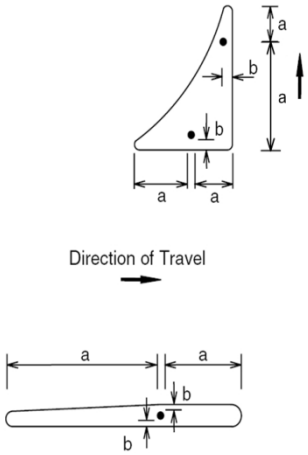
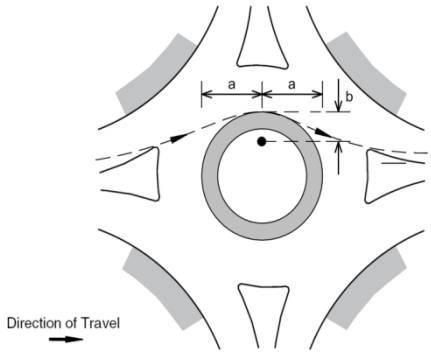
In mid block locations, the selection of frangible pole type should be based on the following criteria.

- Slip-base poles should be used in high speed areas (i.e. greater than or equal to 80km/h) such as freeways, in medians 2m or greater in width, where there is adequate clearance to overhead conductors, etc and where pedestrian activity is low.
- Impact absorbing poles should be used in areas where there is risk of a secondary impact with a dislodged pole, where there is limited clearance to powerlines or where vehicle speeds are low (i.e. less than 80km/h) and pedestrian activity is expected. Areas where there is a risk of a secondary impact include:
    - narrow medians (i.e. less than 2m wide)
    - adjacent to railway tracks
    - on or adjacent to bridges.

2.13.4 Frangible pole selection - intersections

At intersections, the selection of frangible pole types is dependent upon a number of factors such as traffic speeds, pole offset, pedestrian activity and the likelihood of impacted poles being involved in secondary impacts. At signalised intersections, joint use poles should be utilised wherever possible to minimise the number of poles on the roadside.

Figure 1 provides guidance on the type of poles best suited to various situations.

	Dimensions as per figure		Favoured Pole Types P = Preferred A = Acceptable	
	a (m)	**b (m)**	**Slip-Base**	**Impact Absorbent**
Left Turn and Splitter Islands  	< 8	any		P
	8 to 15	< 1.5		P
	8 to 15	> 1.5	P	A
	> 15	< 1.5		P
	> 15	> 1.5	P	A
Roundabouts  	< 8	any		P
	> 8	< 1.5		P
	> 8	> 1.5	P	A

a = the pole position to roadway before or after the pole measured parallel to the direction of adjacent traffic.
b = lateral distance from the kerb.

Figure 1: Selection of Pole Type at Intersections

Note for Roundabouts:

It is preferable that poles not be placed in the area of a central island likely to be traversed by out-of-control vehicles (shown shaded on the diagram). In addition, dimensions *a* and *b* should be observed for selection of impact absorbing and slip-base poles at any location within the central island. The areas at the periphery of the roundabout, also shown shaded, are particularly vulnerable to out-of-control vehicles and likewise, should not have lighting poles installed where possible.

2.13.5 Rigid poles

Rigid poles shall only be used where:

- Joint use poles can be utilised.
- Necessary clearances to overhead powerlines cannot be achieved using an impact absorbing pole. In this situation, a crash barrier shall be provided to protect the rigid pole.
- A crash barrier is required for other purposes and lighting poles can be effectively located behind the barrier. Rigid lighting poles shall be used behind concrete barrier systems.
- Road lighting poles are incorporated into concrete crash barrier systems (e.g. narrow medians in freeways).
- Road lighting poles are located on the outside of or on top of bridge parapets. The bridge parapet is to be designed for the resultant load. No pole, rigid or otherwise, shall be placed in front of the parapet.
- Overhead power supply is required.

2.13.6 Centre-hinged poles

Centre-hinged poles shall be used in the following locations:

- In the central island of roundabouts.
- Within 10m from overhead transmission lines (measured from the nearest conductor, including an allowance for sway, to the nearest part of the pole, bracket or luminaire). However, the Design Consultant is to check these requirements with the relevant electricity Distribution Company.

Where possible, symmetrical brackets should be used on hinged poles. Single brackets with an outreach up to 3m may be used, subject to manufacturer requirements.

2.14 Clearance of road lighting from overhead conductors

Electricity Distribution Companies require adequate clearances from poles, brackets, etc to any overhead electrical conductor. Clearances are measured from the outer electrical conductor to the closest part of a pole, bracket or luminaire. Clearances shall also include an allowance for sway of the conductors.

No poles shall be erected near a high voltage lines without first obtaining the agreement of the relevant authority. Hinged poles shall be used where required by the relevant electricity Distribution Company.

The Design Consultant is responsible for ensuring that all necessary clearances to overhead electrical cables (as required by electricity Distribution Companies, railway and tramway operators etc.) are met.

The Design Consultant is responsible for ensuring that all requirements of the *Electrical Safety (Network Assets) Regulations* and Energy Safe Victoria are met.

In all cases, the maximum practical clearance should be achieved.

2.14.1 Dynamic clearances for frangible poles

The minimum horizontal clearance of a frangible pole from an overhead power line is 0.6H, plus an allowance for sway of the conductors. This is shown in Figure 2. However, where slip-base poles are to be used, if the overhead line traverses the direction of traffic (or the likely path of an out of control vehicle), then the minimum clearance for slip-base poles shall be increased to 1.2H as shown in Figure 3. This situation may occur when an overhead line crosses the carriageway, or at an intersection as shown below.

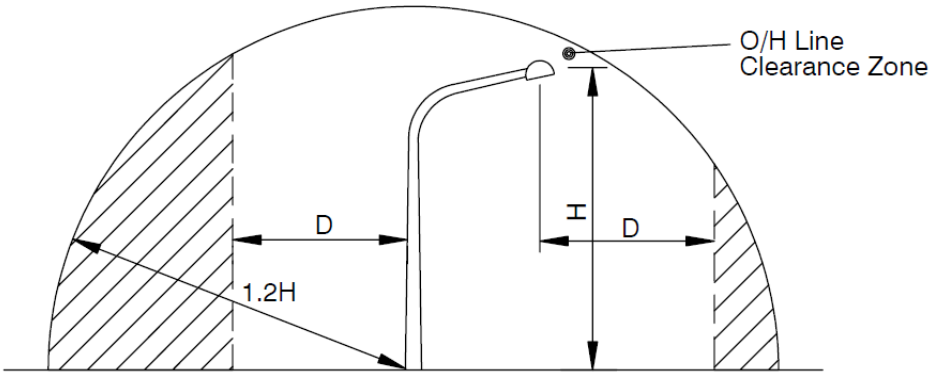
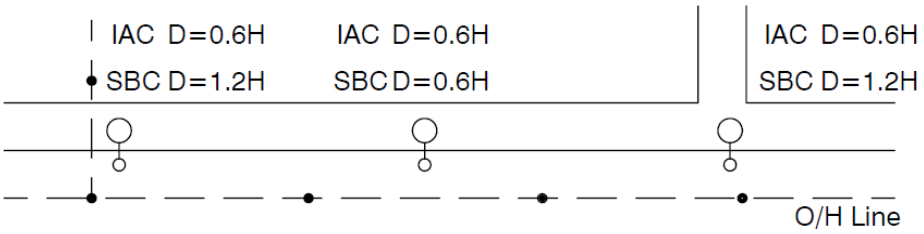


Figure 2: Dynamic Clearances (Source: Powercor Standard FA061)



IAC = Impact Absorbing Pole
SBC = Slip-Base Pole

Figure 3: Dynamic Clearances (Source: Powercor Standard FA061)

2.14.2 Static clearances for rigid poles

Clearances shall be in accordance with the *Electricity Safety (Installations) Regulations 2009*.

2.15 Pits

Pits shall be provided in accordance with the following:

a) Pits shall be located adjacent to each pole, generally within 1m of the pole and on the departure side from traffic.

b) Pit shall be located at all horizontal and vertical changes of direction of conduits.

c) Adjoining pits shall be placed no more than 100m apart.

d) Pits shall be located to minimise water ingress.

2.16 Distributor-operated installations

All un-metered Distributor-operated installations (including all luminaires mounted on power supply poles) shall meet relevant Distribution Company (i.e. VESI) standards. This includes all aspects of the installation, including the power supply, wiring, conduits, poles, pits, luminaires, photo electric cells, etc. These luminaires shall not be connected to VicRoads circuits and distribution cabinet.

2.17 Non-standard equipment

Councils occasionally wish to install non-standard or decorative style road lighting schemes.

VicRoads-Owned Schemes

Non-standard or decorative equipment may be acceptable on VicRoads-owned lighting installations provided:

- Lighting levels are not compromised
- The required luminaire mounting heights are achieved
- The efficiency of frangible poles is not reduced
- The safety of the installation is not compromised
- VicRoads electrical circuitry requirements are adhered to
- Standard VicRoads fittings are used wherever practicable
- Council provides all funds in excess of the cost of a standard scheme
- Council indemnifies VicRoads against any action in respect of the non-standard equipment
- VicRoads and the council enter into an agreement regarding terms and conditions.

Distributor-Operated Schemes

Non-standard or decorative equipment as part of distributor-operated schemes on arterial roads may be acceptable provided:

- Council provides all funds in excess of the cost of a standard scheme
- Replacements of all non-standard fittings are provided by the council, as required by the Essential Services Commission Public Lighting Code (2005)
- The council indemnifies VicRoads against any action in respect of the non-standard equipment
- VicRoads and the council enter into an agreement regarding terms and conditions.

2.18 Painting of road lighting poles

VicRoads may allow municipal councils or private developers to paint street lighting poles in colours specific to a precinct treatment (e.g. heritage colours or a colour consistent with used for a local shopping centre). These agreements can be made based on the council or developer bearing all costs associated with original painting and adequately maintaining the paintwork in perpetuity.

3. Freeway lighting schemes

3.1 Extent of lighting on freeways

Because of their inherent safety features with respect to design, control of access and usage, freeways usually have low accident rates and operate safely at night without continuous route lighting.

Continuous route lighting on a section of urban freeway is provided where one or more of the following criteria are met:

- The section of freeway has a significant night-time crash record - e.g. casualty crashes per year more than two times the average for urban freeways.
- Geometric design of the freeway section is significantly below standard - e.g. alignment, sight distance, cross-section, lateral clearances or absence of a left side emergency stopping lane.
- Traffic operation on the section of freeway involves substantial volumes of traffic making complex weaving or lane-changing manoeuvres - e.g. those related to closely spaced interchanges.
- The section of freeway is in tunnel, including approaches to the tunnel portals.
- The section of freeway is less than 1km long between other sections of continuous route lighting.

Continuous route lighting is not provided on rural freeways.

Unless otherwise specified by VicRoads:

a) The design of lighting shall comply with Australian Standard AS/NZS 1158, Category V3.

b) In urban areas, the exit ramp diverge area and the entry ramp merge area shall be lit in accordance with Section 3.3 below.

c) In rural areas, the exit ramp diverge are and the entry ramp merge area are not lit.

d) Where an interchange is located in the urban fringe environment, (i.e. not clearly rural or urban) the merge and diverge areas shall be lit if the total AADT (existing and estimated) on the ramps is greater than 10,000 vpd.

e) Freeway to freeway ramps in urban areas shall be lit.

f) Lighting of the ramp terminal intersection shall be in accordance with Section 3.4 below.

g) In urban areas, help phone locations shall be lit in accordance with Section 3.5 below.

3.2 Freeway lighting design

Further to the requirements of Section 2, where lighting on freeways is provided, it shall comply with the following:

a) Lighting poles shall be installed between, or on, concrete barrier sections where provided, or behind other barriers if provided.

b) On the through carriageway of freeways, poles not protected by barrier systems shall be slip-base.

c) The designed luminaire spacing shall be based on meeting the requirements of both interim and, where provided, the ultimate freeway configuration.

d) Poles and luminaires should be located along the left side of ramps. Poles shall not be placed in gore areas.

3.3 Ramp lighting

Where VicRoads has specified continuous lighting along the freeway, the luminance based design shall include the full length of entry ramps and exit ramps.

Where VicRoads has specified lighting of the ramps but no lighting in the central median of the freeway, the following is to be provided:

a) Exit ramp lighting shall commence at the diverge taper and extend for at least one (lighting) span along the ramp beyond the ramp nose. If the left lane on the freeway is an exclusive exit ramp lane, then lighting should be provided for 160m before the ramp nose. Luminance based design shall be provided from the start of the diverge taper to the ramp island nose, and shall be based on a maximum carriageway width (W_K) of 10.5m. Illuminance based design shall be provided at the ramp island nose by locating a luminaire in advance of the island nose.

b) If there is a lane drop just downstream of the exit nose, additional luminaires are to be provided to cover the merge taper.

c) Entry ramp lighting shall commence at least one span in advance of the ramp nose and extend to the end of the merge taper. If the entry ramp leads into an added lane, lighting shall be provided for 320m beyond the ramp nose. Luminance based design shall be provided from the ramp island nose onwards, and shall be based on a maximum carriageway width (W_K) of 10.5m.

d) If the ramp terminal intersection is to be lit (see Section 3.4.1 below), ramp lighting shall be provided on the approach to and departure from the ramp terminal intersection. This shall be a minimum of 3 spans or 150m. The maximum possible design spacing for the appropriate lighting arrangement shall be used.

e) Any resultant gap in ramp lighting less than 300m shall be lit.

3.4 Ramp terminal lighting

The ramp terminal intersection shall be lit if:

- it is in an urban area
- the surface road has continuous lighting
- the intersection is controlled by traffic signals or a roundabout, or
- the intersection is controlled by Stop or Give Way Signs and meets the criteria outlined in Section 3.4.1.

3.4.1 Ramp terminal lighting at priority controlled intersections

If a ramp terminal is controlled by Stop or Give Way signs in a rural area, it should be lit where some or all of the following factors apply:

- There is complex geometry, particularly if complicated by access roads within 300m of the entry or exit ramps;

- Drivers could be confused about the travel paths through channelized islands;
- Traffic volumes at the ramp terminal intersection are high (e.g. if traffic volume of the cross road through the intersection is 3600 vpd or greater);
- Sight lines are restricted; or
- There is a significant night time crash record.

Depending on the level of complexity and safety risk, the ramp terminals controlled by Stop or Give Way signs in rural areas may be provided with:

- full Category V5 lighting (V5 rather than V3 is appropriate as it is a rural area);
- flag lights at the key turning points; or
- no lighting.

3.5 Help phones

Lighting is provided at help phone locations on urban freeways. Where possible, this is to be provided by locating help phones underneath, or adjacent to, freeway route lighting to avoid the need for additional poles to light help phones.

Where there is median mounted lighting, help phones shall be lit by locating a luminaire within 15m from the help phone, preferably on the approach side (i.e. there is no need to have a dedicated light for the help phone).

For help phones located on the outside of the carriageway and where median mounted lighting does not provide Category V3 illuminance levels for 5m either side and 3m beyond the help phone (as detailed in Figure 4 below), additional lighting shall be installed in accordance with VicRoads standard drawing TC-2021.

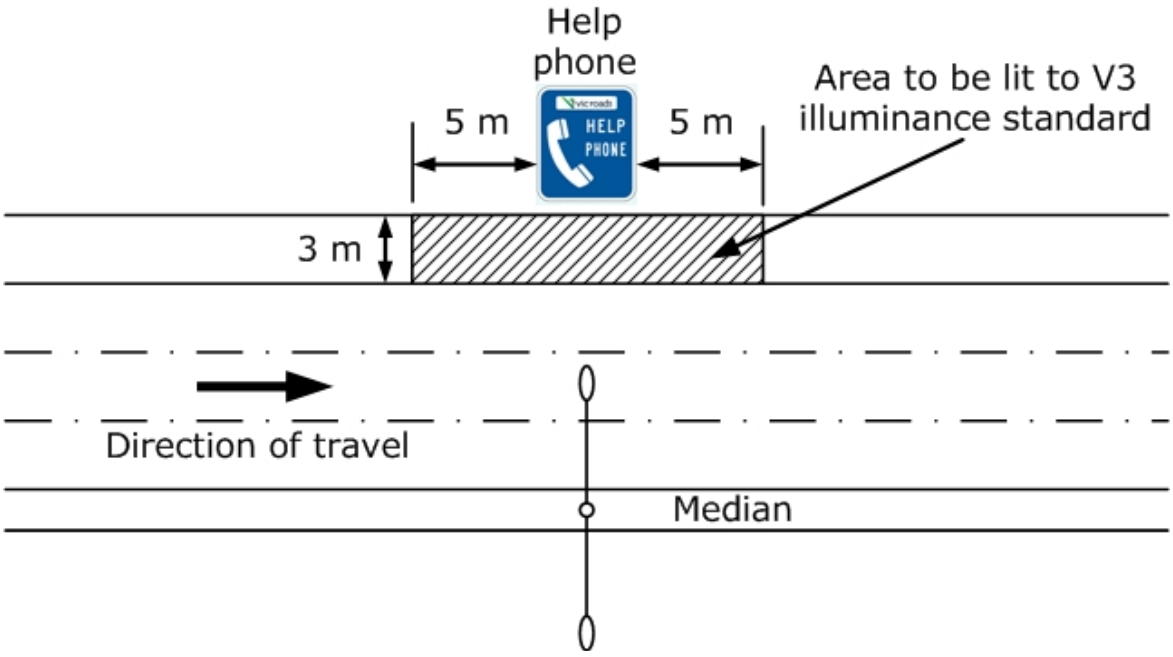


Figure 4: Help phone lighting outside of the carriageway

3.6 Freeway terminal lighting

a) Freeway Connected To Lit Road

Where an unlit freeway ends in a connection to a road which is lit, lighting of the terminal area of the freeway should be provided. The actual length of the freeway to be lit will depend on the geometry of the terminal and the transition in design standards, but will generally not exceed 500m.

b) Freeway Connected To Unlit Road

Where an unlit freeway ends in a connection to an unlit road, the geometry of the terminal and the transition in design standards should determine whether lighting of the terminal area is necessary. Each case must be considered individually and a detailed report justifying the need for any lighting provided.

3.7 At-grade intersections on freeways

At-grade intersections of freeways with surface roads are to be lit if the freeway has a median opening to allow for right turns or U-turns. Lighting is not usually provided for at-grade intersections that cater for left turn in and left turn out movements only.

3.8 Roads under or over freeways

Lighting of roads under or over a freeway is to be provided in accordance with the requirements for lighting arterial roads (see Section 4). However, for roads under a freeway, lighting is to be provided if the structure meets the definition of a tunnel in AS/NZS 1158.5. For those sections of road on the freeway reserve, road lighting is fully funded by VicRoads.

3.9 Pathway lighting

Pathway lighting is to be provided and funded by VicRoads for overpasses and underpasses where pedestrian or bicycle paths cross an urban freeway. However, where a freeway is lit, this may produce an adequate level of lighting on an overpass so that no additional lighting may be necessary.

VicRoads does not fund route lighting for pedestrian or bicycle paths along freeways. However, special arrangements may be agreed with a municipal council if the council wishes to fund the installation and ongoing operating costs of pathway lighting.

3.10 Extensions of existing roads to freeway interchanges

Where an existing road is extended by VicRoads to provide a connection to a freeway interchange and lighting is provided on the existing part of the road and at the proposed interchange, consideration will be given to lighting the extension of the road. These situations will be considered on an individual case basis, taking into account such factors as traffic volumes, length of road and abutting development.

3.11 Deviation of roads to enable freeway construction

Where an existing road is deviated to enable a freeway to be constructed, VicRoads will pay for the reinstatement of any existing lighting to its former standard.

3.12 Cross roads remote from freeway

The practices and responsibilities with respect to lighting sections of roads which connect to freeway interchanges, terminals and grade separations, but that are outside the limits of the freeway declaration and are not included in the cases set out above, must conform to the responsibilities set out in section 1.5.1 above.

3.13 Feature lighting

Generally, feature lighting should be avoided. It shall only be included in a lighting design with VicRoads approval.

However, consideration may be given to the provision of lighting specifically designed to highlight the external form and features of structures associated with freeway interchanges, grade separations and pedestrian overpasses. Such proposals should be developed and assessed on a case by case basis, taking into account the function of the lighting (e.g. place making, way finding or highlighting a bridge or other icon), aesthetics, costs of installation and the ongoing operating and maintenance costs. Such lighting is to be designed to be as energy efficient as practicable. Such lighting must not detract from any other lighting provided on road safety grounds.

3.14 Provision for future lighting

Where continuous route lighting is not to be provided on an urban freeway at the time of construction, it is important to make provision for future lighting, particularly in those areas where post-construction changes are difficult or expensive to achieve.

For future longitudinal lighting of urban freeways, 100mm conduits (and pits) shall be provided under the freeway at a spacing of 500m.

All structures shall be designed to accommodate at least one 90mm conduit for road lighting power supply and should include a structural deck outstand above the central pier or at the centre point of the structure to accommodate the mounting of a lighting pole outside of the guardrail. On wide or longer structures, conduits and outstands should be provided to ensure that Category V3 lighting can be installed in the future.

4. Arterial road lighting schemes

4.1 Extent of lighting on arterial roads

Generally, VicRoads provides road lighting on arterial roads at the following locations:

- Roundabouts
- Signalised intersections
- Pedestrian zebra crossings
- Signalised pedestrian crossings
- Approach lighting to the above locations as per AS/NZS 1158.1.1
- Pedestrian underpasses
- Routes with on-road tram and bus stops
- Urban railway level crossings
- Median openings for U-turn movements (generally flag lighting only)
- Underpasses or beneath structures where lighting is required in accordance with AS 1158.5.

It is undesirable to leave short unlit sections between lit areas as this causes significant fluctuations in lighting levels which may be particularly hard on the eyes of persons with visual difficulties. Therefore, where a lighting installation at any of the above locations results in an unlit road section less than 300m in length between lights (excluding flag lights), lighting shall be provided to fill the resultant gap.

VicRoads may also provide road lighting where it is a cost effective road safety treatment. This will normally be funded under a road safety program.

Other locations where new road lighting will be considered include situations where lighting would provide significant safety benefits or route continuity with adjacent sections. Such situations may include:

- Pedestrian refuges
- Median openings (generally flag lighting only)
- Channelised intersections
- Rural intersections (generally flag lighting only).

4.2 Lights affected by VicRoads road works

Where VicRoads road works affect existing road lighting on an arterial road, the reinstated lighting should meet the requirements of AS/NZS 1158 (Category V3 standard for arterial roads) as part of the project.

With the agreement of the VicRoads Executive Director Policy & Programs or the Project Review Committee, a standard lower than Category V3 may be reinstated. For instance, it may be agreed to reinstate poles and luminaires to provide levels that are comparable to the existing lighting level, but lower than Category V3.

Where VicRoads road works affect existing lighting in minor or local intersecting roads controlled by the relevant council, lighting should be re-instated to provide a standard similar to that which existed prior to the road works. Agreement should be obtained from the relevant council to ensure re-instated lighting conforms to its current standards and policies. Where lighting does not exist in the minor or local road at the time of VicRoads road works, the installation of lighting is the responsibility of the relevant council.

4.3 Lighting of other areas

Road lighting installations for the benefit of service roads, footpath pedestrian traffic, security and the amenity of adjacent land use, are the responsibility of councils.

As VicRoads is the co-ordinating road authority for arterial roads, the relevant council is required to obtain VicRoads consent to such installations. However, VicRoads should not unreasonably withhold agreement to the installation of lights on an arterial road by the council because of the ongoing operating costs. Similarly, a council should not unreasonably withhold agreement to the installation of lights on an arterial road by VicRoads.

4.4 Arterial roads – design requirements

Where lighting is provided, generally arterial roads shall be lit with L2 LED luminaires. Where excessive road width or other factors dictate, L4 LED luminaires may be considered. Where mounting heights cannot be achieved or overhead wires preclude the installation of dedicated lighting poles, then L2 or L1 LED luminaires may be considered for mounting off Distribution Company poles.

L1 LED luminaires may be used to light slip lanes and municipal roads or where the use of L2 LED luminaires inefficient.

4.5 Approach and departure lighting - arterial roads

Unless otherwise specified, approach / departure lighting at intersections requiring an illuminance based design on arterial roads shall be provided in accordance with AS/NZS 1158 or for a minimum of 100m, whichever is the greater. The minimum of 100m shall be measured from the stop or give way line of the intersection.

For isolated pedestrian operated signals, approach / departure lighting shall be provided in accordance with Section 2.5.2.

In all cases, the maximum possible design spacing for the appropriate lighting arrangement shall be used. This will usually result in approach lighting that exceeds the distances specified above.

Any lights that need to be placed on a local road to meet these requirements need to be agreed by the municipal council.

4.5.1 Median island noses on the approach to intersections

Where the nose of a median island (i.e. change from undivided to divided carriageway) is within 3 spans or 150m from the stop or give way line of an intersection that requires illuminance based design, the requirement for approach lighting specified in Section 4.5 shall be extended to light the island nose in accordance with AS/NZS 1158.

Where the median island nose is more than 3 spans or 150m away from the stop or give way line of the intersection, approach/departure lighting to the intersection shall be provided in accordance with Section 4.5 and the median island nose shall be illuminated by providing flag lighting at the island nose.

4.6 Tram and bus stops

Route lighting shall be provided along tram routes with kerbside (on-road) tram stops on arterial roads. New kerbside tram stops should be lit to a minimum of Category V1 illuminance standard over the following limits:

- Laterally - from the edge of the footpath to the closest tram track.
- Longitudinally - from 10m prior to and 3m beyond the tram stop sign.

The tram operator is responsible for providing lighting at:

- tram stops within a central median;
- the vehicular approach to safety zone (i.e. the prow);
- raised platforms at tram stops; and
- within waiting shelters.

The recommended lighting level should be a minimum of Category V3 or Category P6.

The lighting design of tram facilities shall ensure that no area is grossly over lit in comparison to the adjacent road. Where significantly high levels of lighting are proposed, a transition zone may need to be incorporated into the design.

Kerbside bus stops in urban areas shall be lit with a Category V luminaire within 10m (preferably in advance) of the bus stop position. Installation costs for the additional lighting on kerbside bus stops should be borne by the initiating party.

5. The use of frangible and rigid poles

5.1 Introduction

This section provides guidance on the use of frangible and rigid poles for lighting installations on freeways and arterial roads.

Crashes involving rigid poles tend to be more severe than the average crash. Around 4% of crashes involving poles result in a fatality, compared with 2% of crashes in total. Almost 50% of crashes involving poles result in serious casualties compared with approximately 30% of crashes in total.

5.2 Types of frangible lighting poles

The differences between the two types of frangible poles in a crash is shown in Figure 5.

Slip-Base Frangible Poles

The slip-base pole is designed to minimise impediment to an errant vehicle by shearing off at its base. This is the most commonly used frangible pole. It is characterised by a three bolt base plate connection, a slip ring and special electrical components that readily disconnect on impact (to assist in electrical isolation of the pole). This enables the pole to break away with only minimal damage to the pole and vehicle. In most cases, the pole can be re-erected, but the brackets and luminaries usually require replacement. A centre hinged version of the pole can also be obtained.

Impact Absorbing Poles

The impact absorbing pole is designed to deform around an errant vehicle and bring the vehicle to rest with minimal deceleration to the vehicle and its occupants. The pole is characterised by a four bolt base plate that is designed to hold in the event of a crash and a weakened structure that yields progressively on impact. Internal electrical components are protected by conduit. A centre hinged version of an impact absorbing pole is not available.

5.3 Use of frangible poles

Frangible poles should be used wherever possible. However, frangible poles are not to be used in the following situations:

- Poles carrying overhead electricity conductors or supply
- Poles within the dynamic clearance to overhead electricity conductors
- Poles supporting overhead tramway electrical assets
- Joint-use road lighting/traffic signal poles.

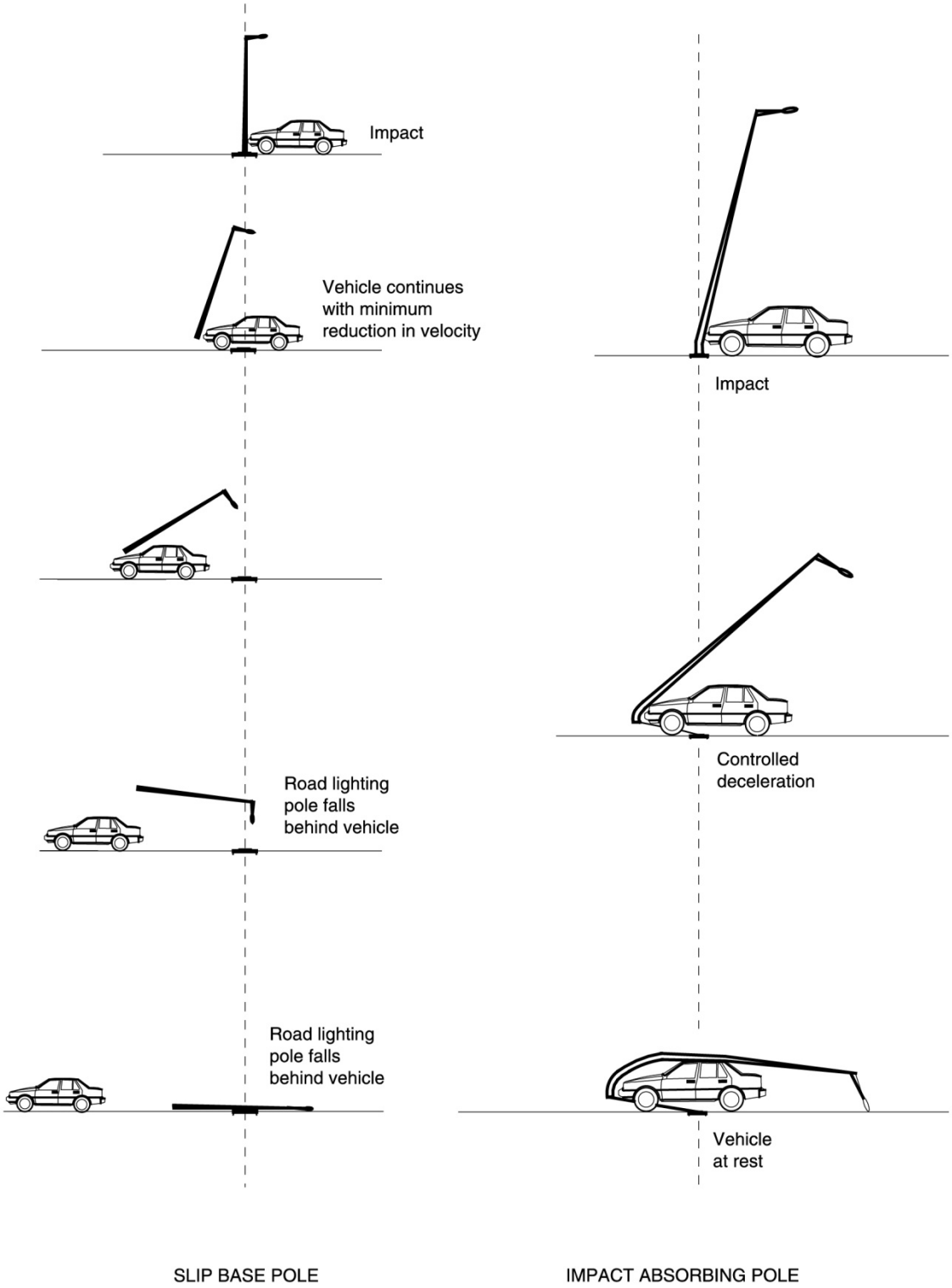


Figure 5: Collapse mode for frangible poles

5.4 Use of rigid poles

Rigid poles shall not be used within the “clear zone” except where:

- necessary clearance to overhead electricity distribution lines cannot be achieved and no alternative is practical
- the pole is shielded behind a safety barrier; however safety barriers must not be used solely for the purpose of shielding rigid road lighting poles.

Unless shielded by crash barrier, the use of rigid poles should be avoided, even outside the clear zone.

5.5 Banners, flags and frangible poles

Banners placed on roadside poles are frequently used to promote civic and community activities and festivals. The installation of banners on an arterial road is subject to an approval process outlined in Section 66 (1)(b) of the *Road Management Act 2004*. If frangible poles are involved, there is a limitation to the wind loading which can be sustained by these poles.

Impact absorbing lighting poles are designed to collapse progressively by crushing when struck by an errant vehicle and, as a result, are designed to be relatively fragile. Generally when loaded to destruction under test conditions, poles collapse at the design load which includes a moderate factor of safety allowance. The design does not allow for any additional loading on poles such as increased wind loading due to the presence of banners or decorative additions. Therefore banners should not be placed on impact absorbing poles.

Slip-base lighting poles are not as likely to collapse under increased wind loading as impact absorbing poles but the safe operation of these poles involves rapid movement of the pole in the event of a collision. The operation of slip-base lighting poles is generally to let the impacting vehicle pass safely beneath the pole in the event of a collision. Additions, such as banners, may result in the pole not operating as intended. Because of the complex nature of the analysis involved in predicting exactly how slip-base poles will react during a collision and without extensive full scale crash testing, it is difficult to determine the acceptable limits for banners attached to these poles.

The collapse mode of each pole type is shown in Figure 5.

Whilst VicRoads holds concerns about the effects that the addition of such banners have on both the impact performance and the long term structural integrity of frangible poles, the guidelines in Table 2 show the size of banners which will be permitted for limited time periods. Allowable banner arrangements are shown in Figure 6.

Any correspondence from VicRoads allowing the addition of banners onto frangible road lighting poles should note that banners may affect the performance of the pole and that the agency placing the banner must agree to be responsible for pole replacement and any resulting claims as per note (vi) in Table 2.

Table 2: Maximum allowable banner size for frangible poles

MAXIMUM TOTAL AREA OF BANNERS			
Banner Attachment Arrangements		Road Lighting Bracket Arrangement	
		Single Outreach Bracket	Double Outreach Bracket
Case 1:	Banner fixed at top and bottom	0.8 sq m	0.4 sq m
Case 2:	Banner fixed at top only or fitted with a mechanism at bottom to release at wind velocity of 20m/s	2.6 sq m	2.0 sq m
Notes:			
(i)	Banners must not be placed on impact absorbing poles.		
(ii)	Banners must be symmetrical about the pole and not increase torsional load (refer Figure 6).		
(iii)	Both cases require that the centroid of the banners is not more than 6.0m from the base of the pole.		
(iv)	Fatigue performance of frangible poles, welds and anchor bolts is not known under the resulting increased stresses from the mounting of banners, consequently: BANNERS MUST NOT BE PERMANENTLY MOUNTED AND MAY NOT BE INSTALLED FOR LONGER THAN AN ACCUMULATED PERIOD OF 10 WEEKS IN ANY 12 MONTH PERIOD.		
(v)	Wind release clips or mounts are the responsibility of the Agency responsible for mounting banners and must be tested to prove reliable release at a wind speed of no more than 20m/s. Results of tests may be subject to audit by VicRoads.		
(vi)	The Agency placing banners must agree to be responsible for pole replacement and any subsequent claims for damage or compensation in the event that poles with banners attached fail from wind loading.		
(vii)	All tapered steel lighting poles installed on declared arterial roads are likely to be either slip-base or impact absorbing poles. If in doubt contact the appropriate electricity distributor or the relevant VicRoads Regional Director.		

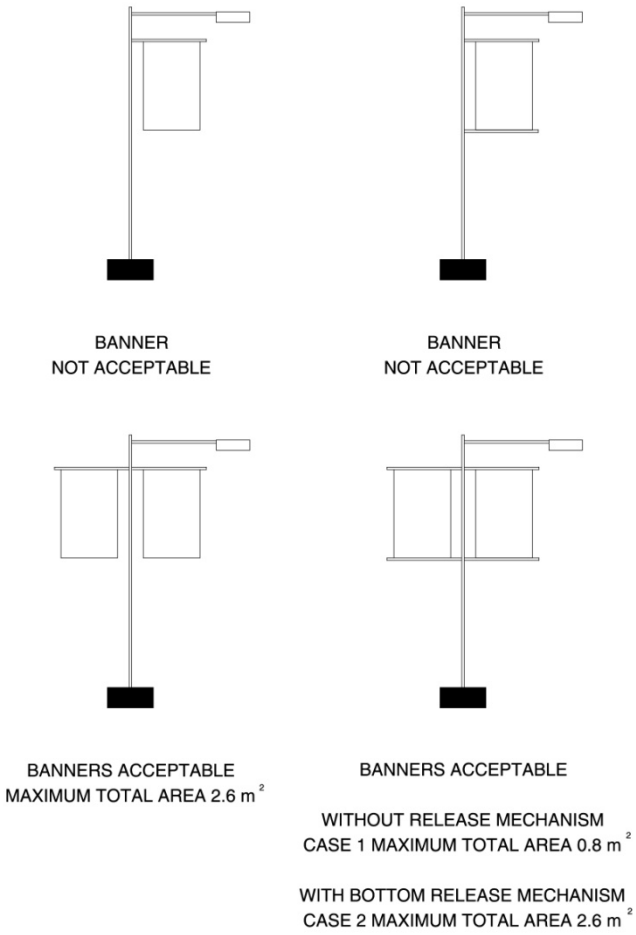


Figure 6: Allowable banner arrangements and sizes for slip-base poles

6. Electrical design - VicRoads operated schemes

All VicRoads operated electrical installations shall fully conform to the requirements of AS/NZS 3000 Australian/New Zealand Wiring Rules.

Independent electrical circuits shall be provided to cater for all VicRoads operated lighting. The electricity supply shall be metered to the VicRoads electrical circuits.

The electrical design for the supply of 240V AC three phase electrical power from the meter in the distribution box to all luminaires shall be approved by a suitably qualified person.

The electrical design shall include all electrical circuits, cabinets and switch gear including determination of power supply points from the appropriate Distribution Company.

VicRoads-owned lighting schemes shall be powered via a VicRoads type-approved distribution box. The distribution box shall meet the requirements of VicRoads Specification TCS043.

All VicRoads lighting schemes are to be designed so that all lighting circuits from a control cabinet are switched simultaneously using a single photo electric (PE) cell.

All above ground electrical installations and works (such as point of power supply and the distribution box) shall, where practicable, be located outside the “clear zone”. The distribution box shall be located appropriately to minimise any vandalism or damage from errant vehicles. Where a distribution box is located within the “clear zone”, consideration should be given to installation of a crash barrier to protect the distribution box.

The distribution box shall be located so that the operation of the PE cell is not adversely affected by light spill.

Where appropriate, the designer shall provide reserved capacity within the circuitry to allow for expansion of the lighting scheme.

Any feature lights shall be supplied using separate circuits (i.e. a circuit that does not contain road or pathway lighting). Feature lighting shall be designed to minimise power consumption.

7. Approval of lighting scheme design

7.1 Detail to be submitted by design consultant

The Design Consultant shall submit all relevant design data including:

a) Written evidence that demonstrates that all requirements of this publication, AS/NZS 1158, AS/NZS 3000 and the relevant electricity distributor standards have been met.

b) Copies of all relevant light technical parameter (i.e. spacing) calculations.

c) Illuminance diagrams showing the E_{Ph} and 0.5 E_{Ph} (as per AS/NZS 1158) contours for all areas where illuminance based design is required.

d) Hard copy format drawings of all non standard fittings and fixtures used (accepted for use by VicRoads).

e) All AS/NZS 3000 electrical computation details including but not limited to cable size, current carrying capacity, protection device calculations, voltage drop, and earth fault loop impedance.

f) A table (in text file format) containing the following information:

- easting and northing co-ordinates for each pole
- pole type and height
- bracket length and type
- luminaire mounting height, type and wattage.

7.2 Detail to be shown on drawings

For distributor-operated installations, drawings shall be prepared in accordance with the local Distribution Company requirements.

For VicRoads-owned installations, the details to be shown on the drawings shall include, but not be limited to:

a) Luminaire wattage, type and manufacturer

b) Luminaire mounting height

c) Bracket type and length

d) Chainages along each road

e) Pole type and length, and coordinates of pole locations. Coordinates shall be recorded to a precision of +/- 0.5 metres using MGA (Map Grid of Australia) Zone 55 Easting and Northing measurements relative to GDA 94 (Geocentric Datum of Australia 1994)

f) Pit type, size and location

g) Conduit type, size and location

h) Circuit diagram(s)

i) Cable type and size

j) Location of the points of power supply and distribution boxes

k) Where appropriate, details of conduits for future supply of lighting along the road

l) Pole numbers

Reference to the requirement to use VicRoads type-approved equipment shall be included on the drawings.