Standards Variation Note

Our Ref:	D23#667548
From:	**A/Manager Electrical Asset Management – Steven Howells**
Reference:	E&ITSDS-01-SVN-02
Effective Date:	13 July 2023
Cease Date:	Until further notice
Standard:	**08/62:** Lighting Design Guideline for Roadway and Public Spaces (Rev. 4V)
Clause(s):	**2.2:** Roadway Lighting, **2.3:** Public Spaces (Pathways and Cycleways) Lighting, **3.6:** Luminaires, **Appendix A:** Specifications for HPS Lamps & Igniters
Subject:	Clarification on the use of light emitting diode technology on Main Roads lighting network

Purpose and Application

The Standard Variation Notes (SVN) are intended to provide temporary modifications to existing Main Roads standards, while these standards are being updated to reflect the changes. It is important to note that the information contained in the SVN does not supersede any statutory regulations unless Main Roads has obtained explicit permission to do so.

It is also important to note that the content of the SVN may be updated, clarified, or integrated into the appropriate standard at a later time as part of a revision to the aforementioned standard. This ensures that the information provided in the SVN remains relevant and accurate.

This SVN provides clarity on the changed requirements for designers to incorporate light-emitting diode (LED) technology into roadway and pedestrian-shared pathways designs.

Background

Main Roads has decided to transition from its current lighting technology, such as high-pressure sodium (HPS) technology, to LED technology for roadway and pedestrian shared pathways lighting – this transition is motivated by several reasons.

LED technology, when compared to HPS, has a higher energy efficiency, consuming less power whilst providing sufficient lighting in accordance with AS/NZS 1158 series requirements. By switching to LED technology as the primary lighting method, Main Roads can reduce energy consumption in alignment with the *Western Australian Climate Change Policy*. The reduction in power usage will additionally reduce the operation expenditure of Main Roads lighting network, by reducing the costs associated with the additional power consumption from tariff charges.

Additionally, LED technology provides further control of several aspects of roadway lighting that are of benefit to Main Roads, such as adjustable light output and colour temperature. These require careful consideration of their use to ensure that the maximum benefit is realised whilst ensuring Main Roads customers' safety and requirements are maintained.

Through this transition to LED lighting, Main Roads aims to embrace sustainable practices, reduce operational costs, and enhance lighting solutions for roadways and public spaces.

Relevant Existing Clause(s)

2.2 Roadway Lighting

The following Main Roads physical parameters shall be stringently followed when designing roadway lighting:

- The luminaire shall be fitted with High output 250 watt High Pressure Sodium (HPS) lamp.

… [not shown for clarity]

2.3 Public Spaces (Pathways and Cycleways) Lighting

Main Roads requires P2 Category lighting for Principal Shared Paths to be achieved with the following additional parameters:

… [not shown for clarity]

- All pedestrian lighting design and installation shall be High Pressure Sodium (HPS) lamps.

… [not shown for clarity]

3.6 Luminaires

… [not shown for clarity] …

6. Appendix A: Specifications for HPS Lamps & Igniters

… [not shown for clarity] …

Clarification

The modified and added clauses to *Lighting Design Guideline for Roadway and Public Spaces* (Rev. 4V) is detailed below. Additionally, *Appendix A: Specifications for HPS Lamps & Igniters* is rescinded from *Lighting Design Guideline for Roadway and Public Spaces* (Rev. 4V). No other clauses are updated as part of this variation notice.

2.2 Roadway Lighting

The following Main Roads physical parameters shall be stringently followed when designing roadway lighting:

- The luminaires employed for greenfield designs must use light-emitting diode (LED) technology. For brownfield designs the designer must use LED technology in consideration of Appendix C: *Roadway and PSP Lighting LED Luminaires – Specific Requirements for Design and Maintenance Replacements* cl. 6.

… [not shown for clarity]

2.3 Public Spaces (Pathways and Cycleways) Lighting

… [not shown for clarity]

- The luminaires employed for greenfield designs must use LED technology. For brownfield designs the designer must use LED technology in consideration of Appendix C: *Roadway and PSP Lighting LED Luminaires – Specific Requirements for Design and Maintenance Replacements* cl. 6.

… [not shown for clarity]

3.6 Luminaires

All road lighting luminaires must comply with AS/NZS 1158.6:2015 and AS/NZS 60598 standard series, in addition to the requirements set out in Main Roads Specification 701.

The designer must always select the most suitable luminaire for the project in terms of cost-effectiveness, luminaire spacing, and maintenance requirements as identified under cl. 2.1.14. Luminaires should be selected from Main Roads *Preferred Electrical and ITS Equipment List* (equipment list), however, the designer may propose a luminaire not on the equipment list through Main Roads *Technical Query and Request for Information Procedure*.

8. Appendix C: Design Requirements for LED Lighting

[refer to note's postscript]

Further information

Any additional questions or concerns on this Standard Variation Notice can be directed to the Main Roads *Technical Query and Request for Information Procedure* found on the Main Roads website.

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We're working for Western Australia.

Roadway and PSP Lighting

LED Luminaires – Specific Requirements for Design and Maintenance Replacements

D23#667570
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Contents

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Owner	Manager Electrical Asset Management
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Amendments

Revision Number	Revision Date	Description of Key Changes	Section / Page No.
0	July 2023	New	All

1 PURPOSE

Main Roads Lighting Design Guideline for Roadway and Public Spaces and Main Roads Specification 701 Roadway Lighting are currently undergoing an extensive review and update. This document serves as a bridge to address the gap in LED lighting requirements until the revised guidelines and updated Specification are published.

The purpose of this document is to provide advice to designers and maintenance contractors when considering and selecting LED luminaires for Roadway or Principal Shared Path (PSP) lighting on the Main Roads network. This document is to be read in conjunction with the existing Main Roads published documentation in regard to roadway lighting as per below:

- Road Lighting - Part A - Policy Statement
- Road Lighting - Part B - Application Approval Guidelines
- Road Lighting - Part D - Administration Guidelines.

2 OVERVIEW

The implementation of LED luminaires on the Main Roads network presents various challenges and factors that are not adequately addressed in the existing documentation. Furthermore, there is a need to address the procedures and specifications for transitioning from traditional lighting to LED lighting, especially when integrating different lighting systems in a seamless and inconspicuous manner.

For all new major projects and maintenance replacement programs, the adoption of LED luminaires is expected to minimise energy consumption, decrease carbon emissions, reduce outages, lower maintenance requirements, and decrease the overall operational and ownership costs of Main Road's lighting systems.

To ensure a standardised approach among all stakeholders during the design and installation of LED lighting, several criteria and constraints must be defined. These include technical requirements for LED lighting:

- specifications for different Colour Temperatures based on specific localities
- considerations for implementing widespread changes in lighting types across the existing road network including determining optimal spacing.

It is worth noting that while Australian Standards for LED luminaires and equipment may not be fully established or published yet, international standards are often used as a reference for such equipment.

3 AUSTRALIAN AND INTERNATIONAL STANDARDS

3.1 General

Please note that while the standards and documentation provided in this section are not an exhaustive list of all standards related to road and PSP luminaires, they are considered appropriate for LED luminaires. If you require additional standards for luminaires, please consult the other Main Roads documentation that is referenced.

We acknowledge that Australian Standards specifically for LED luminaires and equipment may not be fully established or published at this time. As a result, international standards are often used as requirements for such equipment.

The most recent standard published by Standards Australia regarding LED lighting is AS/NZS 5341:2021, which covers test methods for energy and functional performance of LED lamps. Furthermore, it is important to recognize that certain clauses in the referenced standards may not be applicable to LED luminaires. Only the relevant clauses should be taken into consideration.

3.2 Australian and New Zealand Standards

Standard	Definition
SA/SNZ TS 1158.6:2015	Lighting for roads and public spaces Luminaires - Performance
AS/NZS 60598.1 :2017	Luminaires General requirements and tests (IEC 60598-1, Ed.8.0 (2014) MOD)
AS 60529:2004	Degrees of protection provided by enclosures (IP code)
AS IEC 60038:2022	Standard voltages
AS 61000.6.2:2022	Electromagnetic compatibility (EMC) Generic standards - Immunity standard for industrial environments (IEC 61000-6-2:2016 RLV (ED. 3.0) MOD)
AS 61000.6.3:2021	Electromagnetic compatibility (EMC) Generic standards - Emission standard for equipment in residential environments (IEC 61000-6-3:2020 (ED 3.0) MOD)
AS/NZS 5341:2021	LED lamps – Test methods – Energy and functional performance
AS/NZS 60598.1:2014	Luminaires General requirements and tests (IEC 60598-1, Ed.8.0 (2014) MOD)
AS/NZS 60598.2.3:2015	Luminaires Particular requirements - Luminaires for road and street lighting (IEC 60598-2-3, Ed. 3.1 (2011) MOD)
AS/NZS 1158.1.1:2022	Lighting for roads and public spaces - Vehicular traffic (Category V) lighting - Performance and design requirements

3.3 International Standards

Standard	Definition
IES LM-80-08	Approved Method: Measuring Lumen Maintenance of LED Light Sources
IES TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources
CIE S 025	Test method for LED lamps, LED luminaires and LED modules
IES LM-79	Approved method for Electrical and Photometric measurements of Solid-State lighting products
IES LM-80	Approved method: Measuring luminous flux and colour maintenance

Standard	Definition
	of LED packages, arrays and modules
IES TM-21	Technical Memorandum: Projecting Long-Term lumen, photon and radiant flux maintenance of LED light sources
IEC 62386-102 Ed. 2.0	Digital addressable lighting interface (DALI) – Part 102: General Requirements – Control Gear
IEC 61643-11	Low-voltage surge protective device – Part 11: Surge protective devices connected to low-voltage power systems – Requirements and test methods

3.4 Other Relevant Documentation

Standard	Definition
ANSI/IES LM-79-19	Approved Method: Optical And Electrical Measurements Of Solid-State Lighting Products
IES LM-79-08	Electrical and Photometric Measurements of Solid-State Lighting Products
IES LM-80-08	Measuring Lumen Maintenance of LED Light Sources
IES LM-84-14	Measuring Luminous Flux and Color Maintenance of LED Lamps, Light Engines, and Luminaires
IES TM-21-11	Projecting Long Term Lumen Maintenance of LED Light Sources
IES TM-28-14	Projecting Long-Term Luminous Flux Maintenance of LED Lamps and Luminaries
NEMA/ANSI C136.41	For Roadway and Area Lighting Equipment – Dimming Control Between an External Locking Type Photocontrol and Ballast or Driver

4 DEFINITIONS

Term	Definition
AADT	Annual Average Daily Traffic
AZ/NZS	Australian Standards / New Zealand Standards
Built-up Area	Any road and the territory contiguous to the road; provided the territory contiguous with the road is developed with structures devoted to business, industry or dwelling houses and these developments have driveway connections to the road at intervals of less than 100m over a distance of 500m or more.
CT	Colour Temperature

Term	Definition
K	Kelvin
LED	Light Emitting Diode
Freeway	A road signed as such in accordance with the Road Traffic Code 2000.
Highway	A road declared as such under the Main Roads Act 1930 that is not signed as a freeway.
LGA	Local Government Authority
Local Road	A road under the care, control and management of a LGA.
PSP	Principal Shared Path - The primary parallel path provided along freeways within an urban area and along passenger rail routes within the Perth Metropolitan Area. *(An urban area being an area that has the characteristics of a city or town.)*
Road Lighting	Lighting within a road reserve that lights the road carriageway and or the paths for cyclists and pedestrians, excluding Flag lighting.
IPWEA	Institute of Public Works Engineering Australasia
State Road	A road declared under the Main Roads Act 1930 to be a highway or a main road
NEMA	National Electrical Manufacturers Association
LLMF	Lamp Lumen Maintenance Factor

5 LED LUMINAIRES

5.1 Colour Temperature

Colour Temperature (CT) refers to the level of warmth or coolness emitted by a light source and is measured in Kelvin (K). LED lighting is available in a variety of colour temperatures, with common options being 3000 K (warm), 4000 K (cool), and 5000 K (daylight). Generally, higher CT values result in a whiter or bluer light appearance. In comparison, High-Pressure Sodium (HPS) lights typically have colour temperatures ranging from 2200 K to 2600 K and tend to emit a more yellowish light.

Numerous studies, reports, commentaries, and opinions exist regarding the use of LED lighting for street lighting, often with divergent findings. The Institute of Public Works Engineering Australasia (IPWEA) has published the IPWEA SLSC Model Public Lighting Strategy (Sept 2020), which Main Roads has consulted and largely incorporated to determine the required colour temperatures for specific locations, albeit with some deviations.

In summary, all LED installations will be mandated to use either 3000 K or 4000 K luminaires, depending on their installation location.

5.1.1 3000 K Installation Locations

3000 K LED luminaires must be the default luminaires to be installed across the Main Roads network. The IPWEA SLSC Model Public Lighting Strategy (Sept 2020) recommends the use of 3000 K *"for resident comfort and to minimise potential environmental harm, lighting with a colour temperature of 3000 K will be the default in all residential roads, parks, and pathways."* Main Roads has considered that the choice of 3000 K is still a brighter light source than typical HPS lighting, and that environmental considerations play a significant role in our overall policies. For this reason, 3000 K has been selected as the current best option to facilitate our requirements.

Routes and locations where 3000 K lighting must be utilised are:

- All routes except for Freeways
- All PSPs.

5.1.2 4000 K Installation Locations

It is acknowledged that the IPWEA SLSC Model Public Lighting Strategy (Sept 2020) recommends the use of 4000 K lighting on *"main roads where maximizing road safety is the priority."* While this recommendation seems generic as road safety is typically a primary objective when installing lighting, there are reported benefits when comparing 4000 K luminaires to 3000 K luminaires in terms of the ability of road users to recognize hazards earlier.

Furthermore, all underbridge lighting, regardless of the route, will utilise 4000 K LED lighting. The purpose of 4000 K lighting in this case is to highlight the bridge as an approaching structure. Similarly, all underpass lighting on PSPs will also utilize 4000 K LED lighting.

For the Graham Farmer Freeway Tunnel, the entire 1.6 km length will be illuminated with 4000 K LED lighting during the transition from HPS and fluorescent lighting to LED lighting.

Other routes and locations where 4000 K lighting must be utilised are:

- Freeways and associated access (on and off) ramps
- Underbridge Lighting
- Underpass Lighting
- Internal Bridge/Structures Lighting
- Graham Farmer Freeway Tunnel.

5.1.3 4000 K to 3000 K Transitions at Freeway Intersections

Generally, freeway access ramps have associated traffic signal intersections and intersection lighting. These intersections are not deemed to be part of the associated Freeway and are therefore required to be lit with 3000 K LED lighting. The freeway access ramps themselves are required to be lit with 4000 K LED lighting. The transition from 4000 K to 3000 K LED colour temperature must occur at a single streetlights distance from the intersection proper, i.e., one streetlight before the intersection for freeway off ramps, and one single streetlight after the intersection for freeway on-ramps.

Note: There are specific requirements for intersection lighting in regards extents of lighting on the intersection approaches. This clause does not mitigate or change these requirements.

5.2 Operational Hours and Warranty

LED road and PSP lighting luminaires must be capable of providing a minimum of 100,000 hours of operation. The LED luminaire must provide a minimum of a 25% reduction in power (wattage) compared to an equivalent HPS luminaire providing the equivalent light coverage.

All luminaires' electronics (including the LED's) must have a warranty of a minimum of 10 years. The luminaire body must have a design life of a minimum of 15 years.

5.3 Specific Requirements - Constant Light Output

Constant Light Output (CLO) is a well-established technology that effectively addresses light output depreciation in LED luminaires. With CLO functionality enabled, the luminaire compensates for this depreciation using a programmable driver, resulting in a linear and consistent light output throughout the LED's lifespan.

CLO technology is particularly advantageous in applications where maintaining consistent lighting levels is critical, such as roadways, public spaces, and security lighting. The ability to sustain optimal light output over time ensures improved visibility and safety for pedestrians, cyclists, and drivers.

Additionally, the energy-saving capabilities of CLO technology lead to reduced power consumption and lower carbon emissions. This aligns with Main Roads sustainability goals and environmental initiatives, contributing to more eco-friendly lighting solutions.

By incorporating CLO luminaires, Main Roads can achieve better optimisation and sustainability. This optimisation is achieved by minimising initial over-illumination and accounting for future light depreciation. The CLO functionality is pre-programmed during the luminaire's manufacturing process, making it a set-and-forget feature. CLO technology not only reduces overall energy consumption but also enhances the longevity of the luminaire. The key benefits of utilizing CLO technology are as follows:

- Consistent light level for the duration of the products lifetime
- No over-illumination
- Lower operating costs
- Decreases environmental impact.

Furthermore, CLO technology allows lighting designs to incorporate a higher lamp lumen maintenance factor compared to the typical usage in HPS lighting. Main Roads will accept a factor of 0.8 for LED lighting with CLO technology, acknowledging its efficacy and long-term performance.

Overall, CLO technology provides a reliable and efficient lighting solution that ensures consistent light output, reduces energy consumption, lowers operating costs, and improves the overall quality and sustainability of lighting installations.

5.4 Specific Requirements - 7 Pin Nema Socket

Luminaires and their associated drivers supplied for Main Roads lighting schemes must be equipped with a 7-pin NEMA socket, as specified in SA/SNZ TS 1158.6:2015. NEMA refers to the National Electrical Manufacturers Association of America.

The NEMA socket serves as an electrical and mechanical connection point between the control cell and the luminaire. The ANSI C136 coded standard provides clear guidelines regarding the

socket's size, locking mechanism, and other relevant details. It is a standardized connection type widely used in the lighting industry.

The demountable structure of the NEMA socket facilitates installation, maintenance, and repair processes. It offers a reliable power connection with robust twist-lock contacts.

The signal contacts in the NEMA socket support the 1-10VDC or Digital Addressable Lighting Interface (DALI) protocol. These protocols are commonly used in intelligent lighting systems that enable remote monitoring and control through a lighting control system.

Please note that LED luminaires selected for under bridges, PSP underpasses, and the Graham Farmer Freeway Tunnel are exempt from requiring 7-pin NEMA socket connectivity. This is because the lighting in these locations will always operate at 100% capacity and will not be subject to future dimming functionality.

5.5 Selection of Luminaire Make and Model

It is recognized that the market for LED luminaires in Australia is extensive, with new products constantly entering the market. The Main Roads Design Standard 04 Preferred Electrical and ITS Equipment List includes a selection of available LED luminaire brands and models. However, it is important to note that this document serves as a guide, and consideration may be given to other brands and models. Priority will be given to LED luminaires from well-known and reputable suppliers, typically globally renowned companies. This ensures that the luminaires can reasonably be expected to be supported and replaced for a reasonable period of time after installation, or that the manufacturer can provide suitable alternatives if required.

To streamline routine maintenance and minimize the stock of replacement parts, the number of LED luminaires will be limited whenever feasible.

If LED luminaires that are not included in the Main Roads Design Standard 04 Preferred Electrical and ITS Equipment List are proposed, they must be accompanied by supporting documentation. These proposals should be submitted to Main Roads through the Technical Query process and procedure, as outlined on the Main Roads website.

5.6 Selection of Autotransformer

It is recognized that the wattage of LED luminaires is less than the equivalent HPS lighting. Main Roads has standard size autotransformers installed on HPS lighting, however Main Roads will accept LED lighting autotransformer rated for a minimum 1.5 times the design luminaires power rating. The autotransformer is to be sized to the nearest higher “standard” rating autotransformer available.

6 LED INSTALLATION ON ROAD NETWORK

6.1 General

It is vital to establish extents and parameters when installing LED lighting on the road and PSP network, which predominantly comprises HPS luminaires. This is crucial to maintain optimal levels of lighting uniformity and minimise the visual impact resulting from different light types operating at varying CTs. The transition from HPS to LED lighting is expected to be a gradual and extensive process, requiring a clear and practical approach.

Furthermore, it is important to acknowledge that frequent changes in lighting schemes during travel can be distracting to road users. Therefore, it is necessary to implement a coherent and consistent strategy to minimise disruptions and ensure a smooth transition to LED lighting.

To ensure that lighting uniformity levels are maintained at the best practical levels and minimise the visual effect of different light types operating at different colour temperatures, it is necessary to define extents and limits when installing LED lighting on the road and PSP network, which currently predominantly uses HPS luminaires. Recognising that the transition from HPS to LED lighting will be a fairly long process, a clear and reasonable approach is required. Additionally, it is acknowledged that frequent changes in lighting schemes during travel can be distracting to road users.

6.2 Determining minimum extents of LED lighting upgrades for Street Lighting

When performing any works on Main Roads' existing street lighting, the following requirements for LED lighting changes and upgrades must be taken into consideration:

1. LED lighting changes/upgrades must be for at least the distance travelled in 30 s at the posted speed limit on the route. For example, a car travelling at 100 kmh^{-1} at the posted speed limit will travel 833 m in 30 s. Assuming street lighting poles are spaced at 70 m intervals, then the number of streetlights is 12.

2. Any section of freeway being changed/upgraded to LED lighting which has associated on or off ramps must also allow for the associated ramps to be upgraded. The entire on or off ramp must be upgraded if associated with a freeway bulk upgrade.

3. If the replacement of LED lighting with HPS lighting is scheduled to take place near a conflict point, such as merge or diverge points, turning pockets at intersections or interchanges, it is crucial to consider whether the installation will still meet the requirements outlined in the relevant clauses of AS/NZS 1158.1.1:2022. In such cases, the LED replacement should begin at a point where the affected conflict points can be incorporated into the change or upgrade process.

4. No LED bulk lighting change/upgrade must start or finish at a signalised intersection. The bulk upgrade must either:
    a. stop 2 light poles before the intersection (if the bulk change/upgrade was originally up until the said intersection, but not inclusive); or
    b. continue 2 light poles past the intersection (if the bulk change/upgrade was originally inclusive of the intersection).

5. Freeway on and off ramps may be considered separately (not as an intersection) for the purpose of bulk LED changes/upgrades.

6. Where bulk LED changes/upgrades (based on the distance travelled calculation) may result in partial lighting on switchboards remaining on HPS, the remaining portion of the affected switchboard lighting circuit/s are also to be changed/upgraded to LED lighting, unless formal approval from Main Roads, via the formal Technical Query process, to deviate from this requirement is granted.

7. If, in the process of undertaking an LED bulk change/upgrade, or during the design process to determine the extents of a proposed bulk LED change/upgrade, it becomes apparent that said change/upgrade will result in “gaps” between sections of road lighting which will remain HPS lighting (but which will then be shorter than the distance travelled in 30 seconds at the posted speed limit on the route), then a formal Technical Query must be raised for Main Roads to be able to assess the impact to the road network.

8. Where a road route is separated by a train route, bulk LED changes/upgrades can be considered in isolation of the traffic flowing in the opposite direction.

9. The selected light poles spacing must be 10 m less than maximum calculated compliant spacing between any two roadway light poles.

6.3 Determining minimum extents of LED lighting upgrades for PSP Lighting

NOTE: All PSP lighting schemes must utilize three-phase configurations. Pits should not be used, and the cabling must loop in and out of each pole, including the unused phase.

When performing any works on Main Roads' existing PSP lighting, the following requirements for LED lighting changes and upgrades must be taken into consideration:

1. If the PSP is being upgraded as part of a project that also includes the upgrade of street lighting, and the PSP runs in close proximity to the upgraded street lighting (visible from the street), the section of the upgraded PSP lighting should cover a distance at least equal to that of the upgraded street lighting.

2. LED lighting changes or upgrades should cover a distance that is equivalent to the distance traveled in 30 s by a bicycle traveling at a speed of 25 kmh^{-1}. A bicycle traveling at 25 kmh-1 covers a distance of 208 m in 30 seconds. Assuming street lighting poles are spaced at intervals of 35 meters, this translates to approximately 6 PSP lights (208/35 = 5.95, rounded up to 6).

3. If the replacement of LED lighting with HPS lighting is scheduled to take place near a conflict point, such as intersections or interchanges, the replacement and associated design should consider whether the installation will still meet the requirements specified in the relevant clauses of AS/NZS 1158.3. It is recommended that any LED replacement affected by such conflict points commence at a location where these points can be incorporated into the change or upgrade process, as recommended by Main Roads.

4. No LED bulk lighting change/upgrade must start or finish at an intersection. The bulk upgrade must either:
    a. stop 2 light poles before the intersection (if the bulk change/upgrade was originally up until the said intersection, but not inclusive); or
    b. continue 2 light poles past the intersection (if the bulk change/upgrade was originally inclusive of the intersection).

5. Where bulk LED changes/upgrades (based on the distance travelled calculation) may result in partial lighting on switchboards remaining on HPS, the remaining portion of the affected switchboard lighting circuit/s are also to be changed/upgraded to LED lighting, unless formal approval from Main Roads, via the formal Technical Query process, to deviate from this requirement is granted.

6. If, in the process of undertaking an LED bulk change/upgrade, or during the design process to determine the extents of a proposed bulk LED change/upgrade, it becomes apparent that said change/upgrade will result in “gaps” between sections of PSP lighting which will remain HPS lighting (but which will then be shorter than the distance travelled in 30 seconds on a bicycle), then a formal Technical Query must be raised for Main Roads to be able to assess the impact to the PSP network.

7. The selected light poles spacing must be 4 m less than maximum calculated compliant spacing between any two PSP light poles.