Ironbark Sustainability

Public Lighting Position Paper

Prepared for
Maroondah City Council

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Ironbark has been operating since 2005 and brings together a wealth of technical and financial analysis, maintenance and implementation experience in the areas of building energy and water efficiency, public lighting and data management. We pride ourselves on supporting our clients to achieve real action regarding the sustainable management of their operations.

Our Mission

Ironbark's mission is to achieve real action on sustainability for councils and their communities.

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1. Executive Summary

This Public Lighting Position Paper has been developed to inform the management of Council's public lighting assets. Consultation with key Council staff and the review of relevant Council policies within the context of best practice public lighting asset management has established a set of key positions and/or recommendations that should be addressed in Council's Public Lighting Policy and Guidelines.

The key positions and/or recommendations are summarised in Table 1.

Table 1: Summary of key positions and recommendations

Section	Position/Recommendation

4.1	The Guidelines and Policy **will** cover:
	• road/street and footpath lighting
	• Council car park lighting
	  ○ standalone car parks
	  ○ public facility or recreation reserve car parks
	• park lights and other pole-mounted open space lights
	  ○ pedestrian path lighting
	  ○ off street bicycle path lighting
	  ○ wayfinding lighting (bollards and in-ground path markers)
	• under-awning and shop window lighting
	• aesthetic lighting
	  ○ building façade lighting
	  ○ tree up-lighting
	  ○ lighting related to sculptures and public art
	• laneway lighting
	• external building lighting
	  ○ perimeter lighting
	  ○ external entrance lighting
	
	The Guidelines and Policy **will not** cover:
	• internal building lighting
	• sports ground lighting
	• sports facility lighting

4.2.1	Council to continue to monitor the vesting of new unmetered public lighting assets in Victoria
5.1	Council to engage a third-party designer to review designs proposed by developers for all subdivisions where the road related assets will be vested to Council (for unmetered standard street lighting installations)
5.2	Council to consider collecting key characteristic data for any new non-standard street lighting assets that are installed

Section	Position/Recommendation
5.3	Council to consider the need to engage a third-party designer to review designs proposed by developers (for metered lighting assets) Council to add all newly installed metered public lighting assets to an asset register
5.3.1	Council to consider public aesthetic lighting in special circumstances
5.3.2	Council's Public Lighting Guidelines to specify private aesthetic lighting shall be considered. Private aesthetic lighting installations shall be considered where it: • is not to be installed on public assets where maintenance of that asset might be affected • is temporary • does not impact negatively on existing functional lighting • contributes to place making • is to be installed, operated and maintained by the person/body making the request • does not require the installation of any permanent supporting infrastructure
6.1	Council will not stock decorative (non-standard) luminaires and poles for maintenance of unmetered public lighting Council to consider commissioning third-party night time audits of unmetered minor road street lighting to collect data on faulty street lighting and subsequently submit them to AusNet for repair Council to consider requesting a greater level of transparency from AusNet regarding bulk lamp and PE cell maintenance work
6.2	Council to undertake proactive maintenance of metered public lighting assets, including: • a 3-year cycle of cleaning visors • either annual operation audits OR 3 to 4-year condition assessments Council to install identification plates on all metered public lighting poles Council will respond to faults (investigation, not action) within 10 days Council will expand upon its existing asset register to create a comprehensive record of it metered lighting assets Council will utilise its existing customer service system which has a street light module that can be refined/developed to access or align with any council public lighting asset register/database Council will not to keep stock of metered luminaires or components, and instead will order in when required

Section	Position/Recommendation
6.3	Council's Public Lighting Guidelines to: • specify design principles to apply to the design of new streetscapes • specify to specify an onsite light level analysis and assessment against standards in response to complaints about trees
7.1	Council to: • continue the existing program to replace 50W and 80W unmetered standard mercury vapour street lights • proactively explore potential renewal projects for unmetered street lighting that offer environmental and/or financial benefits • consider replacement options for existing non-standard unmetered street lighting including their potential replacement with standard street lighting
7.2	Council to consider: • undertaking regular metered public lighting asset audits and reviews of maintenance works to better understand when an asset has reached the end of its life either via poor condition or escalating maintenance costs • regular investigation of new technologies via feasibility studies that look into the financial and environmental costs and benefit of renewing metered public lighting assets before they reach the end of their life • future metered public lighting requirements as part of any precinct or activity centre strategies
8.1.1	Council's Public Lighting Guidelines to specify a minimum luminaire efficacy ratio to effectively exclude the use of fluorescent, MV, HPS and MH luminaires for unmetered installations
8.1.2	• Council's Public Lighting Guidelines to prohibit the installation of new non-standard unmetered fittings • Council to advocate for the approval of energy efficient alternatives for all existing non-standard luminaire types • Council to advocate for the approval of an LED retrofit lamp • Council to trial LED retrofit lamps • Council to carry out a comprehensive cost-benefit analysis of all upgrade options for its existing non-standards unmetered assets.
0	Council's Public Lighting Guidelines to include a specification and checklist outlining minimum design and performance requirements for metered assets (poles and luminaires)
8.3	Relating to public lighting in key precincts: • Council's Public Lighting Guidelines to identify key precincts • Council's Public Lighting Guidelines to specify the same design requirements as for metered public lighting, with limited variation permitted in surface finish and colour, and CCT • Council's Public Lighting Policy to specify that at the time of upgrade or renewal the following should be considered: ○ transitioning from unmetered to metered supply

Section	Position/Recommendation
	○ transitioning from overhead to underground supply
9.1	Council to develop a Smart Cities Policy/Strategy Council's Public Lighting Guidelines to specify the use of luminaires with a 7-pin NEMA base wired to a dimmable driver Council to liaise with AusNet to ensure that all new unmetered luminaires are smart-enabled (featuring a 7-pin NEMA base wired to a dimmable driver)
9.2	Council's Public Lighting Guidelines to permit the use of solar lighting only where connection to the grid is not considered viable
10.1	Council to consider collecting key characteristic data for any new non-standard unmetered street lighting assets that are installed Council to continue to opportunistically collect locational data on existing non-standard unmetered street lighting assets during bulk upgrade works Council to consider carrying out a more comprehensive audit of non-standard unmetered street lighting assets to collect data on paint colour, entry point and models
10.2	Council to add all newly installed metered public lighting assets to an asset register Council to collect the minimum data on each metered lighting asset (to be specified in Public Lighting Policy) Council to install ID plates on each metered lighting asset to provide a cross reference between the physical asset and the book asset Council to implement a clear internal process for the maintenance of the asset register Council to audit all assets every 3 to 4 years to assess condition and capture any changes to assets that aren't otherwise captured as part of the ongoing asset register maintenance process
11	Council's Public Lighting Guidelines to specify: • best-practice process for responding to requests for new street lighting • requests for street lighting on currently unlit streets will be assessed on a case-by-case basis • requests for removal of street lighting will not be considered • best-practice process for responding to complaints
12	Council's Public Lighting Guidelines to specify where and when to provide public lighting and what controls (dimming, switching, sensors) shall apply
12.1	Council's Public Lighting Policy to define the road reserve as: • kerb-line to kerb-line where no footpaths exist; • kerb-line to property boundary where only one footpath exists; or

Section	Position/Recommendation
	• property boundary to property boundary where no footpaths or only one footpath exists within the Principle Pedestrian Network and pedestrians are expected to walk on nature strips
12.2	Council's Public Lighting Policy to define appropriate design solutions to minimise light pollution
13	Council's Public Lighting Guidelines to specify the method for assigning lighting categories as per AS/NZS 1158, including any site-specific exceptions
14	Council's Public Lighting Guidelines to specify: • An acceptable colour temperature range of 3000K to 4250K for metered lighting • A desired colour temperature range of 3000K to 4250K for unmetered lighting, noting the current restrictions based on what has been approved by AusNet Services to date. • How to apply colour temperature in different circumstances, noting that 4000K is the generally preferred colour temperature.
15	Council to include best-practice recycling and waste disposal requirements in any tender or RFQ documentation for public lighting works, including the requirement that evidence of appropriate recycling and/or disposal is provided
16	Public Lighting Policy and Guidelines to be subject to review every 3-5 years

2. Introduction

This Public Lighting Position Paper has been developed by Ironbark Sustainability in collaboration with key Council staff to inform the development of Council's Public Lighting Guidelines and Policy. The issues discussed in this Paper were identified during a series of two workshops and follow-up meetings with key Council staff. The Paper provides a description of each issue relating to public lighting, presents both best practice and Council-specific considerations, and makes recommendations for Council consideration and possible inclusion in the finalised Public Lighting Guidelines and/or Policy.

3. Background

From June to August 2017 a series of stakeholder workshops and internal meetings were conducted with key Council stakeholders. Council stakeholders included representatives from the following Council departments/areas:

- Transport & Traffic Engineering
- Development Engineering
- Engineering Projects
- Facilities
- Asset Management
- Open Space
- Operations
- Built Environment
- Sustainability and Environment
- Business and Development
- Statutory Planning
- Contracts and Purchasing
- Waste and Special Projects
- Community Planning and Development
- Sport and Recreation
- Economic Development

The purpose of these discussions was to establish the guiding principles for the development, implementation and maintenance of public lighting schemes in the City Maroondah, with a focus on:

- best practice
- sustainability
- financial responsibility
- adherence to community expectations
- innovation
- asset management

Development of this Position Paper has also been informed by reference to the following documents:

- Ringwood Transit City Lighting Strategy November 2007
- Ringwood Urban Design Manual December 2014
- Road Management Plan 2013-2017
- Carbon Neutral Strategy & Action Plan 2014/15-2020/21

At present, Maroondah does not have any Council-wide guidelines or policies relating to public lighting. Recent projects have identified the need for an informed policy position on public lighting asset management, safety and public expectations, application of standards, sustainability and energy efficiency, and how to balance the often competing demands of the need to light public spaces while preserving neighbourhood character. The advent of "smart" lighting also presents challenges and opportunities which Council needs to consider.

This consultation represents the first step towards development of a set of Public Lighting Guidelines and ultimately a Public Lighting Policy. This Position Paper discusses the key issues that were identified during the Council stakeholder consultation process, and is intended to guide further discussion within Council in the context of what is considered best practice, and considerations that are specific to the City of Maroondah. Where relevant, recommendations for the content of Council's Public Lighting Guidelines and Policy have been made.

While Council can exert significant influence on pedestrian lighting, it is also acknowledged that a wider range of stakeholders need to be consulted and collaborated with to achieve ideal outcomes. As such, Council may seek further targeted consultation with external stakeholders following the development including:

- AusNet Services
- Local Police
- Public Transport Victoria (PTV)
- VicTrack
- VicRoads
- Local business and community members (or community groups)

In August 2019, this Position Paper was amended to reflect the recommendations found in two reports developed by Council in response to resident feedback (See Appendix 5 and 6). These reports related to decorative lighting and the impact of artificial light at night.

4. Context

4.1 Public Lighting Guidelines and Policy Scope

Following consultation with key Council stakeholders it was decided that the following types of lighting will be included in the scope of Council's Public Lighting Guidelines and Policy.

The Guidelines and Policy **will** cover:

- road/street and footpath lighting
- Council car park lighting
    - standalone car parks
    - public facility or recreation reserve car parks
- park lights and other pole-mounted open space lights
    - pedestrian path lighting
    - off street bicycle path lighting
    - wayfinding lighting (bollards and in-ground path markers)
- under-awning and shop window lighting
- aesthetic lighting
    - building façade lighting
    - tree up-lighting
    - lighting related to sculptures and public art
- laneway lighting
- external building lighting
    - perimeter lighting
    - external entrance lighting

The Guidelines and Policy **will not** cover:

- internal building lighting
- sports ground lighting
- sports facility lighting

4.2 Ownership and Responsibility for Public Lighting

A summary of the current ownership and decision-making arrangements for all in-scope lighting is outlined in Table 2, and is based on discussion with key Council staff during the workshop process.

Table 2: Current ownership and responsibility for public lighting

Area	Strategic Planning	Operation and Maintenance	Asset Renewal	Capital Works	Pole & Light Ownership
Parks and Open Space lighting (generally metered lighting)	Traffic Engineering Open Space Leisure	Operations Asset Management (when attached to a building)	Asset Management	Asset Management	Council or AusNet[1]
Street lighting – standard unmetered (majority of lighting)	Traffic Engineering	AusNet	AusNet (maintenance)	Sustainability (bulk changeovers) Traffic Engineering (ad-hoc replacements)	AusNet
Street lighting – non - standard unmetered	Traffic Engineering	AusNet[2]	AusNet (maintenance)	Sustainability (bulk changeovers) Traffic Engineering (ad-hoc replacements)	Council
Car park lighting (generally metered lighting)	Traffic Engineering	Operations	AusNet (maintenance)	Traffic Engineering Open Space	Council or AusNet[3]
External building lighting	Asset Management Traffic Engineering	Asset Management Facilities	Facilities	Facilities	Council
Aesthetic lighting	Site specific but may include: Business development Open space Traffic Engineering Arts and Cultural Development Local businesses	Site specific but may be: Operations Local businesses	Site specific but may be: Asset Management Local businesses	Site specific but may be: Asset Management Local businesses	Site specific but may be: Council Local businesses
Lighting of shared public-private spaces ("quasi-private" e.g. Town Square)		Site-specific			

[1] Limited (and decreasing) in number.
[2] Maintenance is limited to lamp (if applicable) and PE cell replacements, and cleaning. Upon failure, replacement luminaire and/or pole must be provided by Council.
[3] Limited (and decreasing) in number.

4.2.1 Vesting of Unmetered Lighting Assets

Council's standard unmetered street lights are owned and maintained by AusNet. At present, and as has been the case for Council's recent bulk LED street light upgrades, the ownership of any new street lights installed by Council is "gifted" or vested back to AusNet. For over a decade, many councils around Australia have sought to retain ownership of new LED street lighting assets in residential streets, of which the vast majority of existing lights are owned by DNSPs. For this to occur, there generally needs to be an agreement between a council and the DNSP. In some states (such as Queensland and Tasmania) this arrangement whereby the new lights can be owned by the Council is integrated within existing contracts. In others, this is not available unless through negotiation.

In **New South Wales**, all LEDs have been vested or "gifted" back to the DNSP. Some councils attempted to retain ownership but inevitably the relevant DNSPs (there are three in NSW) have not been willing to sell back their assets.

In **Victoria**, a handful of councils have attempted to retain ownership of the new LEDs, most notably Moreland City Council who released an alternative maintenance tender in a process that began in 2007. In late 2013, it was announced that the preferred tenderer was Citelum Australia, a subsidiary of European energy, distribution network and nuclear giant EDF (Electricite de France). Citelum began negotiations with DNSP Jemena, to see if an agreement could be made around the transfer or sale of DNSP-owned assets from Jemena to Council, so they could be independently maintained. However, progress stalled with the Australian Energy Regulator confirming in 2014 that "unless a distributor agrees to give a third-party access to its network for maintenance services, it cannot be forced to. They're not contestable if the distributor provides the services and continues to provide them". The project was ultimately unsuccessful and in late October 2015 Council undertook a bulk changeover to LEDs with the assets vesting with Jemena.

In **Queensland**, there are at least three external providers who are interested in assisting councils to retain assets and engage a third party to manage and maintain their assets. Over the past few years a handful of councils have also been negotiating closely with DNSP Energex around a valuation and transfer of existing Energex-owned assets. In mid-2016, Energex developed guidelines under which the transfer of public lighting assets needs to comply. The next steps are to finalise the transfer documentation and develop access agreements, also known as a Facilities Access Agreement or FAA.

In **Tasmania**, Hobart and Glenorchy Councils retained ownership of the street lights after a change to LED lighting last year. They are currently negotiating an access agreement for councils to manage and maintain the newly installed LEDs. The relationship between councils and TasNetworks is collaborative and aimed at seeking mutually agreeable outcomes, with other councils (including Launceston and region) and the LGA of Tasmania playing a key role in ensuring these relationships are smooth and productive. If, as expected, these negotiations are successful, then Hobart and Glenorchy will be able to engage third parties to manage and maintain the new LEDs, or indeed deliver these services in-house.

In the **Northern Territory**, street lighting assets will be transferred from NT Power and Water Corporation to councils on 1st January 2018. This is for 22,000 lights across the territory and the negotiations for this transfer has been in motion for years. Negotiation has been in good

faith and there are good existing relationships between all parties, noting that NT Power and Water Corporation are a government-owned corporation compared with the privately-owned SAPN.

In **Western Australia**, there has been no meaningful attempt to retain ownership of lights, noting that NT and WA are not part of the National Electricity Market and not regulated by the AER.

In **South Australia**, the DNSP SA Power Networks (SAPN) offers an "Energy Only" tariff where councils can retain ownership of the assets on council-owned infrastructure. However, for street lighting assets currently owned and operated by SAPN (i.e. the majority of lights in the state) it's a bit more complicated. Thankfully the situation is changing and over the last year a group of 9 leading councils from across South Australia have been having regular, open and collaborative discussions with SAPN. This group has been able to facilitate discussions around SAPN approving LED technologies for use on the network and in improving the transparency of street lighting management. The group has been influential in developing a larger range of tariffs and undertaking negotiations that has led to downward revision of the tariffs for LEDs that are now being offered by SAPN. There are also discussions around "access agreements" that could allow councils to retain ownership of new LEDs.

Finally, in the **Australian Capital Territory**, where street lights are currently publicly owned and managed, the government planned on selling their street lights in 2015, however a tender process in November of that year was unsuccessful. The government is instead trying to find a third party to upgrade and manage their 79,000 lights.

There are potential risks and rewards for councils who do take over ownership and maintenance responsibility of unmetered lighting assets. In the event that ownership is transferred back to a council, the possible benefits include:

- reduced costs by opening up the market for street lighting maintenance service providers
- improved transparency regarding costs and maintenance procedures
- increased control over the costs of the council-owned components of the street lighting network (noting that there would likely still be DNSP-owned cost components e.g. supply cable wiring, the pole etc.).
- increased control over maintenance services such as the type and frequency of maintenance and management of lights.
- more control over smart city services

The key risk associated with any move to reclaim ownership of street lights is that it may never eventuate. While councils around Australia have attempted to seek more control over street lighting assets over the past decade, their success has been very limited. Quite simply, the challenge of "taking over" the assets of another party who do not wish to part with them represents a major obstacle. Other key risks include:

- undefined internal resourcing within Council and an internal lack of expertise in street lighting
- asset management, maintenance and replacement risks rest with Council which council does not currently have expertise in

- maintenance costs end up higher due to the inefficiencies of having multiple maintenance providers - for example, Council maintains the parts of the assets it owns and AusNet concurrently maintains their components (poles etc.) when it may be most efficient to have one provider maintaining the entire network
- legal challenges prevent the transfer of assets or costs blow out
- timeframes blow-out

To date, no council in the AusNet distribution area has sought to challenge or enter into negotiations with AusNet regarding the ownership of their street lights. In the event that a council does go down this path, it is likely that AusNet will refuse to relinquish control, in which case the state government would need to force them to through legislative change. There is currently no indication that this situation is likely to change in the near future.

Given the above, Ironbark would encourage Council to continue to monitor the state of play, especially in Victoria. If and when there is significant change (e.g. a Victorian council successfully takes ownership of their lights, or AusNet indicates they are open to a transfer of ownership) then Council should undertake detailed analysis to determine whether a benefit exists in pursuing ownership.

Recommendation:

- **Council to continue to monitor the vesting of new unmetered public lighting assets in Victoria**

5. Approval Processes for New Assets

A well-defined and well-governed approval process for new pubic lighting assets is an important component of an overarching asset management system. Its main purpose is to provide a framework for Council to verify that key requirements relating to design, technology, efficiency and asset consistency are being met.

5.1 Unmetered Standard Street Lighting Assets

The approval process for new unmetered standard street lighting is relatively straightforward due to the constraints that exist in terms of which products can be used on the unmetered AusNet network.

Figure 1 describes the existing process whereby Council has oversight of the design/preparation phase and AusNet has control of the installation, commissioning and ongoing management of the asset. There are three steps within this process where Council needs to decide what level of control and oversight it wants to have.

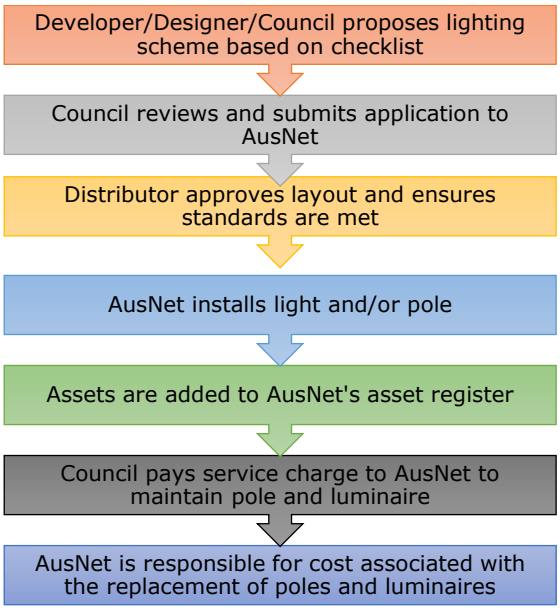


Figure 1: Approval process for standard unmetered lighting assets

The first step is during the design phase and is related to the checklist that is provided to inform the proposed lighting scheme. This checklist can dictate minimum energy efficiency requirements, required levels of lighting and preferred product types. A checklist has been developed based on outcomes of the two workshops held with Council staff.

The second step is the Council review stage whereby Council staff verify that the requirements of the checklist and/or the Australian Standards are being met. The greater the complexity of the checklist, the more this stage becomes important to ensure that the desired outcomes are achieved and a consistent approach to new lighting assets is maintained. This stage is also important in terms of signing off on AS 1158 compliance and/or asset minimisation. Experience

has shown that it is not always the case that minimum standards are met and/or the most efficient street lighting layout is used to minimise the number of poles and lights that are required. Whilst a third-party review for all proposed lighting schemes represents best practice, Council has indicated a preference for the following rule of thumb:

- when it is a capital works project involving metered lighting, or an unmetered intersection redesign, Council is happy to rely on the designer that they engage to do this
- when it is a developer proposing a design, then Council is will engage a third-party designer to check off on compliance and that the least number of poles/luminaires have been proposed for lighting designs relating to all subdivisions where the road related assets will be vested to Council, including key intersections within or connecting to the residential subdivisions. For smaller scale developments within a single street, Council will rely on the design submitted by the developer.

The third step is the asset register stage which is spoken about in more detail in Section 10. In short, however, AusNet is responsible for maintaining the asset register of unmetered street lighting assets in the City of Maroondah. Some councils choose to augment this asset register to address certain shortfalls in the data that AusNet maintains. At this stage, Council has indicated that it will only consider keeping a record of non-standard unmetered lighting assets (refer to Section 5.2).

Recommendation:

- **engage a third-party designer to review designs proposed by developers for all subdivisions where the road related assets will be vested to Council**

5.2 Unmetered Non-Standard Street Lighting Assets

The existing approval process for new unmetered non-standard lighting is largely the same as the process outlined for unmetered standard street lighting (refer to Figure 2), and the same issues outlined in Section 5.1 need to be addressed. However, the following additional considerations (discussed in further details in the sections specified) are specific to non-standard street lighting and would need to be accommodated by a checklist and processes relating to asset registers:

- greater restrictions on the use of non-standard assets (refer to Section 8.1.2)
- limitations on non-standard asset data in the AusNet asset register (refer to Section 10.1)

In addition to the above considerations, the key difference that applies to non-standard unmetered assets (compared to standard) relates to ownership and maintenance responsibilities. AusNet have confirmed that the ownership of non-standard assets, in their

view, remains with Council after installation (i.e. they are not vested to AusNet). In this context, the maintenance fee Council pays to AusNet only covers lamp and PE cell replacements and visor cleaning. Upon failure, replacement poles and luminaires must be provided to AusNet by Council. AusNet will then install the replacement materials at cost to Council.

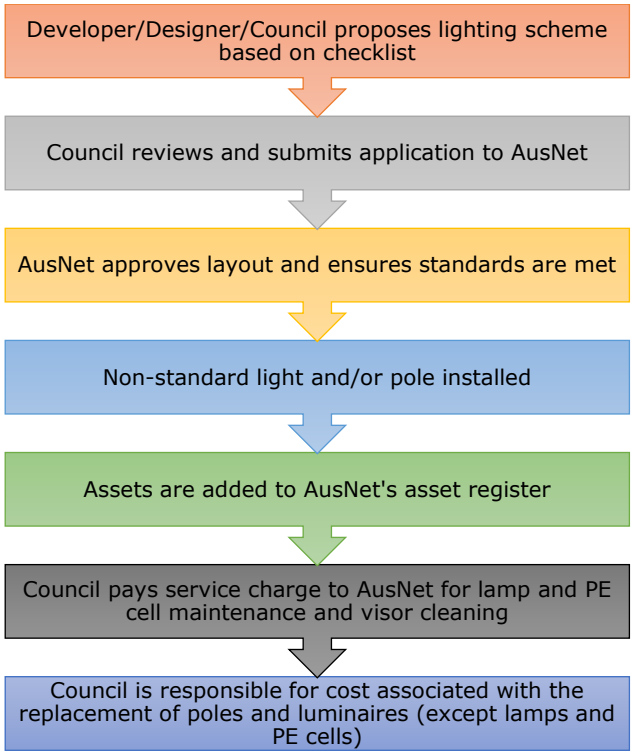


Figure 2: Approval process for non-standard unmetered lighting assets

Recommendation:

- **consider collecting key characteristic data for any new non-standard street lighting assets that are installed (refer to Section 8.1.2)**

5.3 Metered Lighting Assets

Council is in full control of the approval process for new metered lighting assets, which is described in Figure 3.

The first step in the approval process occurs during the design phase and is related to the checklist used to inform the proposed lighting scheme, which is provided to whoever is carrying out the design for the new lighting scheme. This is usually a third-party lighting designer but can also sometimes be a developer or a Council staff member. This checklist can dictate minimum energy efficiency requirements, required levels of lighting and preferred product types. A checklist has been developed based on outcomes of the two workshops held with Council staff.

The second step is the Council review stage whereby Council staff verify that the requirements of the checklist and/or the Australian Standards are being met. The greater the complexity of the checklist, the more this stage becomes important to ensure that the desired outcomes are achieved and a consistent approach to new lighting assets is maintained. This stage is also important in terms of signing off on AS 1158 compliance and/or asset minimisation. Experience has shown that it is not always the case that minimum standards are met and/or the most efficient street lighting layout is used to minimise the number of poles and lights that are required. Whilst a third-party review for all proposed lighting schemes represents best practice, Council has indicated the following rule of thumb:

- When it is a capital works project involving metered lighting, or an unmetered intersection redesign, Council is happy to rely on the designer that they engage to do this.
- When it is a developer proposing a design, then Council is open to considering engaging a third-party designer to check off on compliance and that the least number of poles/luminaires where used.

Once the assets are installed as part of the third step, they should be immediately added to an asset register of Council's metered lighting assets. Council's has expressed a desire to achieve as close to best practice as possible whilst at the same time taking into consideration the resources required to maintain such an asset register versus it's benefits. Further details of how Council will approach asset registers can be found in Section 9.2 of this document.

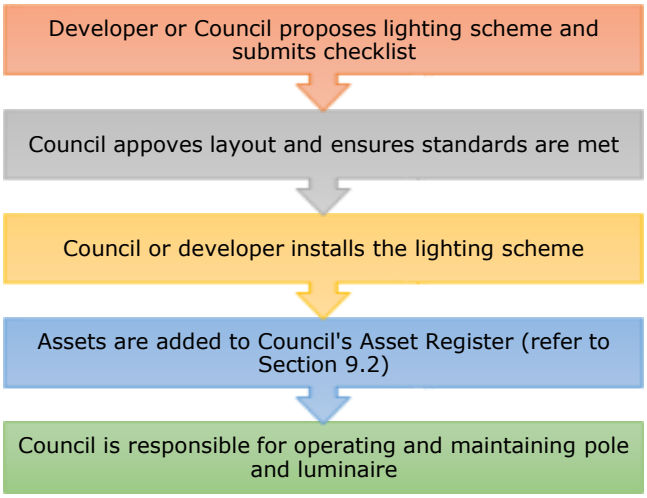


Figure 3: Approval process for metered lighting assets

Recommendations:

- **consider the need to engage a third-party designer to review designs proposed by developers**
- **add all newly installed metered public lighting assets to an asset register**

5.3.1 Special Consideration – Public Aesthetic Lighting

Special circumstances may dictate the need for Council to install aesthetic lighting (uplighting, feature lighting, façade lighting). This might include instances where public art (murals, sculptures, statues), memorials or heritage building facades warrant being illuminated from a place-making perspective. Whilst generally aesthetic in purpose, providing such lighting also has the advantage of reducing vandalism and damage, through enhanced security and surveillance. Other examples might include colour changing lighting along garden beds or atop existing path lighting where the purpose is purely aesthetic rather than functional.

Recommendation:

- **consider public aesthetic lighting in special circumstances**

5.3.2 Special Consideration – Private Aesthetic Lighting

Periodically, Council may be approached by a private body or local business seeking to install some kind of aesthetic or feature lighting (e.g. uplighting of, or bud lighting in trees, feature lighting of a building façade etc.). In such circumstances, the key issues Council needs to consider are:

- when to allow such lighting
- who will pay for the installation
- who will maintain the installation
- who will pay for the electricity consumption
- the potential impact of the installation

Providing local business groups and/or businesses with the opportunity to implement their own aesthetic or feature lighting elements in the public realm is an excellent way to promote the local economy with minimal investment from Council. Limitations, however, need to be applied in term of what can be illuminated, where the lighting is situated and when the lighting is on.

Typically, aesthetic or feature lighting implemented by local business groups and/or businesses are paid for and maintained by the local business groups and/or businesses that implemented them.

The lighting should not be installed on a public asset where Council maintenance activities might be affected. For example, bud lighting in trees will affect Council tree pruning activities. The lighting should also not be installed where it will have a negative impact on flora or fauna, for example upward lighting of trees into habitats of sensitive receptors.

Lighting should be temporary in nature and not form part of the permanent street scape so as to avoid neglect if local business groups and/or businesses are no longer able to fund ongoing maintenance. This precludes the installation of pole mounted lights as well as underground wiring and switchboard pillars located in the public realm.

Council's considerations for instances where a private body or local business is seeking to install some kind of aesthetic or feature lighting largely aligns with what is currently best practice.

Council has indicated that it would allow lighting to be installed under the following circumstances:

- there is a clear communal place-making benefit
- there is little or no impact on the functional lighting of the area e.g. no bright lighting impacting on uniformity
- the proposed lighting fits into existing and future place-making strategies
- there is no involvement required from Council in terms of installation-related activities and costs
- there is no involvement required from Council in terms of maintenance-related activities and costs
- associated energy costs are paid for by the private body or local business installing the lighting
- the lighting is temporary in nature, allowing it to be removed or adapted as funding for ongoing operation and maintenance and/or place-making strategies change
- the lighting does not require any permanent elements such as poles, underground wiring or switchboards within the public realm

Bud lighting in trees has been specifically addressed due to its impact on tree pruning activities. Council has indicated that it would like to avoid any new bud lighting in trees and will actively seek to remove any existing bud lighting as trees are renewed.

Other methods to light trees include pole-mounted direction spot lights or ground-mounted up lighting. Both of these solutions would typically require Council to be responsible for implementation and maintenance.

Recommendations:

- **Council's Public Lighting Guidelines to specify aesthetic lighting shall be considered. Private aesthetic lighting installations shall be considered where it:**
    - **is not to be installed on public assets where maintenance of that asset might be affected**
    - **is temporary**
    - **does not impact negatively on existing functional lighting**
    - **contributes to place making**
    - **is to be installed, operated and maintained by the person/body making the request**
    - **does not require the installation of any permanent supporting infrastructure**

6. Maintenance and Repair Procedures

Best practice asset maintenance and repair procedures not only assist in providing a high level of service to the public but also contribute to extending the serviceable life of an asset, thus lowering the capital required for asset renewal projects over time.

The following section provides a discussion on best practice asset maintenance and repair procedures, the options that exists for Council to pursue these procedures and the decisions that Council has made to date regarding committing to these procedures.

6.1 Unmetered Assets

Unmetered public lighting assets in Maroondah are maintained and repaired by AusNet. This is covered by an annual operation, maintenance and replacement (OMR) cost charged to Council by AusNet. The Victorian Essential Services Commission's Public Lighting Code sets out that at a minimum, the ***distributor*** must (or must ensure that a person responsible to it must):

a) operate a 24-hour call centre to receive public and ***public lighting customer*** reports of public lighting faults
b) repair or replace ***standard fittings*** within 7 ***business days*** of a ***fault report*** and use best endeavours to repair or replace ***non-standard fittings*** within 7 ***business days*** of a ***fault report*** subject to the availability of fittings
c) replace ***non-major road lamps*** at least every 4 years or otherwise as required by ***public lighting standards***
d) clean, inspect for damage and repair ***luminaires*** during any re-lamping
e) replace photo-electric cells at least every 8 years or otherwise as required by ***public lighting standards***
f) routinely patrol ***major roads*** at night to inspect, replace or repair ***luminaires*** at least 3 times per year
g) replace ***luminaires*** with appropriate new ***luminaires*** at the end of their economic life

Based on the above, different unmetered asset types fall under different processes for maintenance and repair. The most notable difference is that Council is required to source, pay for and supply replacement non-standard street lights and poles whereas AusNet's OMR costs cover replacement standard street lights and poles.

Table 3: Overview of repair and maintenance processes for unmetered asset types

	Minor Road Light (P-Category)	Major Road Light (V-Category)
Standard	• Faults are identified passively via reports from the public or Council • Faulty lamps or PE cells are replaced under OMR costs • Replacement luminaires and poles (due to fault or end-of-life) are replaced under OMR costs • Lamps and PE cells upgraded at pre-defined cycles	• Faults are identified proactively via regular night time patrols • Faulty lamps or PE cells are replaced under OMR costs • Replacement luminaires and poles (due to fault or end-of-life) are replaced under OMR costs • Lamps and PE cells are replaced only on failure.

Non-Standard	• Faults are identified passively via reports from the public or Council • Faulty lamps or PE cells are replaced under OMR costs • Replacement luminaires and poles must be paid for and supplied by Council • Lamps and PE cells upgraded at pre-defined cycles	• Faults are identified proactively via regular night time patrols • Faulty lamps or PE cells are replaced under OMR costs • Replacement luminaires and poles must be paid for and supplied by Council • Lamps and PE cells are replaced only on failure.

Council has limited scope to affect change to the maintenance and repair procedures of unmetered public lighting. Council's options include:

- keeping stock of common decorative (non-standard) street lighting luminaires and poles to improve response times to faults (based on workshop discussions this option will not be pursued due to the limited number of non-standard lighting assets in Maroondah)
- commissioning annual third-party night time audits of minor road street lighting to collect data on faulty street lighting and subsequently submit them to AusNet for repair
- requesting a greater level of transparency from AusNet regarding bulk lamp and PE cell maintenance work (this would most likely be in the form of recording replacement dates)

The advent of smart lighting may present opportunities for Council, including in terms of maintenance and repair of public lighting (for broader discussion of the potential features and benefits of a smart lighting network, refer to Section 9.1).

AusNet does not currently have an explicit policy around incorporating smart lighting technology within their network, however there are informal discussions occurring between AusNet and various councils. In other distribution areas there are also regular discussions around smart technology being held at monthly "customer innovation forums" facilitated by Ironbark. These forums do not determine binding policies or official positions, however they are being used to inform the sector and ensure customers and DNSPs are discussing key issues and opportunities.

In practical terms, AusNet has recently approved LEDs that have a 7-pin NEMA PE cell base and a dimmable driver, which essentially means the LEDs are "future proofed" and ready for smart networks of the future.

Recommendations:

- **Council will not stock decorative (non-standard) luminaires and poles for maintenance of unmetered public lighting**
- **Council to consider commissioning third-party night time audits of unmetered minor road street lighting to collect data on faulty street lighting and subsequently submit them to AusNet for repair**
- **Council to consider requesting a greater level of transparency from AusNet regarding bulk lamp and PE cell maintenance work**

6.2 Metered Assets

Council has full control over the process and systems it puts in place to maintain and repair metered public lighting assets. Typically, there are large gaps between what a council actually does and what best practice is. For Maroondah, this is no different with a largely reactive process in place whereby faults or issues are identified either by members of the public or incidentally by Council staff or contractors working on or in the vicinity of metered public lighting assets.

For metered public lighting assets, best practice maintenance and repair procedures are based largely on a proactive approach. The following dot points provide a summary of what is considered best practice:

- Regular (every 6-12 months) audits to test for the operation of lighting assets followed by repairs to fix any assets that are not working.
- Regular (every 3 to 4 years) audits to assess the condition of lighting assets in order to identify structural faults (rust, pole lean etc.)
- Recording of all maintenance and repair work carried out in order to identify assets/sites with reoccurring issues and thus better inform asset renewal.
- The creation and upkeep of an asset register to record the location, characteristics, condition and maintenance history of each metered public lighting asset
- The installation of identification plates (with unique ID and Council phone number) on metered light poles to assist the public and Council in reporting and identifying faults.
- Holding stock of common pole and luminaire types as well as luminaire components in order to improve response times to faults.
- An overarching goal of asset consistency across the municipality to assist in product familiarity by maintenance staff and to simplify stock management of replacement components

Council made the following decisions in regard to how it would like to improve the way in which it maintains and repairs metered public lighting assets:

- As a general goal, Council will seek to implement proactive rather than reactive maintenance and repair processes.
- Council will seek to commit to a 3-year cycle of cleaning visors. Three years will align with the cycle that Council operates on for regular maintenance work.
- Council was not able to reach a clear decision on whether it wanted to implement annual operation audits or 3 to 4-year condition assessment.
- Council will seek to implement identification plates on all metered public lighting poles.
- Council will seek to respond to faults (investigation, not action) within 10 days. This aligns with Council's current service requirements
- Council will seek to expand upon its existing asset register to create a comprehensive record of it metered lighting assets.

- Council will utilise its existing customer service system which has a street light module that can be refined/developed to access or align with any council public lighting asset register/database.
- Council will not to keep stock of luminaires or components, and instead will order in when required due to storage issues; lack of purchasing power for such small quantities; risk of equipment becoming obsolete

Recommendations:

- **Council to undertake proactive maintenance of metered public lighting assets, including:**
  - **a 3-year cycle of cleaning visors**
  - **either annual operation audits OR 3 to 4-year condition assessments**
- **Council to install identification plates on all metered public lighting poles**
- **Council will respond to faults (investigation, not action) within 10 days**
- **Council will expand upon its existing asset register to create a comprehensive record of it metered lighting assets**
- **Council will utilise its existing customer service system which has a street light module that can be refined/developed to access or align with any council public lighting asset register/database**
- **Council will not to keep stock of metered luminaires or components, and instead will order in when required**

6.3 Public Lighting and Trees

The interaction between trees and public lighting presents the challenge of balancing the need to provide adequate public lighting at night, and adequate shade and amenity during the day. This problem can occur with immature trees, and both small and larger species, with the primary issue being tree canopies shading luminaires resulting in lower light levels. How to best manage the relationship between trees and public lighting was a key issue raised during the workshop process.

Best-practice management of this issue can be separated into two parts:

- ensuring adequate separation of trees and lighting at the planning stage for **new streetscapes**
- establishing a clear and consistent approach for responding to complaints about **existing trees and lighting**

Wherever possible, street lighting, trees and other elements of the streetscape should be designed at the same time. The design process should consider the following principles:

- the locations of street trees and light poles should be coordinated to minimise shading (shadowing)
- where street trees and poles are co-located, luminaires should be located below the canopy (if possible)
- where necessary, lighting may be placed nearer the centre of streets, out of reach of foliage
- supplementary lighting may be considered where street trees or verandahs would otherwise produce shadowing

A process for dealing with complaints about tree shading should involve a light level assessment and assessment against standards.

Current Council practice for new streetscapes is to require trees and public lighting to be separated by at least 2 metres. It was noted that tree species are also chosen to suit the local context on a case-by-case basis.

Current Council practice for existing trees and lighting involves pruning trees in response to complaints from the public. Following receipt of a complaint a day-time assessment of the proximity of the tree to the light is performed, and if a tree is confirmed to be blocking lighting, then it may be pruned if practical to do so.

It is therefore recommended that Councils Public Lighting Guidelines specify the design principles to be applied to the new streetscapes (as above).

Council has indicated a willingness to consider a best-practice approach to responding to complaints regarding existing trees and lighting. It is recommended this involve (refer also to the general complaints response procedures discussed in Section 11):

1. an on-site analysis utilising a high-quality light meter to determine the existing levels of lighting 40 metres on either side of the tree
2. a comparison of existing lighting levels against the requirements of the Australian Standards
3. the development of a succinct report detailing the outcomes of the analysis including advice on whether tree pruning or tree/light relocation should be investigated further

The process described above is typically carried out by a suitably trained member of staff or a lighting designer/consultant.

Recommendations:

- **Council's Public Lighting Guidelines to:**
    - **specify design principles to apply to the design of new streetscapes**
    - **specify to specify an onsite light level analysis and assessment against standards in response to complaints about trees**

7. Asset Replacement/Renewal Procedures

The typical drivers for the renewal of existing public lighting assets are:

- **Environmental** – the renewal of existing assets may present opportunities for energy savings as well as the elimination/minimisation of contaminants such as mercury.
- **Financial** – The renewal of existing assets may present opportunities to reduce maintenance and operation costs. This would typically be due to the use of a more reliable and energy efficient technology.
- **End of Life** – Luminaires are designed to last 20 years and poles for 35 years. In practice, however, where no other drivers exist, the end of life is typically based on the point in time at which maintenance and repair is no longer proving effective in addressing faults. At this time the individual asset or all assets of its type and age should be considered for replacement.
- **Design (place-making)** – Public spaces are periodically upgraded as part of Council place-making strategies. This typically involves public lighting as one of many elements that are upgraded.
- **Design (change of purpose)** – Urban environments and pedestrian and vehicular usage patterns evolve over time. This may necessitate a review of required lighting levels and the subsequent upgrade of lighting assets.

The following section provides a discussion on best practice asset renewal procedures, the options that exists for Council to pursue these procedures and the decisions that Council has made to date regarding committing to these procedures.

7.1 Unmetered Assets

It is extremely unlikely that an AusNet-initiated asset renewal program will occur on a scale large enough or time-frame short enough to present Council with any noticeable environmental of financial benefits. As such, Council-initiated projects are the only viable way to fast-track large-scale renewal projects involving unmetered public lighting assets.

Council has been pro-active with asset renewal in the recent past, having successfully replaced the majority of its existing standard unmetered 80W mercury vapour street lights with LED equivalents.

For unmetered public lighting assets, best practice renewal procedures as of August 2017 are:

- successful completion of a program to replace all 50W and 80W standard mercury vapour street lights with energy efficient (T5, CFL or LED) equivalents
- active exploration of replacement options for full-cost main road lighting (typically 150W and 250W high pressure sodium) via a cost-benefit analysis
- active exploration of the replacement options for non-standard street lights via a cost-benefit analysis including consideration for replacement with standard street lights to reduce capital and ongoing costs (see Section 5.1 Maintenance and Repair)

Council made the following decisions in regards to how it would like to approach the renewal of its unmetered public lighting assets:

- continue the existing program to replace 50W and 80W unmetered standard mercury vapour street lights
- proactively explore potential renewal projects for unmetered street lighting that offer environmental and/or financial benefits
- consider replacement options for existing non-standard unmetered street lighting including their potential replacement with standard street lighting

Recommendations:

- **Council to:**
  - **continue the existing program to replace 50W and 80W unmetered standard mercury vapour street lights**
  - **proactively explore potential renewal projects for unmetered street lighting that offer environmental and/or financial benefits**
  - **consider replacement options for existing non-standard unmetered street lighting including their potential replacement with standard street lighting**

7.2 Metered Assets

Proactive asset renewal processes that take into account environmental, financial and design considerations is a fundamental aspect of best practice asset management. Technology evolves over time to offer potentially lucrative cost savings and lower energy usage. Similarly, the function of a space will evolve over time and may require a redesigned lighting scheme to better serve current usage patterns. Lastly, place making is an increasingly important role of local government and lighting, either through the style of the hardware or the quality and type of light it delivers to a space, is an important element of most streetscape or open space upgrades.

Maroondah City Council has expressed a desire for a more proactive metered lighting asset renewal program. It is recommended that this includes:

- regular asset audits and reviews of maintenance works to better understand when an asset has reached the end of its life either via poor condition or escalating maintenance costs
- regular investigation of new technologies via feasibility studies that look into the financial and environmental costs and benefit of renewing assets before they reach the end of their life
- the consideration of future public lighting requirements as part of any precinct or activity centre strategies

Recommendations:

- **Council to consider:**
  - **undertaking regular metered public lighting asset audits and reviews of maintenance works to better understand when an asset has reached the end of its life either via poor condition or escalating maintenance costs**

- **regular investigation of new technologies via feasibility studies that look into the financial and environmental costs and benefit of renewing metered public lighting assets before they reach the end of their life**
- **future metered public lighting requirements as part of any precinct or activity centre strategies**

8. Asset Consistency

Asset consistency in public lighting asset management relates to the variety of pole and luminaire types that exist in Council's public lighting asset base. The degree of variation has significant implications for ongoing management of public lighting assets, as well as impacting on the aesthetic or "feel" of public spaces throughout the municipality.

Best practice in public lighting asset management involves limiting the range of approved asset types, which may be achieved by specifying minimum design and performance requirements on poles and luminaires, or specifying particular products. The benefits of this best-practice approach include:

- simplified maintenance processes
- simplified design and procurement processes (including potential supply deals where large volumes are involved)
- continuity of style or aesthetic across Council

Typically, where no limits are placed on the range of accepted poles and luminaires, the public lighting asset base becomes increasingly complex and costly for a council to manage going forwards, with the main issues relating to:

- increasing demands on resources required for maintenance
- increasing difficulty in sourcing replacements
- inconsistency of style throughout the municipality

Council staff have indicated a desire to strive for consistency and reduce variation in its public lighting asset base by specifying minimum design and performance requirements for luminaires and poles in relation to the following:

- luminaire system efficacy (refer also to discussion in Section 8.1.1)
- pole height
- paint type and colour or finish
- offsets from paths (for pathway lighting)

Council staff have also expressed interest in investigating the possibility of banning completely the use of non-standard (decorative) poles and luminaires, but acknowledge the potential political sensitivity of such a move. There is also consensus that some flexibility (from general requirements) should be allowed for key precincts (e.g. the Ringwood MAC), where public lighting often contributes to a unique sense of place and identity (different to that which exists elsewhere in the municipality).

While the approach for unmetered and metered assets differs slightly, many of the underlying principles are the same. The following sections discuss in further detail key issues relating to unmetered and metered assets, as well as lighting in key precincts.

8.1 Unmetered Assets

For unmetered street lighting assets Council is limited to choosing from the list of AusNet-approved poles and luminaires, however within this list there still exists choice for any given application. For example, AusNet's list of approved poles and luminaires includes:

- LED, fluorescent, high pressure sodium (HPS) and metal halide (MH) luminaires
- standard and non-standard (decorative) luminaires and poles

The following sections provide background and guidance on each of the above options.

8.1.1 Luminaire Technology

For lower output luminaires (typically of less than 500W), the use of LED technology is now established best practice, achieving a superior luminaire efficacy rating (LER). For existing luminaires of greater than 500 watts, traditional HID options (e.g. MH, HPS) may still compete with LED technology in terms of LER in certain applications. However, with continual upgrades and improvements, LEDs are also expected to become the preferred technology choice at these higher light output levels.

Table 4 presents a comparison of the LER of various technologies. As can be seen, specifying a minimum LER of 100 lm/w would effectively exclude the use of MV, fluorescent and HPS technologies.

Table 4: Comparison of LER of different luminaire technologies

Luminaire	Efficacy (lm/w)
MV80	28
HPS150	65
HPS250	75
T5 2x14W	76
HPS400	88
LED 275W	116
LED 17W	120
LED 70W	129
LED 155W	132

When assessing the life-cycle impacts of HID or fluorescent versus LED technology the materials used in manufacturing should also be considered. Fluorescent and HID lamp technologies typically contain significant levels of mercury, whereas LED light sources do not.

It is therefore recommended that Council specify a minimum LER such that MV, fluorescent, HPS and MH technologies are effectively excluded. This approach is preferred to the blanket

specification of LED (without a minimum LER) to avoid the risk of approving LEDs with poor efficacy. The specified minimum LER should be regularly reviewed to ensure alignment with improvements in technology.

Recommendation:

- **Council's Public Lighting Guidelines to specify a minimum luminaire efficacy ratio to effectively exclude the use of fluorescent, MV, HPS and MH luminaires for unmetered installations**

8.1.2 Standard and Non-Standard Fittings

AusNet has approved standard and non-standard (decorative) luminaires and poles on their network. Standard luminaires and poles are items that AusNet keeps in stock, and will install and maintain without the need for procurement from Council. In contrast, non-standard luminaires and poles are not kept in stock by AusNet. When a non-standard fitting requires maintenance or repair (with the exception of standard components such as the lamp, PE cell or supply cable) any replacement materials must be sourced by Council. The suite of AusNet-approved standard fittings is more limited (in number and style e.g. finish/colour) than the suite of non-standard fittings.

Generally speaking, the photometric performance of standard luminaires is superior to the equivalent non-standard luminaire that would be used in the same context, enabling greater pole spacings and therefore reduced energy consumption of the overall installation.

With a view to limiting the ongoing resource and cost burden placed on councils, best practice involves restricting the use of non-standard fittings. For some councils, typically those located on the metropolitan urban fringe, and where the number and type of non-standard fittings has historically been high, this involves banning non-standard fittings completely. In support of such a policy position it may be argued that the purpose of unmetered public lighting is to provide the base level of functional lighting required in the most cost-effective and consistent manner possible. Complementing this, non-standard fittings may be installed to differentiate or highlight key sites or features of the public realm, but only at specific locations, and only at *metered* supply points (refer to Section 0).

For other councils, a common approach is to permit limited use of non-standard fittings through one or a combination of the following:

1. specifying a shortlist of approved fittings (from the AusNet approved list)
2. specifying limits on:
    a. colour and/or finish (e.g. grey, black or green, or galvanized only)
    b. entry type (e.g. side-entry only)
    c. minimum pole height (e.g. 5.5m)
3. specifying the locations where non-standard fittings are permitted (e.g. along a foreshore)

It is recommended that Council bans completely the installation of new non-standard fittings for unmetered connections in line with the best-practice approach described above. Doing so would reduce costs and increase the uniformity of unmetered public lighting throughout Council. However, should such a policy position be deemed too restrictive or politically sensitive, then options 1 to 3 above should be considered.

Where there are existing non-standard fittings, it is recommended that Council explores a number of options that will allow it to better understand the financial, environmental and social impacts of either transitioning to standard fittings or replacing the existing non-standard fittings with energy efficient alternatives. Options available to Council are:

1. Convert non-standard assets to standard luminaires and poles
2. Convert non-standard assets to standard luminaires and painted poles
3. Convert non-standard assets to standard luminaires and poles to meet Australian Standards for lighting levels (this is likely to result in a net reduction in pole and luminaire numbers due to the superior performance of standard luminaires)
4. Convert non-standard luminaires to standard luminaires but retain non-standard poles
5. Replace non-standard luminaires with energy efficient aesthetic equivalents
6. Retrofit non-standard luminaires with LED lamps

Each of the above options will have different cost, environmental and social impacts. Currently, the cost implications of moving from non-standard to standard assets is not fully understood. Further to this, not all non-standard luminaires have an AusNet-approved direct energy efficient replacement option and LED retrofit lamps have not been approved for use.

For Options 1 to 4 above, more information is needed from AusNet Services and installation contractors about processes and costs. Further to this, Option 3 requires a design analysis to understand the impacts of meeting Australian Standards.

For Option 5 and 6, advocacy to AusNet Services is required to ensure suitable products are approved for use on the unmetered network. Further to this, for Option 6, a trial would be required to ensure that the use of LED retrofit lamps does not adversely impact lighting levels.

A more detailed summary of each of the above options can be found in Council's *Public Lighting Policy Community Consultation: Decorative Lighting Overview* document (provided as an appendix). This document was developed in response to feedback from the community that Council's draft Public Lighting Policy did not appropriately consider alternatives to replacing non-standard lighting assets with standard assets.

Recommendation:

- **Council's Public Lighting Guidelines to prohibit the installation of new non-standard unmetered fittings**
- **Council to advocate for the approval of energy efficient alternatives for all existing non-standard luminaire types**
- **Council to advocate for the approval of an LED retrofit lamp**
- **Council to trial LED retrofit lamps**

- **Council to carry out a comprehensive cost-benefit analysis of all upgrade options for its existing non-standards unmetered assets.**

8.2 Metered Assets

In contrast to unmetered assets, Council has complete control over the selection, installation and maintenance of metered luminaires and poles. As a result, Council may in practice select any available luminaire or pole currently on the market. This freedom comes with the increased risk that the range of metered assets may become too large and costly to easily manage, and that poor-quality products will be installed.

To address this risk, best practice typically involves limiting the available choice via the use of a specification (or checklist) with which approved products must comply, and/or specifying any key precincts where exceptions to the specification will be permitted (note that the treatment of key precincts is discussed further in Section 8.3). Specifying design and performance requirements is preferred to specifying particular products given the risks of relying on a single supplier.

Council staff have highlighted the following as design and/or performance aspects over which Council would like to exert some control:

- luminaire technology (LED preferred)
- minimum pole height
- minimum offset of poles from pathways (preferred offset of 1m, minimum offset of 0.5m)
- luminaire/pole finish (preferred galvanised, or black if painted)
- "Smart City" compatibility

Council staff have also expressed a desire to limit the use of bollard lighting due to its limitations in assisting with the identification of facial features from people approaching as well as its susceptibility to vandalism.

Based on the above it is recommended that Council develop a specification for metered poles and luminaires. Table 5 outlines a recommended list of design and/or performance features that should be addressed by a specification, including a brief discussion of specific requirements.

Table 5: Recommended requirements for metered luminaire and poles

Feature	Recommended requirement
Luminaires	
Luminaire design	Consider using a general statement such as "The luminaire design should be contemporary, with clean, minimalist lines and no decorative detailing". Such a requirement will assist with reducing variation in styles, and support the objective of achieving a coherent style or aesthetic across Council.
Surface finish	A galvanised finish is considered lowest maintenance with paint finishes prone to fading, wear and tear over time. If a paint finish is preferred, then this should: • be limited to a single paint colour (e.g. black or grey) with reference to a colour standard (e.g. AS 2700 or Dulux colour chart) • use a durable method of coating (e.g. *a heavy-duty zinc protective coating or two pack adhesion promoting primer over a sand blasted, galvanised steel pole to prevent corrosion, followed by two coats of two pack aliphatic polyurethane*)
Protection against dust/water ingress and mechanical impact	Minimum IP65 (ingress) and IK06 (mechanical impact) ratings are standard for outdoor public lighting and recommended.
Energy efficiency	Specification of a minimum LER is recommended such that non-LED technologies are effectively excluded (e.g. 100 lm/w). Refer to discussion in Section 8.1.1.
Upward Waste Light Ratio	Upward waste light ratio (UWLR) is a measure of the amount of light emitted by a luminaire in directions above the horizontal. By limiting UWLR, urban sky glow from public lighting will be reduced. New lights should have a maximum UWLR of less than 1%.
Correlated colour temperature (CCT)	The Australian Standard for street lighting (SA SNZ TS 1158.6:2015) does not specify CCTs for all available technology types, but does note concerns regarding the impacts of blue-rich spectral content from LED luminaires and therefore recommends the use of "intermediate" CCTs, stating that 4000K is "preferred" for LED street lights. LEDs above 4000K produce more blue light which is generally seen as undesirable in the night-time environment, while LEDs below 4000K will produce light with a "warmer" tone but are less efficient in terms of light output per unit of energy consumed. 4000K is also a more desirable colour temperature for facial recognition in CCTV camera footage. In order to give Council the flexibility to adapt lighting to its surroundings, it is recommended that an acceptable range of 3000k to 4250K is assigned for all new metered lighting schemes. Refer also to discussion in Section 14.1.
Colour rendering index (CRI)	SA SNZ TS 1158.6:2015 does not specify a minimum CRI for all available technology types, but does specify a minimum of 70 for LED luminaires. A higher CRI (e.g. white lights) is generally considered better in terms of safety, with a lower CRI (e.g. yellow lights) being less effective at reducing accidents. A higher CRI is also preferred where CCTV is in use. It is recommended that Council opts for a minimum CRI of 80.
Entry type	It is recommended that entry type be restricted to side entry only.
Compliance with relevant standards	Requiring compliance with SA/SNZ TS 1158.6 is recommended.
"Smart City" compatibility	Luminaires should feature a 7-pin NEMA base wired as per the requirements of ANSI C136.41-2013 to a variable output control gear (for dimming/brightening). Consideration should also be given to the dimming protocol with which the control gear is compatible (options include 0-10V or DALI). Refer also to discussion in Section 9.1.
Design life	Minimum 20-year life is recommended. This is standard for outdoor street lighting.
Poles	

Feature	Recommended requirement
Pole design	Consider using a general statement such as "The pole design should be contemporary, with clean, minimalist lines and no decorative detailing".
Surface finish	Paint colour consistency (e.g. black or grey). Type of paint.
Compliance with relevant standards	Requiring compliance with AS 4100 is recommended.
Entry type	It is recommended that entry type be restricted to side entry only.
Mounting height	The luminaire mounting height of any pole should be of an appropriate scale for the space it is in, with a minimum height of 5.5m.
Offset from pathways	Where the purpose of lighting is to illuminate a pathway, the minimum offset of the pole from the pathway shall be 0.5m, with a preferred offset of 1m.
Design life	Minimum 35-year life is recommended. This is standard for street lighting columns.

The specification should take the form of a checklist to be included in Council's Public Lighting Guidelines, with the checklist to be completed for any proposed metered installation (e.g. by a lighting designer or developer). Assessment of compliance with the specification may be undertaken by Council staff or a third-party (discussed further in Section 5).

Recommendation:

- **Council's Public Lighting Guidelines to include a specification and checklist outlining minimum design and performance requirements for metered assets (poles and luminaires)**

8.3 Key Precincts

Key Council staff have indicated a preference for allowing some variation from the requirements of a standard Council specification for poles and luminaires (refer to Section 0) when lighting key sites or precincts (e.g. the Ringwood MAC, or select suburban shopping strips). This acknowledges that lighting can be an effective way to highlight particular spaces and provide contrast to the surrounding "standard" lighting in such a way as to enhance the night-time experience and attract pedestrian activity. This approach also aligns with the broader Council objective of enhancing the night time economy.

Best practice would involve specifying the sites at which such variation is permitted by explicitly listing areas and/or mapping them in Council's Public Lighting Guidelines. It is also recommended that certain general, minimum design and performance requirements still apply. For example, the following requirements (refer to Table 5 for further detail on particular items) are still recommended:

- minimum luminaire IP and IK rating, LER and CRI
- SA/SNZ TS 1158.6 compliance (for luminaires)
- AS 4100 compliance (for poles)
- side entry only
- "smart city" compatibility
- minimum design life
- minimum mounting height (poles)

Limited variation in the following areas may be permitted:

- Design – Although variation may be desirable, consideration should be given to the risk that a particular product line may be discontinued and therefore replacements cannot be sourced for maintenance purposes. To mitigate this, it is recommended that the same broad design guidelines apply to luminaires and poles as recommended for metered assets (refer to Table 5).
- Finish/colour – The method of finish or coating application should be as for metered assets (refer to Table 5), with greater colour variation permitted to suit the particular site.
- CCT – A CCT of less than 4000K (neutral white) may be considered appropriate for certain precincts (e.g. areas where outdoor dining occurs), however the issues raised in Section 14.1 should be considered, the choice of CCT should be consistent with Council's CCTV Policy, and the CCT used should be consistent throughout a given space.

When considering the lighting of key sites or precincts, key Council staff also raised specific issues which are summarised in Table 6. For each issue a recommended policy/design response is provided in line with best practice.

Table 6: Issues relating to lighting of key precincts

Issues	Recommended response
Council can't always afford to replace/upgrade all street lights in a given area at one time. Instead upgrades are staged incrementally over time. With this approach comes the risk that different products are used (due to availability, changes to approvals) for different stages within the same precinct, thereby undermining the objective of achieving a consistent style or aesthetic.	**Enforce the same broad design requirements on poles and luminaires as specified in Table 5 for metered sites.**
Where existing connections are unmetered, past Council best practice has involved the conversion to metered supply whenever a major upgrade takes place. This gives Council more control over ongoing operation and maintenance.	**Specify in Public Lighting Policy that at key sites or precincts, transitioning from unmetered to metered supply should be considered at the time of upgrade or renewal.**
Where existing supply is overhead, past Council best practice has involved the conversion to underground supply whenever a major upgrade takes place. This contributes to decluttering of the streetscape, and more flexibility in the choice of pole and luminaire.	**Specify in Public Lighting Policy that at key sites or precincts, transitioning from overhead to underground supply should be considered at the time of upgrade or renewal.**

Recommendations:

- **Relating to public lighting in key precincts:**
  - **Council's Public Lighting Guidelines to identify key precincts**
  - **Council's Public Lighting Guidelines to specify the same design requirements as for metered public lighting, with limited variation permitted in surface finish and colour, and CCT**
  - **Council's Public Lighting Policy to specify that at the time of upgrade or renewal the following should be considered:**
    - **transitioning from unmetered to metered supply**
    - **transitioning from overhead to underground supply**

9. Lighting Technology

Many of the key considerations around technology choice have already been discussed and are addressed by the recommendations of Section 8.1.1. In brief, current best practice in terms of luminaire technology choice for the types of applications to be covered by the scope of Council's Public Lighting Guidelines and Policy is LED. At this point in time, there may still be some sports lighting applications where the business case for use of traditional HID technologies competes with LED, however the market trend is increasingly showing a shift toward LED technology even in this context.

During the workshop process the other issues raised which relate to technology choice were:

- 'smart' lighting and 'smart cities' compatibility
- solar lighting

Each of these issues is discussed below.

9.1 Smart Cities Compatibility

The term 'smart cities' has emerged in recent years to describe the transformative effect modern technology is having on the way urban infrastructure is used, operated and managed.
As a concept, smart cities is inherently ambiguous owing both to the broad range of asset and infrastructure types within an urban environment and the seemingly endless ways in which technology can be integrated into the application, operation and management of assets and infrastructure. This ambiguity is leading many local governments in Australia to seek to better define what the concept of smart cities means for them.

For Maroondah, public lighting has the potential to be both directly enhanced by smart city technology as well as playing a central role in a broader smart city network.
The ability to control and monitor public lighting via remote switching, dimming and fault reporting are ways in which smart city technology can beneficially augment public lighting. In addition, the ubiquity, existing power supply and presence above ground level allows public lighting and poles to act as the hubs and nodes of a smart cities network.

When talking about public lighting within the context of smart city infrastructure there are two elements to consider:

- how smart city infrastructure can be used to augment public lighting; and
- how public lighting infrastructure can be used as a central element with in a broader smart city network

The first element is relatively simple in that it relates to controlling (switching, dimming, colour changing) and monitoring (faults reporting, energy usage) public lighting assets via a smart city network. The benefits of implementing dimming or switching controls include the maximisation of energy savings, and the appropriate targeting of light levels in different places at different times. Importantly they can also give Council the ability to increase light levels, either temporarily (e.g. for public events or in emergency situations) or on a longer-term basis (because of the changing use of a space) without the need to install new infrastructure. Remote adjustment of the colour temperature of lights may be desirable in some key precincts. Remote fault reporting and energy monitoring have obvious benefits in terms of improved service levels and reporting.

The second element is more complex in that it relates to using public lighting infrastructure as the backbone of a smart city network as well as a key connection point (either physically or as a wireless node) for other smart city technologies such as sensors and input/output devices. Standard street lights connected to a smart grid system can assist in establishing a smart grid system in a given location and ensuring effective coverage. In addition, smart (or multifunction) poles can be located in certain areas to achieve specific smart city outcomes.

Smart poles are one of the more obvious solutions for leveraging public lighting infrastructure to create a smart city network. They are generally modular in design and easily adaptable to current and future smart city needs. This allows them to incorporate smart city technologies such as telecommunications, Wi-Fi, community messaging, parking management, data capture, surveillance, people counting, and electric vehicle car charging as well as traditional pole functions (signage and lighting) into a single uncluttered solution. Smart poles may also be designed to include features that contribute the aesthetic of the public space, such as audio art forms. Figure 4 provides an example of a smart pole and possible features and functionality.

Smart poles would potentially allow Council and others to consider more innovative business models to on-sell the location of the pole for advertising, to telecommunication carriers and others.

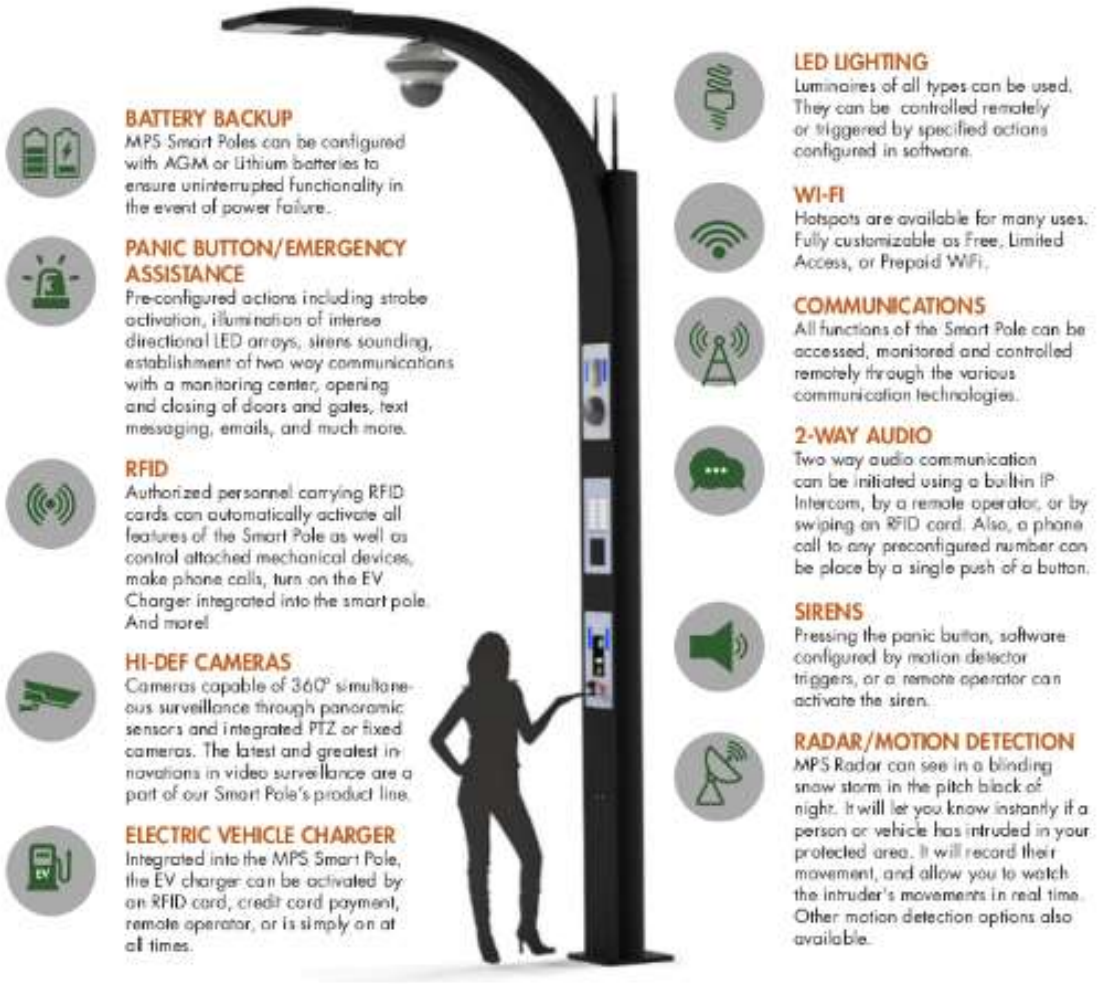


Figure 4: Examples of 'smart pole' features and functionality

It should be noted that the development of a smart city network and activation of smart controls (e.g. dimming, switching, colour changing etc.) using metered public lighting (Council-owned) is possible now. In contrast, the dimming, switching or other remote control of unmetered public lighting (DNSP-owned) would require further negotiation with AusNet (re governance arrangements, access etc.) before being implemented.

Council has indicated a desire work towards deployment of a smart cities network including smart poles, given the potential benefits outlined above. As part of the workshop discussions, the difficulties of installing CCTV devices on third-party infrastructure (i.e. not Council-owned) were noted.

It was also noted that Council already has demonstrated, practical experience of implementing smart lighting solutions with the successful deployment of a system whereby sports ground lighting is linked to a sports facility security system, allowing emergency services to activate lighting after hours (to assist landing of an air ambulance).

Due to the complex nature of the smart cities concept, and its relatively recent development, it is recommended that the issue be managed with a separate, targeted strategy or policy. However, as an immediate next step, Council's Public Lighting Guidelines should specify the use

of smart controls in public lighting applications, and aim to future proof any infrastructure for potential smart cities applications.

It is therefore recommended that all new lights be "future-proofed" for compatibility with a smart city network, both unmetered and metered, by specifying the use of luminaires with 7-pin NEMA PE cell base connected to a variable output control gear (as specified in Section 0). The use of smart poles may be considered for metered lighting locations in key precincts.

Recommendations:

- **Council to develop a Smart Cities Policy/Strategy**
- **Council's Public Lighting Guidelines to specify the use of luminaires with a 7-pin NEMA base wired to a dimmable driver (refer to Section 0)**
- **Council to liaise with AusNet to ensure that all new unmetered luminaires are smart-enabled (featuring a 7-pin NEMA base wired to a dimmable driver)**

9.2 Solar Lighting

Solar lighting is generally not recommended due to high capital costs and high maintenance costs for panels and batteries. However, where the cost to install grid-connected electricity is high, solar (or other localised renewable energy) may be considered.

Because the need for trenching is normally eliminated when installing solar lighting, it may also be considered in instances where minimal ground and surface interference is required

Recommendation:

- **Council's Public Lighting Guidelines to permit the use of solar lighting only where connection to the grid is not considered viable**

10. Asset Registers

An asset register is an essential element of best practice public lighting asset management. It provides a framework to log and store information on assets including condition, location, age, characteristics and maintenance history.

10.1 Unmetered Assets

For unmetered street lighting assets, AusNet Services maintains an asset register that includes a range of information such as location, lamp wattage, lamp type, pole ID and commission date.

Council is provided with access to an online portal through which it can download up to date asset registers at any time.

Existing limitations to the portal and the AusNet asset register do, however, exist. These include:

- no pole ID included in the data downloaded via the portal making it difficult to cross reference street lights in the field
- luminaire type is not recorded making the management of non-standard lighting potentially difficult
- non-standard pole types and their paint colour are not recorded, which adds to the difficulty of managing of non-standard street lighting assets
- lamp replacement dates are not recorded often making dealing with resident complaints regarding under or over-lighting difficult to manage
- inaccuracies in data fields such as lamp type and lamp wattage as well as the location and even existence of the asset

In Victoria, best practice in terms of an unmetered street lighting asset register typically involves the augmentation of AusNet's asset register by Council to address the above limitations. This includes:

- Council-run audits of street lighting to identify the location, type and paint colour of non-standard assets
- Council-run audits of street lighting to identify any major data issues such as incorrect wattage and lamp types and importantly to identify lights that do not exist in the field
- ongoing maintenance of the assets register so that the location, type and paint colour of non-standard assets are added as they are commissioned

For Maroondah, who do not have large numbers of non-standard street lighting assets, it may not be considered vital to identify their location, type and paint colour as the management of replacement stock can be carried out reactively. However, the issues in identifying appropriate lights to replace during the recent bulk replacement program demonstrates that an understanding of where non-standard street lighting assets exists and also has benefits from a planning perspective.

Council is using the bulk replacement program to opportunistically identify the location of non-standard street lighting and it has indicated that it may consider a follow up audit to identify luminaire type and paint colour. Beyond this, Council has indicated that it will not actively pursue the best practice approach of augmenting AusNet's asset Register.

Recommendations:

- **Council to consider collecting key characteristic data for any new non-standard unmetered street lighting assets that are installed**
- **Council to continue to opportunistically collect locational data on existing non-standard unmetered street lighting assets during bulk upgrade works**
- **Council to consider carrying out a more comprehensive audit of non-standard unmetered street lighting assets to collect data on paint colour, entry point and models**

10.2 Metered Assets

For metered assets, Council has full responsibility for the creation and upkeep of an asset register. The process of creating a comprehensive asset register typically begins with an on-site mapping and condition audit. This provides Council with a snapshot in time of the metered street lighting assets under its control including their location, characteristics and condition.

Common pieces of data to collect during an audit includes but is not limited to:

- Luminaire type and manufacturer
- Luminaire colour
- Luminaire condition rating
- Luminaire faults
- Lamp type
- Lamp wattage
- Pole type and manufacturer
- Pole material
- Pole colour
- Pole condition rating
- Pole faults
- Pole base type
- Pole base condition rating
- Pole base faults
- Overview photo
- Location (GPS co-ordinates)
- Mounting Height
- Switching (PE cell, timer etc)
- Timer settings
- ID number
- Site Name

The creation of an asset register via an audit is in many respects the easiest part of the process. The more difficult part and arguably the more important part of the process is the maintenance of the asset register. This includes the population of the asset register with valuable information relating to asset maintenance works, inputting information on new assets and updating existing asset data as changes are implemented (lamp upgrades, luminaire upgrades etc.).

The difficulty that exists in the maintenance of an asset register is largely related to the "buy in" that is required from multiple staff across multiple departments and the associated time and resources that need to be allocated.

Best practice processes for the maintenance of an asset register includes, but is not necessarily limited to:

- The logging of maintenance work carried out on an asset such as dates on which components (lamps, drivers, PE cells) were replaced
- The input of new assets into the asset register on or near to their commission date
- The gradual linking of lighting assets to their corresponding electricity meter and subsequently their corresponding electricity bill
- The logging of any opportunistic information relating to an asset by asset management staff during site meetings

Council currently has a park lighting register but it has been acknowledged that this was based on a once-off audit with a narrow scope in terms of which metered public lighting assets were audit and the data that was collected about each asset.

Council's has expressed a desire to achieve as close to best practice as possible whilst at the same time taking into consideration the resources required to maintain such an asset register versus it's benefits. It is recommended that Council collects the data listed above on each lighting asset at a minimum.

It is also recommended that Council installs accompanying ID plates on each lighting asset to provide a cross reference between the physical asset and the book asset and to also improve resident fault reporting processes.

It is understood that Council's current asset register framework is fully customizable and can thus accommodate any changes in terms of data fields and data collection processes.

Council has also indicated that it would like link electricity meter details to each lighting asset.

It is recommended that clear internal processes are implemented for the maintenance of the asset register including the roll out of a mobile data capture system to minimise double handling of data and the risk that information is never digitised.

In terms of wholesale updates to the asset register it is recommended that all assets are audited every 3 to 4 years to assess condition and capture any changes to assets that weren't otherwise captured as part of the ongoing asset register maintenance process.

The advent of smart lighting has potential benefits in relation to achieving the above outcomes. Smart lighting that is DALI-compatible introduces the capacity to have lighting assets that automatically communicate with an asset register. That is, the driver in the luminaire can be pre-programmed by the manufacturer with asset information (e.g. make, model, wattage, colour etc.) that can be automatically populated to Council's asset register.

Recommendations:

- **Council to add all newly installed metered public lighting assets to an asset register**
- **Council to collect the minimum data on each metered lighting asset (to be specified in Public Lighting Policy)**
- **Council to install ID plates on each metered lighting asset to provide a cross reference between the physical asset and the book asset**
- **Council to implement a clear internal process for the maintenance of the asset register**
- **Council to audit all assets every 3 to 4 years to assess condition and capture any changes to assets that aren't otherwise captured as part of the ongoing asset register maintenance process**

11. Complaints Procedures

11.1 Requests for New Street Lighting (Existing Lighting)

Periodically, Council may receive requests for the installation of additional street lighting in areas where some street lighting already exists. Requests are typically based on subjective opinions of the quality of existing lighting levels or increased concern for safety due to changes to traffic volumes or crime rates.

A consistently applied empirical process to assess the merits of any request for additional street lighting represents best practice. Typically, this would include the following steps:

1. an on-site analysis utilising a high-quality light meter to determine the existing levels of lighting
2. a comparison of existing lighting levels against the requirements of the Australian Standards (refer also to Section 13)
3. the development of a succinct report detailing the outcomes of the analysis including advice on whether additional lighting is or isn't required

The process described above is typically carried out by a suitably trained member of staff or a lighting designer/consultant.

Where additional lighting is deemed necessary, Council would then liaise with a lighting designer and AusNet to determine the most suitable location for the new lighting to be installed. A request for additional lighting would then be sent through to AusNet to implement.

Council indicated through the workshop process that it would like to achieve best practice, given that current responses use an inconsistent approach.

It is therefore recommended that Council follows the best practice approach described above.

11.2 Requests for New Street Lighting (No Existing Lighting)

Periodically Council may receive requests for the installation of street lighting on roads where there is currently no street lighting.

Common practice would involve only addressing unlit streets when a complaint or request is received (i.e. reactively) as opposed to the proactive identification of locations. Also, the provision of lighting should only be considered where it is viable to do so (i.e. there are existing poles on to which lights can be installed, or the provision of poles and connection to supply is not prohibitively expensive), or where there is a legitimate need identified (e.g. public safety concern). Where

considered viable, new installation shall light the street to the appropriate standard (refer to Section 13).

It is therefore recommended that Council's Public Lighting Guidelines specify that requests for street lighting on currently unlit streets will be assessed on a case-by-case basis.

11.3 Requests for Removal of Lighting

Although rare, Council may receive requests for the removal of street lighting along parts or all of a street (usually relating to more isolated and/or rural locations).

Some Councils accept that residents living in semi-rural areas desire a decrease in light pollution/ambient light and therefore allow submissions from residents for the removal of lights in a street/area. This is typically assessed on an as needs basis and depends on a number of factors including gaining consensus from all resident affected by the proposed removal and ensuring that the area where the removal is being proposed does not serve as a thoroughfare.

In general, however, the existence of processes to allow the removal of street lighting is very rare amongst local government, which is reflective of a number of limiting factors including:

- the fact that consensus amongst those affected by the removal is extremely unlikely
- the fact that street lighting is generally installed in residential areas to provide illumination for not only residents but also those visiting the residents and those travelling through the area
- the fact that whilst existing residents may not want street lighting, future residents may end up requesting that the removed street lights are re-instated

During the workshop process, key Council staff indicated a preference for Council's public policy position (i.e. that specified in the Public Lighting Guidelines) to be that Council will not remove existing lighting. However, if special circumstances apply (e.g. the request represents the consensus of all residents in a street), then lights will only be removed following formal approval by Council (involving submission of a report detailing the specifics of the request and why Council's formal policy position should not apply in that instance).

11.4 Complaints About Overlighting or Light Spill

Periodically, Council may receive complaints about over lighting or light spill into properties from existing street lighting, park lighting or sports lighting. Complaints typically stem from the ingress of lighting into a dwelling but may also relate to light spill into front and back yards.

AS 4282 *Control of the Obtrusive Effects of Outdoor Lighting* provides guidance on the acceptable levels of light spill into habitable dwellings. Although the Standard specifically states that it does not apply to public lighting, best practice Councils tend to adopt the following requirements:

- limiting light spill to no greater that 1.0 lux on the window of a habitable room in a dwelling on a residential side street with P-Category street lights

- limiting light spill to no greater that 2.0 lux on the window of a habitable room in a dwelling on a road with V-Category street lights
- limiting light spill to no greater that 4.0 lux on the window of a habitable room in a dwelling on within a commercial area or at the boundary of a commercial area
- limiting light spill to no greater that 1.0 lux on the window of a habitable room in a dwelling adjacent to a park with metered path lighting

In order to assess whether light spill is in breach of the above requirements, a consistently applied empirical process to assess the merits of any request for additional street lighting represents best practice. Typically, this would include the following steps:

1. an on-site analysis utilising a high-quality light meter to determine the existing levels of lighting on the window of a habitable room in a dwelling
2. a comparison of existing lighting levels against the requirements of the Australian Standards
3. the development of a succinct report detailing the outcomes of the analysis including advice on whether light spill control is or isn't required

The process described above is typically carried out by a suitably trained member of staff or a lighting designer/consultant.

Where light spill control is deemed necessary, Council would then liaise with a lighting designer and AusNet to determine the most suitable solutions. This might include:

- installing shielding on or within the luminaire
- installing a different luminaire (lower output or more directional photometrics)
- relocating the luminaire
- dimming the luminaire
- recommending a new window treatment e.g. block out blinds

Council indicated through the workshop process that it would like to achieve best practice, given that current responses use an inconsistent approach.

It is therefore recommended that Council follows the best practice approach described above.

Recommendations:

- **Council's Public Lighting Guidelines to specify:**
  - **best-practice process for responding to requests for new street lighting**
  - **requests for street lighting on currently unlit streets will be assessed on a case-by-case basis**
  - **requests for removal of street lighting will not be considered**
  - **best-practice process for responding to complaints**

12. Where and When to Light

To ensure that public lighting is installed in a consistent and appropriate manner throughout Maroondah City Council, best practice involves the development of a step-by-step decision-making process to determine if, when, where, and how lighting should be installed.

It is recommended the decision-making process include the following basic steps:

1. establish the need for lighting
2. determine site type and site-specific considerations
3. determine the appropriate lighting category

Steps 1 and 2 are discussed further in this section, while step 3 is discussed further in Section 13.

Typically, where such a decision-making process is absent or lacking, decisions around where and when to light and to what level is left to the discretion of a Council officer or a lighting designer, with over-lighting often the result. The process described here is intended to strike a balance between being too prescriptive (whereby Council can be forced to install lighting where it's in fact not appropriate) and allowing too much flexibility, resulting in the situation outlined above.

At various points throughout this Section, the possibility of remote dimming and/or switching is discussed. It should be noted that at this point in time, while technically possible with the installation of LED street lights with dimmable drivers, remote dimming or switching is not possible for unmetered connections points. In contrast, remote dimming and switching are possible for metered connections right now.

At a high level, the decision-making process should be framed by a set of high-level guiding principles, such as those outlined in Table 7.

Table 7: Recommended guiding principles for installation of public lighting in Maroondah

Making better use of open space
Most people use public space during the day and early evenings. Lighting should support positive evening use and selective all-night lighting should be provided only where required
Assisting walking, cycling, public transport and safe driving
Appropriate lighting will allow for higher visibility and encourage people in Maroondah to walk, cycle and take public transport.
Improving safety
Council will avoid creating a false sense of security by not installing lighting in remote or poorly surveyed locations. Lighting will be discouraged in sites where it promotes inappropriate behaviour after hours in accordance with principles of the Crime Prevention through Environmental Design Guidelines.
Ensuring economically sustainable assets are installed and managed
At the scoping stage, a high-level business case analysis should be conducted to ensure that only lighting assets that are easy to install, have low maintenance requirements and are cost effective over the life of the asset are deployed.
Protecting habitat value areas
In some cases lighting (or some types of lighting) can be harmful to biodiversity (in particular insects and nocturnal animals).
Showcasing urban features in an effective way
When people are visiting Maroondah, they should see and enjoy our urban features; for example, monuments, signs, and public art. Lighting can be an effective way of doing this in key locations at selective times.

Step 1 of the decision-making process should first establish the actual need for new lighting.

Reasons that new lighting may not be needed include:

- adequate lighting is already available from an alternate source such as street, public transport zone, car park, building or any other adjacent lighting (in some locations this can reduce the number of new lights installed)
- the area is one where lighting is not recommended (as identified in Table 8)
- Council has identified the lighting purpose as not recommended (e.g. up-lighting, feature lighting, and daytime recreation areas)

There may also be safety reasons that new lighting is not needed. Whilst this may seem contradictory, it is important to not light spaces that may be inherently dangerous with or without lighting. Reasons include:

- an area does not have sufficient natural (passive) surveillance looking into the space from houses facing the space or passing vehicular and pedestrian traffic
- an areas/pathway leads to a dead end or otherwise unsafe area with little natural (passive) surveillance

Key Council staff have indicated that new lighting should also only be considered if one or a combination of the following apply:

- there is a pedestrian path that provides a legitimate shortcut or thoroughfare
- there is a 'critical link' as per Council's Bicycle Strategy and/or Pedestrian Strategy
- new lighting will increase outdoor activity
- the site allows for passive security

Other consideration should include an assessment of whether:

- activity or traffic will be all night or only for a portion of the night
- a new metered supply will be required

Step 2 of the decision-making process should determine the site type and any site-specific considerations such as:

- the aim of lighting in the area: for example, aesthetic, to create atmosphere, for safety or to guide preferred usage patterns
- whether the area is a 'high risk' security area, or vandalism risk area, based on evidence
- the type of users and usage function, as well as usage patterns for the area, as this may indicate particular lighting controls that can be applied

Table 8 provides a summary of best practice and Council-specific considerations based on feedback from key Council stakeholders. A similar table may be reproduced in Council's Guidelines to guide decision making.

Table 8: Recommended lighting requirements for specific types of locations in Maroondah

Site/Application	Best Practice and Council-specific Considerations	Controls[4] (e.g. dimming, switching, sensors)
Large Parks	Best practice: • lighting only paths and thoroughfares through parks, not lawns • avoid lighting dead-ended paths, unless the path provides access to a facility within the park that is used during night time hours Additional Council-specific considerations: • Lighting should only be considered for large parks under the following circumstances: o if there is a thoroughfare for pedestrians/ cyclists o if it promotes night time physical activity (e.g. running track) o public benefit or demand exists (e.g. for a dog park)	Use dimming and timers to turn lights off or down when usage levels drop off or no longer exist, or where activity is no longer desired after certain hours. Switch off/dim: between 11pm and 1am Switch on/brighten: 5am
Small local "pocket" parks	Best practice: • Generally, lighting should not be considered for local "pocket" parks. • Lighting should only be considered if there is a thoroughfare for pedestrians and/or cyclists.	If lighting is installed, use dimming and timers to turn lights off or down when usage levels drop off or no longer exist, or where activity is no longer desired after certain hours.

[4] Where controls such as dimming or switching are implemented, consideration should be given to the need for public signage alerting the public to when lights will be turned off or dimmed.

Site/Application	Best Practice and Council-specific Considerations	Controls[4] (e.g. dimming, switching, sensors)
Nature reserves	Best practice: • Generally, lighting should not be considered for nature reserves as it may disrupt local flora and fauna. Additional Council-specific considerations: • Lighting should only be considered if there is a 'critical link' as per Council's Bicycle Strategy and/or Pedestrian Strategy. • Where lighting is installed, consider (in order of preference): 1. lights with site-specific optics (to minimise light spill) and dimming or switching after hours of use 2. use of a lower CCT (lower impact on local fauna) 3. solar path markers • Reference should also be made to Council's Habitat Corridor Strategy.	If lighting is installed, use dimming and timers to turn lights off or down when usage levels drop off or no longer exist, or where activity is no longer desired after certain hours. Switch off/dim: between 11pm and 1am Switch on/brighten: 5am
Recreation areas	Best practice: • Lighting should only be installed with timers. Additional Council-specific considerations: • Basketball courts – no. Unless used for organized competitive sporting activities. • Skate Parks – lighting shall be considered on an as needs basis. • BBQs, gazebos etc. - lighting shall be considered on an as needs basis.	Lighting shall be switched off no later than 10 pm, and shall be dimmed over short shoulder period (e.g. 15 min) to allow safe departure from the area.
Playgrounds	Best practice: • Lighting is not appropriate as playground activity is better suited to daylight hours.	
Train stations	Best practice: • Lights may be installed with timers and/or dimmers linked to operating hours of public transport. Council-specific considerations: • Defined areas or routes around or leading to train stations shall be lit to higher than the surrounding area. Council to define areas/routes around train stations.	At present switching is via PE cell control. Dimming, while technically possible (with new LEDs), is not possible for unmetered loads.

Site/Application	Best Practice and Council-specific Considerations	Controls[4] (e.g. dimming, switching, sensors)
Bus routes/stops	Best practice: • Lights may be installed with timers and/or dimmers linked to operating hours of public transport Council-specific considerations: • Lighting should be installed on every pole along bus routes (refer to Council's Principal Pedestrian Network/Pedestrian Strategy)	At present switching is via PE cell control. Dimming, while technically possible (for new LED installations), is not yet possible for unmetered loads
Bike paths (off road)	Best practice: • Lights may be installed on popular commuter routes Council-specific considerations: • Popular commuter routes should be identified by reference to the Strategic Cycling Corridors identified by VicRoads (refer to Appendix 1)	Lights may be installed with timers and/or dimmers Switch off/dim: between 11pm and 1am Switch on/brighten: 5am
Bike paths (underpass)	Best practice: • Lights may be installed on popular commuter routes Council-specific considerations: • Underpasses may be lit throughout the whole day and during part of the night to minimise the effects of daytime dark/light transitions.	Lights may be installed with timer controls and/or dimmers Switch off/dim: between 11pm and 1am Switch on/brighten: 5am

Site/Application	Best Practice and Council-specific Considerations	Controls[4] (e.g. dimming, switching, sensors)
External building lighting	External building lighting may be considered if the building is adjacent to and/or within: 1. a Council car park (e.g. lighting on the building provides light for the car park) 2. a Council reserve (e.g. lighting on the building provides light for the reserve) 3. a Council footpath or shared path, including a path to a Council building (e.g. lighting on the building provides light for the path that leads to the building entry or lighting on the building provides light for shared path that runs adjacent to the building) 4. a Council public art project For the above scenarios the following arrangements would occur: 1. any existing lighting on a building shall be included as part of any existing lighting condition assessment (i.e. the external building lighting is contributing to the public lighting) 2. the external building walls may be used to support lighting as part of a new lighting design/scheme for a metered lighting supply 3. external building lighting should be included in the assets register (refer to Section 10.2)	Controls to be applied depending on the nature of the adjacent public space (e.g. car park). Refer to relevant section of this table for controls to be applied.
Car parks	If lighting a car park, consideration should also be given to lighting any pedestrian linkages to the facility that the car park services	Lights may be installed with timers set to the hours of operation of the associated site or building or dimmers set to the usage levels of the car park over the course of the night

Site/Application	Best Practice and Council-specific Considerations	Controls[4] (e.g. dimming, switching, sensors)
Laneways	Best practice: • Lights may be installed where the laneway provides a logical shortcut for pedestrians or if it is a key thoroughfare for pedestrians and/or cyclists Council-specific considerations: • Lighting should be avoided wherever there is poor passive surveillance • Where lighting is installed, the design process should consider the need for light spill control (i.e. the use of glare shields/baffles) and/or site-specific optics • Consider space constraints such as: the ability to install and protect infrastructure whilst maintaining a trafficable laneway, the ability to supply power to this infrastructure, operational and maintenance issues due to the infrastructure being located in the laneway and excessive light spill within the rear properties that are adjacent to the laneway • If a suitable alternative pedestrian path that requires minimal additional travel time and distance exists, then pedestrians should be encouraged to walk on the existing footpath network where there is sufficient existing street lighting available	For unmetered connection points, at present switching is via PE cell control. Dimming, while technically possible (with new LEDs), is not possible for unmetered loads For metered connection points, dimming/switching is encouraged where usage patterns allow, or where activity is not desired after certain hours Switch off/dim: between 11pm and 1am Switch on/brighten: 5am
Shopping strip lighting schemes – additional lighting to street lighting	Best practice: • Generally, lighting is not considered appropriate if unmetered street lighting already exists. Lighting may be considered if AusNet agrees to remove existing public lighting • Additional lighting may be considered in some circumstances if the existing street lighting scheme is not deemed appropriate for the level of pedestrian traffic/crime/prestige in an area Council-specific considerations: • Where place-making/urban renewal is planned for a shopping strip, Council will explore options to remove existing unmetered street lighting and install metered lighting	For unmetered connection points, at present switching is via PE cell control. Dimming, while technically possible (with new LEDs), is not possible for unmetered loads For metered connection points, dimming is encouraged where usage patterns allow, or where activity is not desired after certain hours. Switching is not recommended for shopping strip lighting

Site/Application	Best Practice and Council-specific Considerations	Controls[4] (e.g. dimming, switching, sensors)
Uplighting/feature lighting of signs, trees, buildings, monuments, art	Best practice: • Lights may be installed with timers based on a needs assessment Council-specific considerations: • The installation of a lit artwork (contributing modest illumination to the public space) may be considered as a means of addressing public perceptions of safety in places where there is no other justification for lighting • Refer also to Section 5 which describes the approval process for new lighting assets	Timers installed linked to operation hours of the associated site or building
High risk areas - this includes entertainment precincts (e.g. the Ringwood MAC)	Best practice: • Lighting should be provided all night in these locations at an appropriate standard Council-specific considerations: • Some areas, such as Ringwood Night Club precinct, only require this lighting at specific times.	Lights are to be installed in these locations. Where risk is specific to hours of operation of a specific site or building, timers installed and linked to these hours of operation.
Areas of high vandalism	Best practice: • Lights may be installed, subject to trial in the following order: • turning lighting off to deter vandalism • using motion sensors • CCTV cameras • increase lighting in accordance with the Crime Prevention through Environmental Design Guidelines	

Following completion of steps 1 and 2 above, the required light levels should be determined, which are discussed further in Section 13.

Recommendations:

- **Council's Public Lighting Guidelines to specify where and when to provide public lighting and what controls (dimming, switching, sensors) shall apply**

12.1 Special Considerations

With regard to the lighting of roads, the Australian Standards for Lighting for Roads and Public Spaces focuses on the need to illuminate the road reserve width in order to achieve compliance. The reserve width is defined as the width of the entire way, between property

lines, devoted to public travel. This leaves scope for interpretation when dealing with roads that have no footpaths (only nature strips) or a footpath on only one side of the road.

The simplest interpretation is to treat the road reserve width as kerb-line to kerb-line where no footpaths exist and as kerb-line to property boundary where only one footpath exists. This, however, does not reflect the fact that nature strips may be used in lieu of a footpath.

Council has expressed a desire to follow the above approach as a general rule but to have an exception for situations where no footpaths or only one footpath exists with the Principle Pedestrian Network. In these instances, where pedestrians would be expected to walk on nature strips, the road reserve width should be treated as property boundary to property boundary.

Recommendations:

- **Council's Public Lighting Policy to define the road reserve as:**
  - **kerb-line to kerb-line where no footpaths exist;**
  - **kerb-line to property boundary where only one footpath exists; or**
  - **property boundary to property boundary where no footpaths or only one footpath exists within the Principle Pedestrian Network and pedestrians are expected to walk on nature strips**

12.2 Control of Light Pollution

Control of light pollution was highlighted as a concern of the community during the community consultation period for Council's Draft Public Lighting Policy. A more detailed summary of this feedback can be found in Council's *Public Lighting Policy Community Consultation: Environmental Impacts Overview* document (provided as an appendix).

Light pollution can be controlled in the following ways in order of effectiveness:

1. Avoid lighting where it is not needed	Lighting is not always a necessary component of the built environment. Consider whether night-time usage is desired and/or prioritise areas of environmental importance and apply restrictions to lighting.
2. Avoid over-lighting	Do not over-light. Over lighting is a major cause of light pollution. Recommended lighting levels exist for most outdoor lighting applications. Consultation of relevant Standards should be carried out to ensure suitable lighting levels are applied.
3. Switch off or dim lights during periods when lighting is not required.	Most people use public space during the day and early evenings. Lighting should support positive evening use and all-night lighting should be provided only where required. Where switching lights off is deemed unreasonable, consideration of changes to usage patterns over time should

		be carried out, with opportunities to dim lighting levels applied wherever viable.
4.	**Reduce or eliminate light spill**	Wherever possible, direct light downwards, not upwards, to illuminate the target area. Where unwanted light spill into areas is still occurring, use shields, baffles and louvres to further reduce light spill

Table 8 in this section provides guidance on where lighting is not needed and how to apply dimming and switching when lighting is no longer needed during night time hours; Section 13 provides guidance on appropriate lighting levels; and Table 5 makes reference to the requirement that new lights should have a maximum upward waste light spill ratio of less than 1%.

Further to what is described above, a number of other design solutions can be applied to lighting schemes where light pollution is anticipated to be an issue. These include:

- The use of specific optics to direct light where it is wanted
- The use of baffles, shields and louvres
- The use of lower pole mounting heights
- The use of bollard and in-ground lighting
- The use of pole set-back and bracket arms to place lighting over the area it is lighting and away from areas that do not need to be lit

Recommendations:

- **Council's Public Lighting Policy to define appropriate design solutions to minimise light pollution**

13. Lighting Categories (Light Levels)

Once the need to light and any site-specific requirements have been established (refer to Section 12) a best-practice approach would then assign the appropriate lighting category (light level). A framework for selecting the appropriate lighting category for a given type of open space or road is provided in the Australian and New Zealand Standard *Lighting for Roads and Public Spaces* (AS/NZS 1158). Best practice would involve deferring in large part to AS/NZS 1158 (see Sections 13.1 and 13.2 below) and to specify any exceptions where a different lighting category may be preferred by Council (refer to Section 13.3).

13.1 Assigning Lighting Categories Using the Standard

Figure 2.1 from AS/NZS 1158.3.1 (see Figure 5) summarises what categories may apply to different space types.

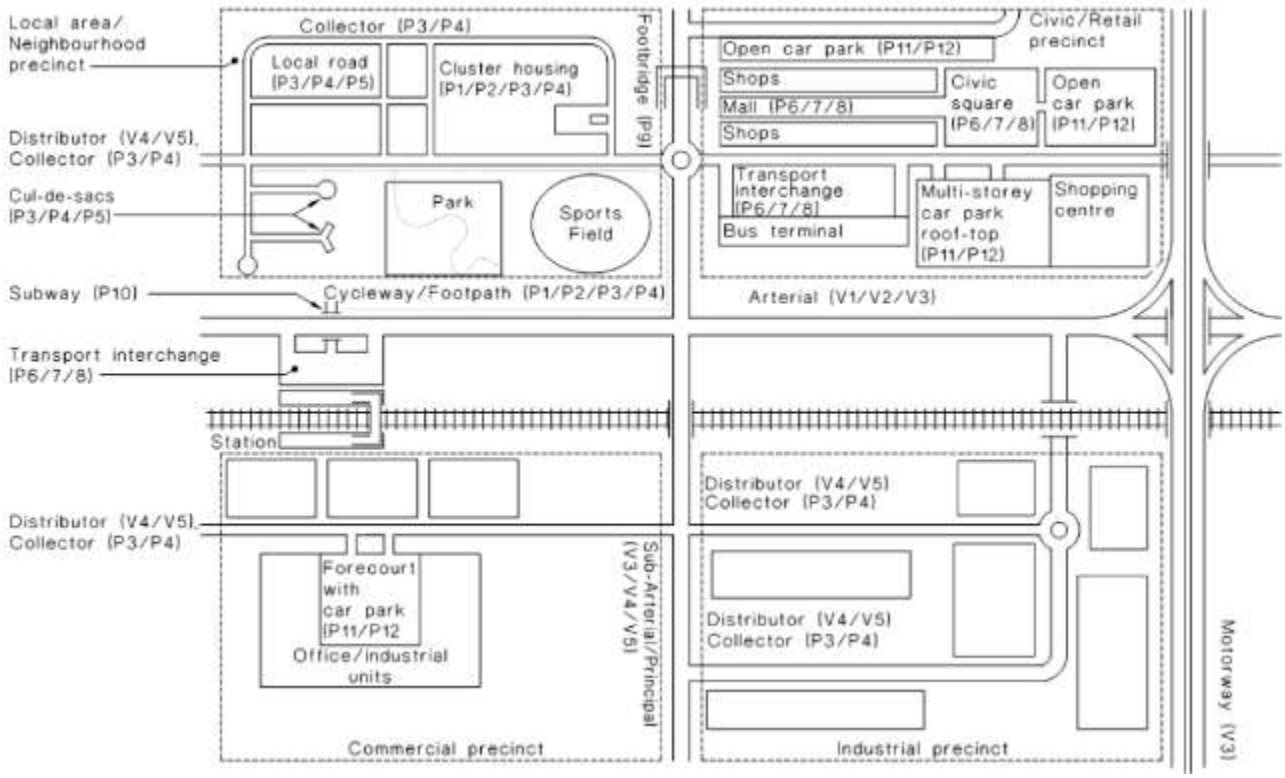


Figure 5: Figure 2.1 from AS/NZS 1158.3.1 2005

Different sections of the Standard apply to car parks, road ways and public activity centres as described in the following sections.

13.1.1 Car Parks

There are three lighting subcategories for outdoor car park lighting as outlined in *AS/NZS 1158.3 Pedestrian Area (Category P) Lighting*. Table 9 provides an overview of these three categories and the associated rates of pedestrian and vehicle traffic, night time occupancy and risk of crime.

Table 9: Car park lighting categorisation system

Type of area	Night time vehicle or pedestrian movements	Night time occupancy rates	Risk of crime	Applicable lighting subcategory
Parking spaces, aisles & circulation roadways	High	Greater than 75%	High	P11a
	Medium	25% - 75%	Medium	P11b
	Low	Less than 25%	Low	P11c

Each of these three sub-categories has lighting level requirements for any given individual point in the assessment area, the average horizontal illuminance across the entire assessment area and the overall lighting uniformity. For the P11a category the required horizontal illuminance at any given point is 3 lux, while the required average for the whole car park is 14 lux. Table 10 provides an overview of the lighting level requirements for each of the three car park sub-categories.

Table 10: Lighting subcategory requirements for car parks

Lighting subcategory	Average horizontal illuminance (lux)	Point horizontal illuminance (lux)	Point vertical illuminance (lux)	Illuminance uniformity
P11a	14	3	3	≤10
P11b	7	1.5	1.5	≤10
P11c	3.5	0.7	-	≤10
P12	-	Greater than 14		-

13.1.2 Public Activity Centres (excluding car parks)

There are three lighting subcategories for public activity centres as outlined in *AS/NZS 1158.3 Pedestrian Area (Category P) Lighting*. Table 11 provides an overview of these three categories and the associated rates of pedestrian and vehicle traffic, risk of crime and need to enhance prestige.

Table 11: Public activity centre lighting categorisation system

Type of area	Night time vehicle movement	Risk of crime	Need to enhance prestige	Applicable lighting subcategory
Areas primarily for pedestrian use e.g. outdoor shopping precincts, malls, open arcades, town squares	N/A	High	High	P6
	Medium	Medium	Medium	P7
	Low	Low	N/A	P8
Transport terminals and interchanges	High	High	High	P6
	Medium	Medium	Medium	P7
	Low	Low	N/A	P8

Table 12 outlines the lighting level requirements for the three public activity area subcategories. The requirements for these categories again include a minimum average

horizontal illuminance, minimum point horizontal and vertical illuminance and maximum illuminance uniformity. As shown in Table 12, P6 requires the highest lighting levels of the three categories whilst P8 is the lowest.

Table 12: Lighting subcategory requirements for public activity centres (excluding car parks)

Lighting subcategory	Average horizontal illuminance (lux)	Point horizontal illuminance (lux)	Point vertical illuminance (lux)	Illuminance uniformity
P6	21	7	7	10
P7	14	4	4	10
P8	7	2	2	10

13.1.3 Roadways, Pedestrian Paths and Laneways

There are five lighting subcategories for roadways, pedestrian paths and laneways as outlined in *AS/NZS 1158.3 Pedestrian Area (Category P) Lighting*. Table 13 provides an overview of these five subcategories and the associated rates of pedestrian and bicycle traffic, risk of crime and need to enhance prestige.

Table 13: Roadway, pedestrian path and laneway categorisation table

Type of area	Pedestrian/cycle activity	Risk of crime	Need to enhance prestige	Applicable lighting subcategory
Collector roads or non-arterial roads	N/A	High	N/A	P1
	High	Medium	High	P2
	Medium	Low	Medium	P3
	Low	Low	N/A	P4
Local roads or streets	N/A	High	N/A	P1
	High	Medium	High	P2
	Medium	Medium	Medium	P3
	Low	Low	N/A	P4
	Low	Low	N/A	P5

Table 14 outlines the lighting level requirements for the five subcategories for roadways, pedestrian paths and laneways. The requirements for these categories again include a minimum average horizontal illuminance, minimum point horizontal and vertical illuminance and maximum illuminance uniformity

Table 14: Lighting subcategory requirements for roadways, pedestrian paths and laneways

Lighting subcategory	Average horizontal illuminance (lux)	Point horizontal illuminance (lux)	Point vertical illuminance (lux)	Illuminance uniformity
P1	7	2	2	10
P2	3.5	0.7	0.7	10
P3	1.75	0.3	0.3	10
P4	0.85	0.14	N/A	10
P5	0.5	0.07	N/A	10

13.2 Background to Assigning Lighting Categories Using the Standard

AS/NZS 1158 provides guidance on assigning appropriate lighting categories and subcategories to various outdoor land uses and roads (refer to Section 13.1). Typical operating characteristics for each sub-category, defined largely via relative terms (low, moderate, high), are provided to assist in determining the most suitable subcategory. The Standard's use of relative terms makes the task of assigning subcategories a subjective one. That is, one person's opinion of what represents a "moderate" level of traffic volume or a "high" crime level will invariably differ from the next person.

The Australian Standard, in Section 2.4 of Part 1.1, acknowledges this issue, explaining that:

> *The concept of using relative terms is employed since it would be both unrealistic and impractical to apply one numerical set of values, for each of the selection criteria, to the lighting level hierarchy to accommodate the relevant requirements of each town, city etc. across both Australia and New Zealand.*
>
> *The terms mixed, low, medium, high, very high and moderate are provided to enable individual road controlling authorities to develop their own specific lighting hierarchy.*
>
> *The appropriate lighting subcategory for a particular road should be a matter for determination in consultation with the client…*

There is therefore inherent ambiguity in the relative terms used in the Standard, unless there is a clearly quantified definition of what is meant by low, moderate and high. This definition would typically be provided within a council Policy or Guidelines document, and would then require traffic counts and crime statistics to be sourced for each site before assigning a suitable lighting category or subcategory.

Only a limited number of road controlling authorities have a clearly quantified definition of what is meant by low, moderate and high in relation to traffic volumes and crime rates. For councils without a quantified definition of the relative terms used in the Standard – which includes Maroondah – the following process to assign desired categories or subcategories to a space or road is recommended:

1. Define the function and busy-ness of the road/space via consultation with relevant Council staff;
2. Match the definition of the road/space with the guidance provided by:
    1. Public Lighting Policy and Guidelines documents
    2. The Australian Standard (AS/NZS 1158)
    3. Lighting schemes in similar roads/spaces in other local government areas
3. Assign the most appropriate lighting subcategory to the road/space

In addition to assessing activity/occupancy levels and risk of crime, for road ways and public activity centres, application of the Standard involves an assessment of the "need to enhance prestige" or the required aesthetic appeal of a space. As an example, the Ringwood MAC may be considered an area where the required aesthetic appeal is higher than other areas.

13.3 Exceptions

The site types or specific locations presented in Table 15 have been identified by key Council staff as areas where lighting categories other than those that may be specified by strict application of the Standard are recommended.

Note that the option of installing a light on every pole (as opposed to meeting the specified lighting category) is suggested for most scenarios in Table 15 given the likelihood it will not be possible to meet the specified lighting category in all areas using existing pole infrastructure (i.e. existing mounting heights and spacings). For some locations, achieving the target (P3 or P4) would require the installation of new poles which adds significantly to the cost of any renewal or upgrade. Nevertheless, a cost benefit analysis of each individual site should be undertaken to determine if the installation of new poles is required (e.g. for high-profile or high-risk sites where meeting the target lighting classification is consider absolutely necessary).

Table 15: Site-specific lighting category requirements identified by key Council staff

Site/Application	Council's preferred lighting category	Comment/Recommendation
Bus routes[5]	Light to P4 category (or a light on every pole)	• The future possibility of dimming lighting along bus routes outside of public transport operating hours (e.g. from P4 to P5) via remote dimming should be considered in Council's Public Lighting Policy. • For PTV bus routes refer to: https://www.ptv.vic.gov.au/getting-around/local-areas/view/29

[5] Note that lighting of bus shelters/stops is the responsibility of PTV, and the lighting of bus interchanges and hubs is the responsibility of VicTrack.

Site/Application	Council's preferred lighting category	Comment/Recommendation
Taxi ranks	Refer to guidance in ATIA Taxi Rank Design Specification (April 2012)	• ATIA Taxi Rank Industry Specification, Table 7.19.3, provides illumination specifications for taxi ranks.
Principal Pedestrian Network (PPN)	Light to P3 (or light on every pole)	• Refer to map in Appendix 2 • Given the extensive coverage of the PPN it is not recommended that the entire network be lit to P3. Instead, it is recommended that P3 be targeted to key routes. For example, overlaying activity centres and other key sites may identify key routes.
Key pedestrian routes around train stations	Light to P3 (or light on every pole)	• Refer to maps in Appendix 3 • Council has identified what it considers to be the key pedestrian routes surrounding train stations (refer to Appendix 3). It is recommended that selection of key routes should be based on a clear understanding of current pedestrian patterns and usage. If possible, Council should encourage the concentration of pedestrian activity along particular routes to reduce lighting costs.
Key pedestrian routes around Maroondah Hospital	Light to P3 (or light on every pole)	• Refer to map in Appendix 3 • Council has identified what it considers to be the key pedestrian routes surrounding the Hospital (refer to Appendix 3). It is recommended that selection of key routes should be based on a clear understanding of current pedestrian patterns and usage. If possible, Council should encourage the concentration of pedestrian activity along particular routes to reduce lighting costs.

Higher order roads	Light to P3 (or a light on every pole)	• Based on consultation with key staff, applicable "higher order roads" include:
		  ○ Blue "link" roads as per Schedule 4 of Council's Road Management Plan (refer to Appendix 4)
		  ○ Roads classified as "major" and "collector" roads by Melways
		• To avoid confusion, it is recommended that Council ensure any road classifications/definitions are used are consistent with those used in Council's roads asset database.

Site/Application	Council's preferred lighting category	Comment/Recommendation
Ringwood MAC and night club precinct	Assign lighting categories using AS/NZS 1158	It is recommended that lighting categories be assigned to specific space types within the Ringwood MAC by application of the Standard (as described in Sections 13.1 and 13.2). Council's Ringwood Transit City Lighting Strategy (2007) specifies nominal lighting classifications for key roads and space types within the Ringwood MAC area, which appears to be based on a high-level assessment against the Standard. Therefore, a more detailed assessment, as per the procedure described in Sections 13.1 and 13.2, would be consistent with the RTC Lighting Strategy.

Recommendations:

- **Council's Public Lighting Guidelines to specify the method for assigning lighting categories as per AS/NZS 1158, including any site-specific exceptions**

14. Lighting Quality

Lighting quality considerations (e.g. CCT, colour rendering etc.) were discussed in detail during the workshop process and are generally catered for by the recommendations of other sections of this report (especially Section 8). However, further background discussion of the issue of blue light (and how it relates to CCT) is provided below given this is a topic of considerable discussion in the public lighting sector at present.

14.1 CCT and Blue Light

There is an increasing amount of public discourse around the potential negative effect of public lighting on human health due to too much "blue light". In June 2016, a report by the American Medical Association (AMA) adopted guidance for USA communities on selecting among LED lighting options to minimise potential harmful human and environmental effects. While the report is based on the experience in the USA, it reinforces what could be considered as "best practice public lighting" which dictates that lighting should be designed and managed by professionals and with concern for broader environment, health and social factors.
The AMA also blames high colour temperatures and recommends a colour temperature of 3000K or lower for LED street lighting to limit the amount of blue light.

Unfortunately, many 3000K lights can have high blue light content and Figure 6 shows that the warmer colour temperatures (LPS and HPS at 3000K or lower) result in slower driver reaction times and have direct road safety implications.

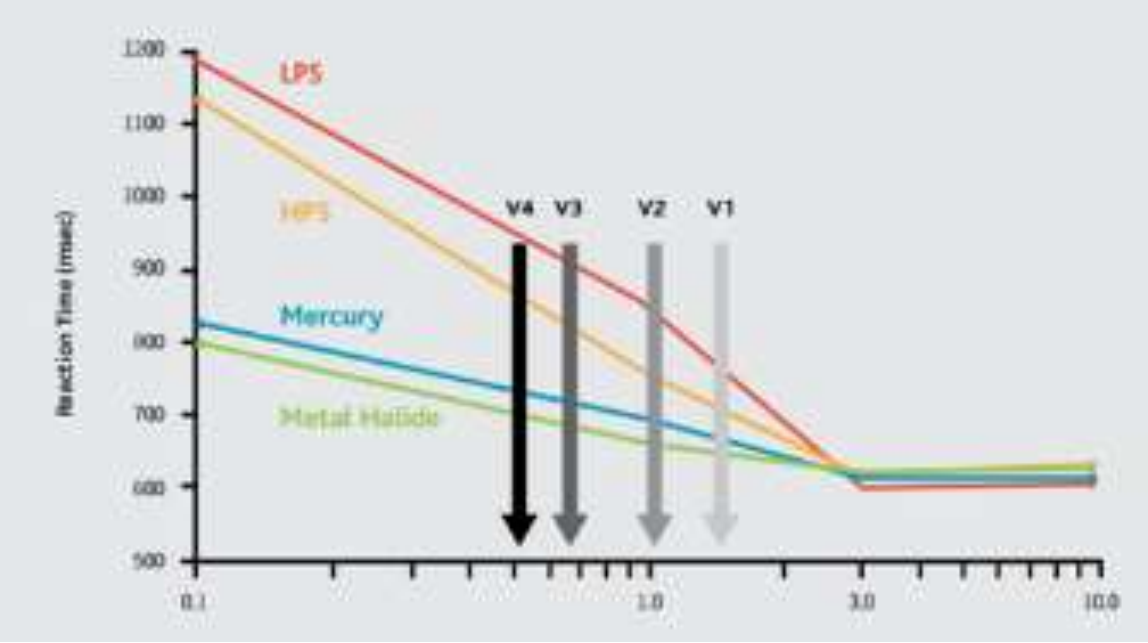


Figure 6: Australian Highway Lighting Categories, reaction times improved by white light (Davis 1999, Arizona DoT, SLPC, from IPWEA SLSC Roadmap 2016)

According to the Institute of Public Works Engineering Australasia (IPWEA) Street Lighting and Smart Controls Roadmap (2016) "in practical terms, this means that at a vehicle speed of

50km/hr, the stopping distance might be reduced by 4.2m" when using a higher colour temperature compared to the warmer colours.

From an Australian point of view, SA/SNZ TS 1158.6 states a "recommended" colour temperature of 4000K for street lighting, which is the colour temperature of the current 80W MV as well as the majority of new LEDs installed throughout Australia. 4000K is generally seen as an appropriate compromise between those arguing against too much light from the blue end of the spectrum and those arguing for better colour rendering, safety and efficiency of lighting.

It is important to note that much of the public discourse around "over lighting" and too much "blue white" is based on experiences in the USA and Europe. While still important, it is of less relevance to Australia because Australian street lighting levels are relatively low by international standards. In the UK, the minimum lighting levels are up to seven times higher than the minimum levels in Australia. What's more, the "old" lights in USA and Europe are commonly HPS lights which generally have a lower colour temperature than the MV lights in Australia.

The potential risks of blue lighting can be largely managed by good design. For example, lighting to the levels required (not higher), reducing light spill through well-designed luminaires and lighting schemes and the use of glare shields where appropriate. These issues and actions are generally discussed and decided with Ironbark's support during the Design and Preparation Stage of a lighting project.

However, in order to have as much flexibility as possible, a range of allowable colour temperatures is desirable. This is discussed further below in reference to metered and unmetered lighting.

A more detailed summary of why Council desires a range of colour temperatures can be found in Council's *Public Lighting Policy Community Consultation: Environmental Impacts Overview* document (provided as an appendix). This document was developed in response to feedback from the community that Council's draft Public Lighting Policy did not appropriately consider the impacts of artificial light at night on the community and the environment.

14.1.1 Metered Lighting

A colour temperature range of 3000K to 4250K is considered acceptable for Council's metered lighting. This will provide the flexibility to assign warmer colour temperatures to areas of identified environmental importance (e.g. nature reserves) and areas where the ambience created by warmer lighting might benefit the night time economy (e.g. outdoor eating precincts).

14.1.2 Unmetered Lighting

For unmetered lighting, AusNet Services has to date only approved LED street lights that fall at or around 4000K. In order to gain the flexibility available to metered lighting, local governments, as the customer, will need to advocate for the approval of a broader range of colour temperatures.

14.1.3 Assigning Colour Temperature

With a proposed colour temperature range of 3000K to 4250K, guidance on where to use certain colour temperatures is important. As discussed in Section 8.3, key retail/restaurant precincts might benefit from warmer colour temperatures due to the softer feel this type of light gives when compared to neutral white light (4000K).

Further to this, 3000K lighting should be considered for use in areas of environmental importance. This may be in nature reserves or on roads running adjacent to nature reserves.

In all other areas, a colour temperature at or around 4000K is considered appropriate.

Recommendations:

- **Council's Public Lighting Guidelines to specify:**
    - **An acceptable colour temperature range of 3000K to 4250K for metered lighting**
    - **A desired colour temperature range of 3000K to 4250K for unmetered lighting, noting the current restrictions based on what has been approved by AusNet Services to date.**
    - **How to apply colour temperature in different circumstances, noting that 4000K is the generally preferred colour temperature.**

15. Waste Disposal at End of Life

Waste materials arising from the removal and/or installation of public lighting assets can include toxic materials and therefore should be handled in an environmentally sensitive way, while the amount of material recycled should be maximised.

The vast majority of materials produced by the replacement of public lighting assets can be recycled, however some components require (e.g. mixed plastics) cannot. Table 16 summarises the best-practice approach to recycling of materials arising from public lighting.

Table 16: Summary of typical components, materials and recycling requirements

Component	Typical Materials	Best-Practice Disposal Method
Lamps (including mercury vapour, high pressure sodium, fluorescent, metal halide)	Glass, mercury, phosphorous, copper, plastic, aluminium	Processed to separate the glass, aluminium, phosphor powder (which contains the mercury) and argon gas Glass and aluminium recycled Mercury and phosphorous distilled and reused
Plastic visor	Acrylic	Recycled (for example, granulated to produce pellets to be used as raw material for producing new plastic products)
Plastic backing	High density polyethylene (HDPE)	Recycled (for example, granulated to produce pellets to be used as raw material for producing new plastic products)
Luminaire body	Aluminium	Recycled
Miscellaneous components attached to luminaire body (including components such as capacitors, lanyards, clips, terminal blocks, grommets etc.)	Plastic, copper, rubber, steel	Copper and steel components recycled
Photoelectric (PE) cell	Plastic, copper and steel. Some PE cells may contain cadmium	Disposed of or recycled in line with EPA regulations PE cells containing cadmium should only be accepted by an approved waste acceptor

Component	Typical Materials	Best-Practice Disposal Method
Control gear/ballast	Iron exterior (older luminaires with iron core ballasts) E-waste (newer luminaires with electronic control gears)	Iron core ballasts - Iron components must be recycled Electronic ballasts – recycled as e-waste
Lamp holder	Ceramic, plastic, copper and steel	Copper and steel components recycled
Steel screws	Steel	Recycled
Copper wires	Plastic and copper	All insulated copper wire can be separated and the copper component recycled
Poles/columns	Steel	Recycled
Packaging	Cardboard, paper, soft plastics	Recycled

The measures outlined in Table 16 should be implemented to ensure compliance with the Environment Protection (Industrial Waste Resource) Regulations 2009 and the following:

- Planning and Environment Act 1987 (Vic)
- Environmental Protection Act 1970 (Vic)

Note that the objectives of the Environment Protection (Industrial Waste Resource) Regulations 2009 are to consolidate subordinate legislation and also assist industry to implement the principle of wastes hierarchy as set out in the original Environment Protection Act 1970 which is the primary legislation.

It is recommended that compliance with the Environment Protection (Industrial Waste Resource) Regulations 2009 and specific disposal of wastes (as per Table 16) be detailed clearly in any installation tender or RFQ process, with evidence of compliance sought from contractors in the form of recycling receipts or similar.

Recommendation:

- **Council to include best-practice recycling and waste disposal requirements in any tender or RFQ documentation for public lighting works, including the requirement that evidence of appropriate recycling and/or disposal is provided**

16. Policy and Guidelines Review

Any Policy or Guidelines should be subject to Council's standard review procedures. This is especially relevant to public lighting given the rapid changes and improvements in lighting technology, and frequent updates to associated standards. As such, it is recommended that Council's Public Lighting Policy and Guidelines be reviewed every 2 to 3 years with particular concern for:

- new technology options
- updates to AS/NZS 1158
- changes in the nature or use of particular spaces that may necessitate changes to public lighting

Recommendation:

- **Public Lighting Policy and Guidelines to be subject to review every 3-5 years**

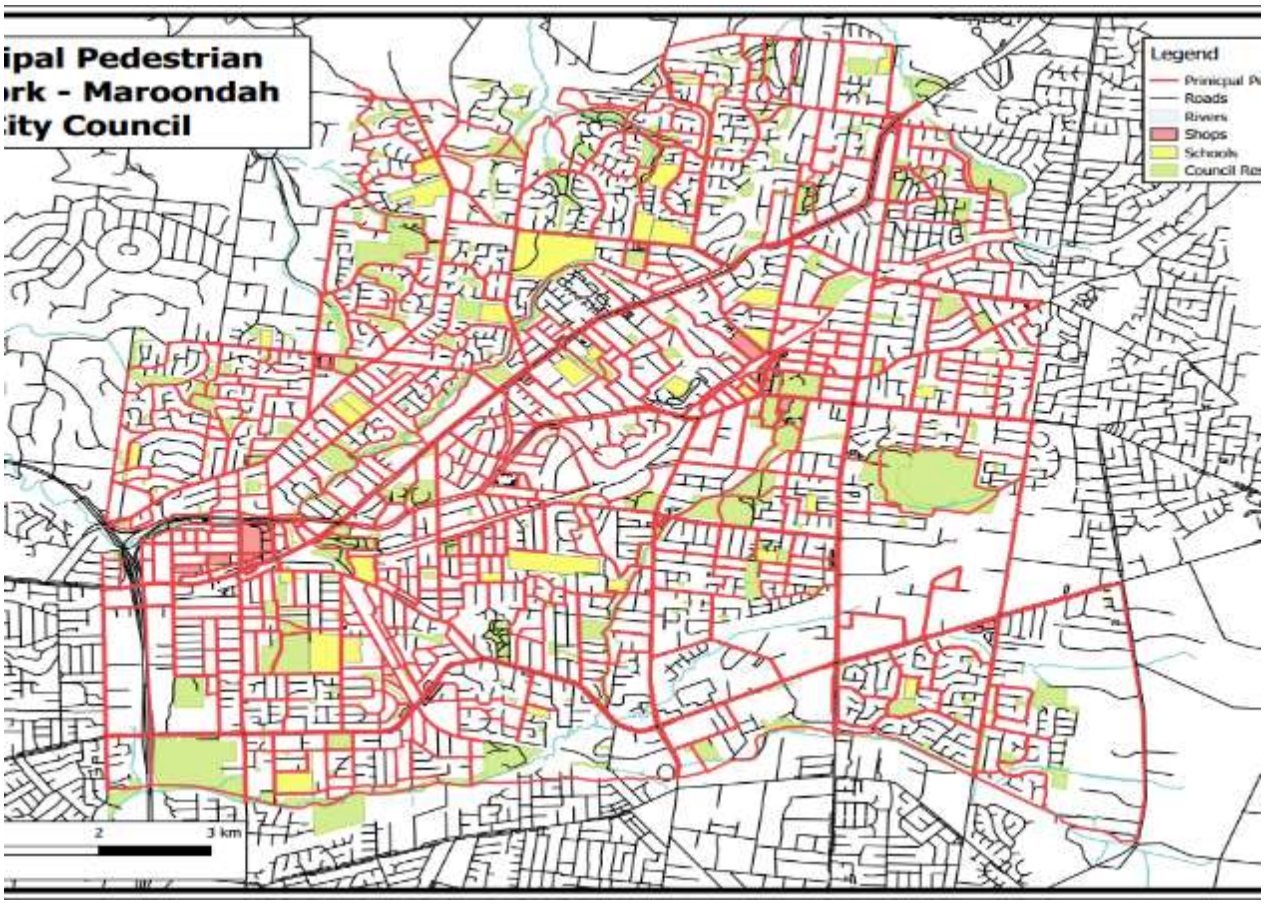
17. Glossary

Term	Definition
HID	High-intensity discharge lamps or luminaires
Luminaire efficacy rating (LER)	A measure of the efficiency with which a luminaire converts electrical energy into light, measured in lumens per watt
Category P	Pedestrian category roads
Category V	Vehicle category roads
CCT	Correlated colour temperature describes the colour of a light source, and is measured in degrees Kelvin (K). Blue-white lamps have a high colour temperature (e.g. 4000K). Yellow lamps have a low colour temperature, (e.g. 2000K)
Colour Rendering Index (CRI)	Colour rendering describes the degree to which natural colours can be perceived under different kinds of artificial light. It is measured on a colour rendering index (CRI). A CRI of 100 indicates that colours are depicted accurately. A CRI of less than 30 indicates colours are distorted and difficult to recognise. A CRI of 80 or above provides an acceptable standard for outdoor lighting.
DALI	Digital Addressable Lighting Interface. A type of standard lighting control system.
Decorative	Refer to 'non-standard'
DNSP	Distribution Network Service Provider, also known as Energy Distribution Business (EDB) also known as distributors.
GHG	Greenhouse gas
HPS	High pressure sodium lamps or luminaires
IK rating	Measure of protection against mechanical impact (vandalism)
IP rating	Measure of protection against ingress by water and solid objects
IPWEA	Institute of Public Works Engineering Australasia
Lamp	The light bulb in a luminaire
LED	Light emitting diode
LPS	Low pressure sodium lamps or luminaires
Luminaire	The light source (lamp or LED module), fitting and control gear of the light
MAC	Metropolitan Activity Centre

MH	Metal halide lamps or luminaires
Non-standard lighting	Lighting that is typically not held in stock by DNSPs, sometimes also referred to as 'decorative' (typically found in URD areas)
OMR	Operation, maintenance and replacement (OMR) costs are charged by a DNSP to a public lighting customer (e.g. Council)
PPN	Principal Pedestrian Network
Standard lighting	Lighting that is typically held in stock by DNSPs, and is found on their list of products approved for use
Street lighting	Street lighting found in residential streets and main roads
URD	Underground Residential Developments

18. Appendix 1 – Strategic Cycling Corridors

19. Appendix 2 – Principle Pedestrian Network



20. Appendix 3 – Key Pedestrian Routes Around Train Stations and Maroondah Hospital

Figure 7: 800m radius around Ringwood Station and Heatherdale Station

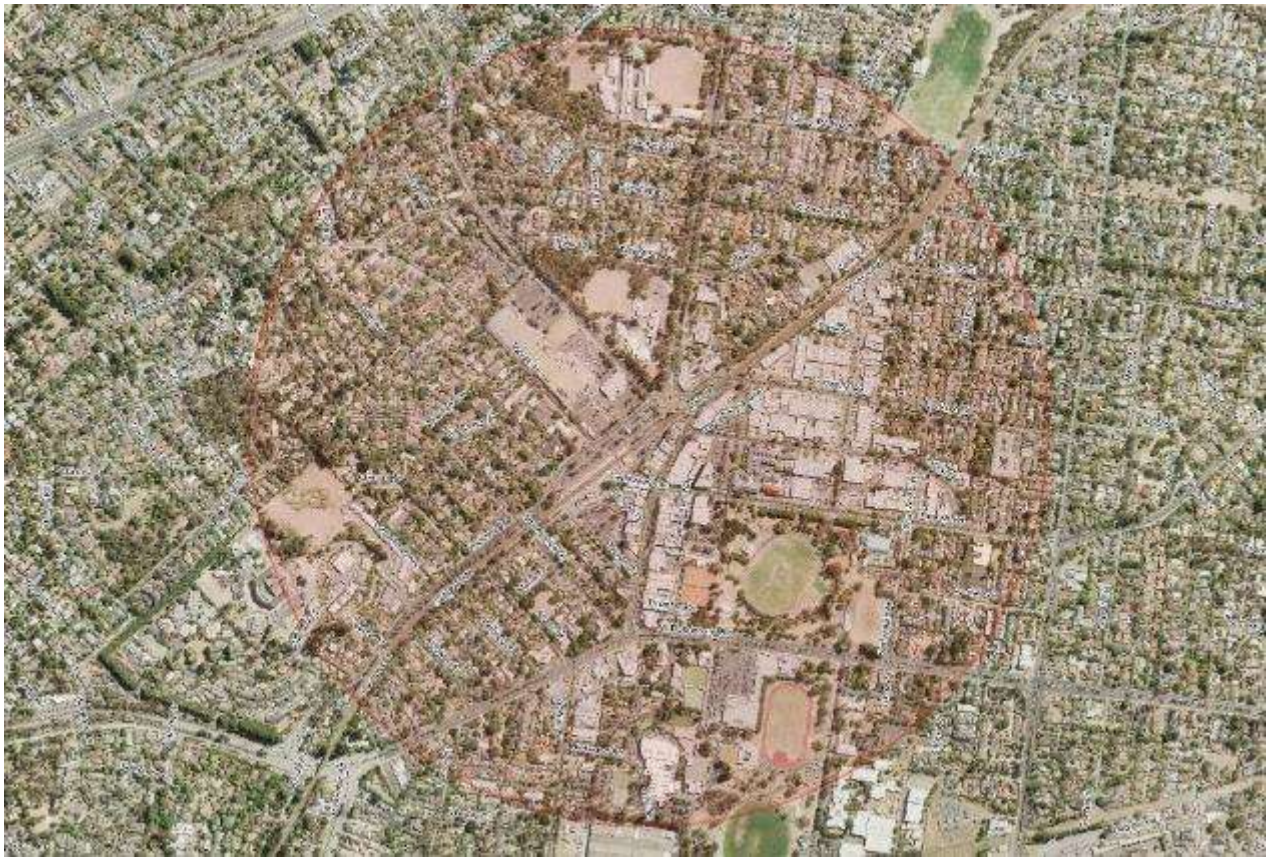


Figure 8: 800m radius around Croydon Station

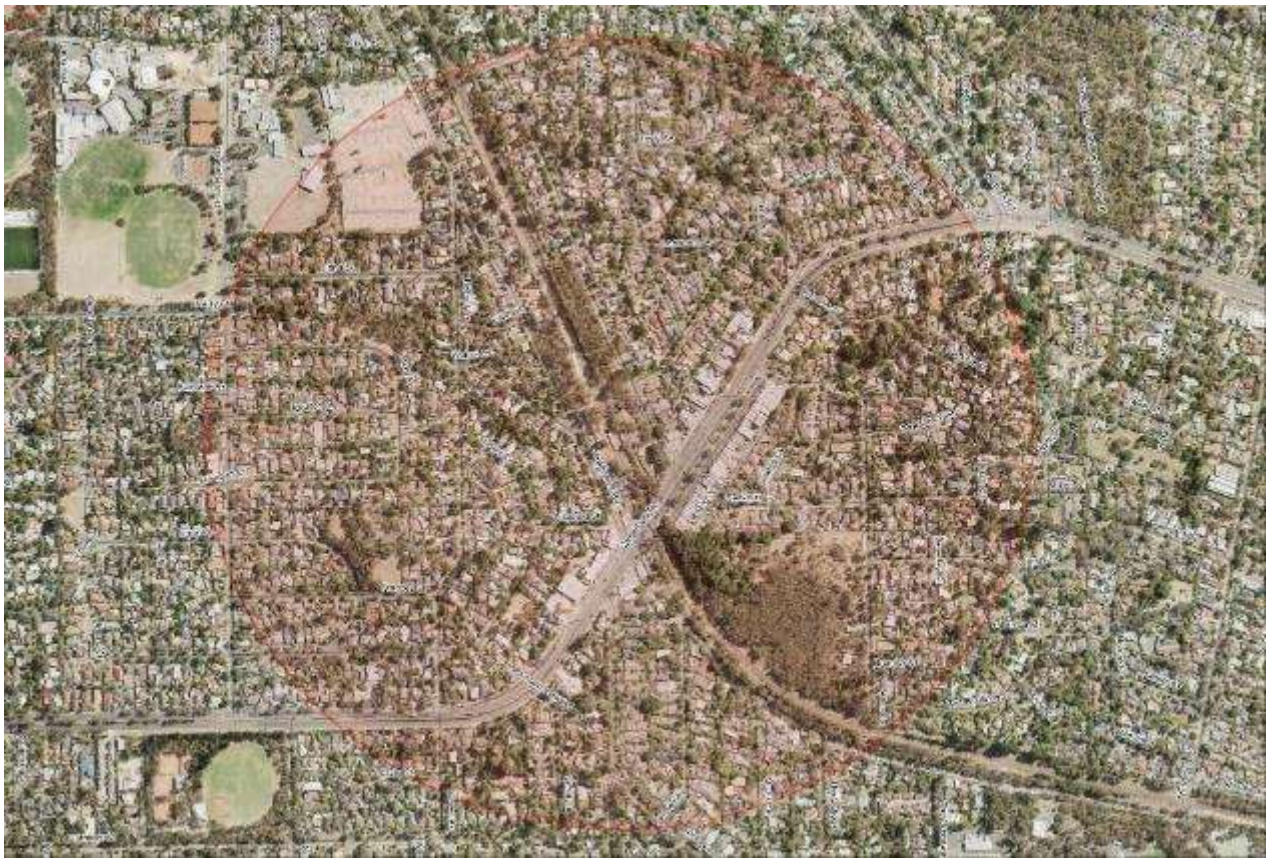
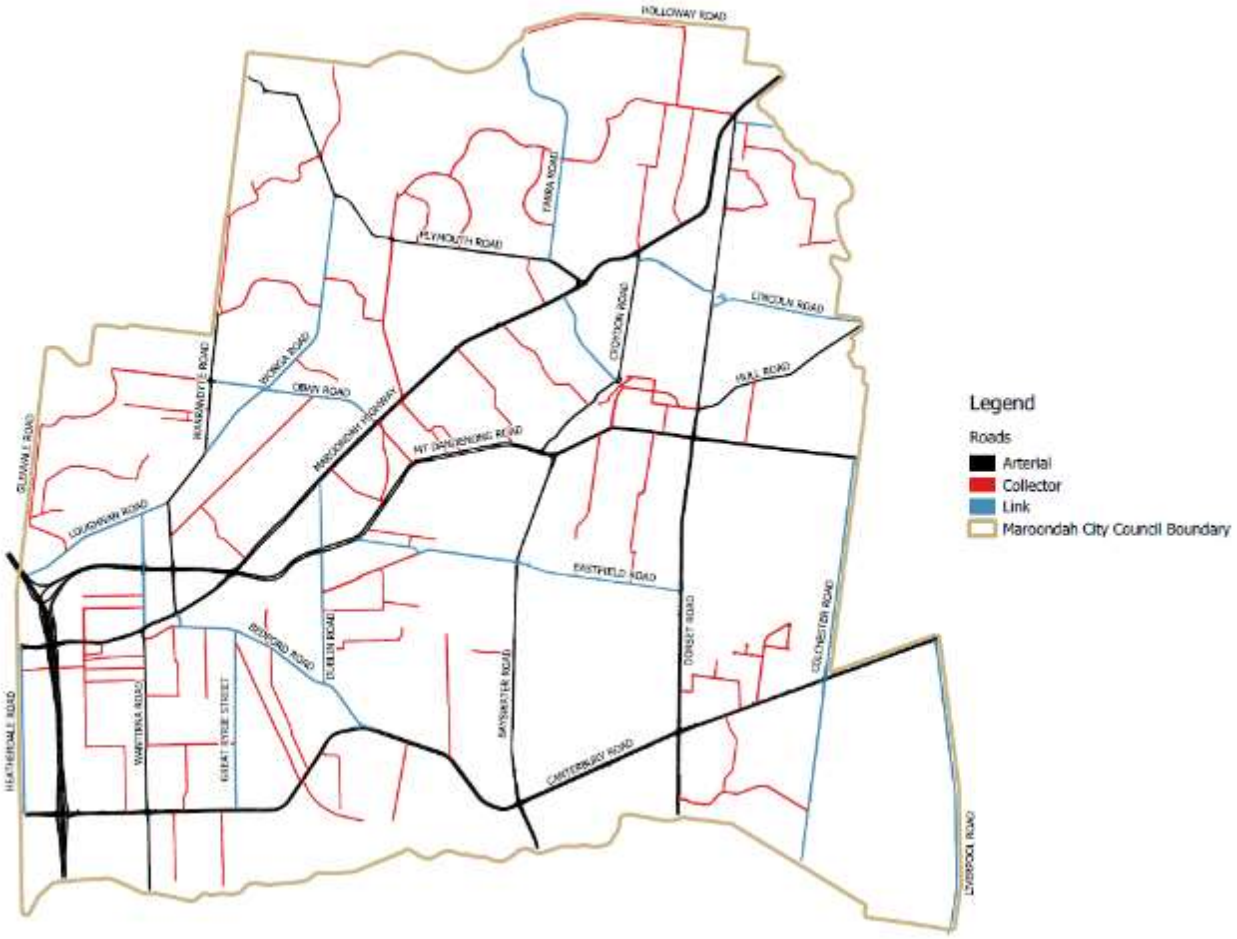


Figure 9: 800m radius around Heathmont Station

Figure 10: 800m radius around Ringwood East Station

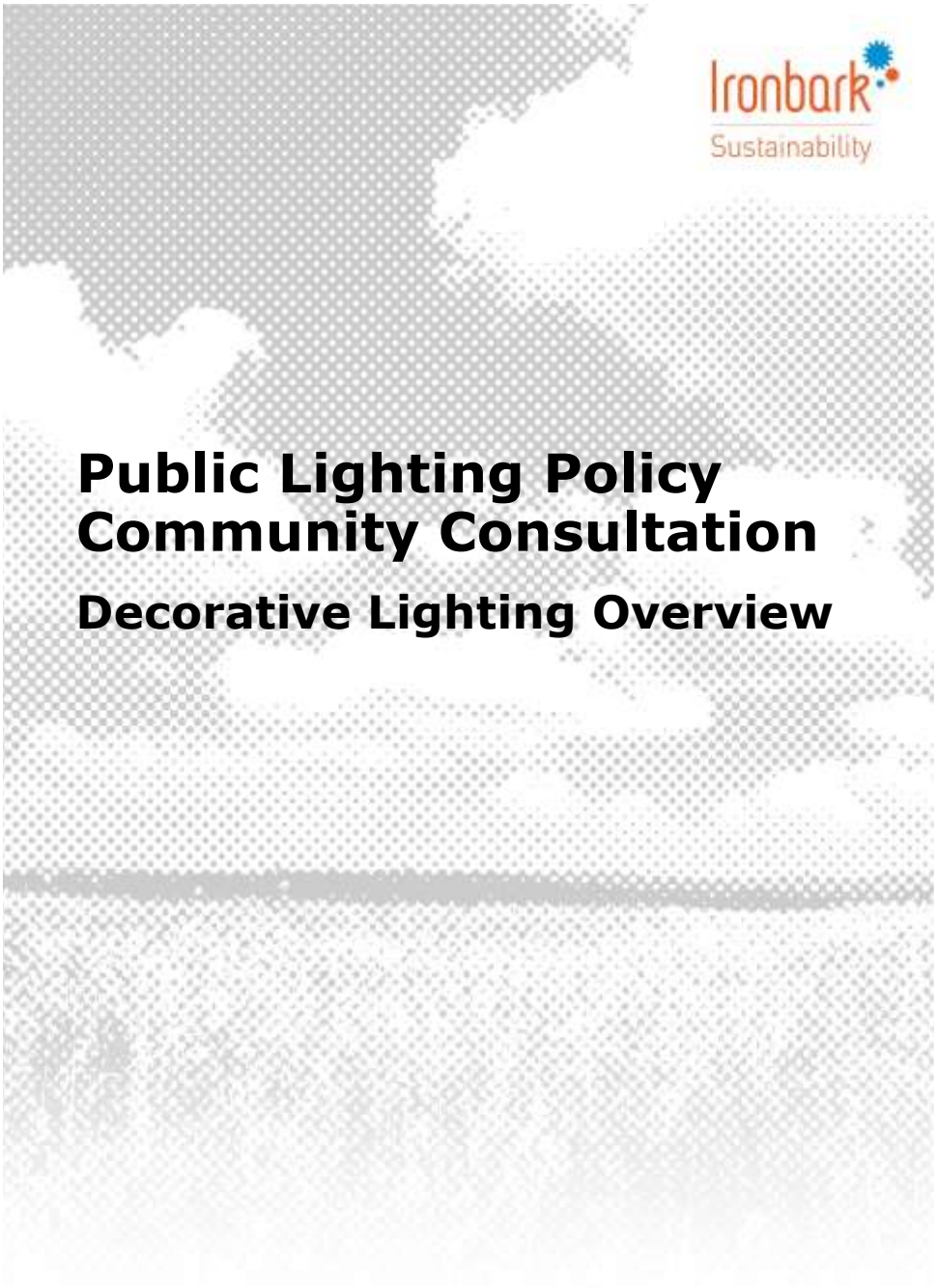
Figure 11: 800m radius around Maroondah Hospital

21. Appendix 4 – Road Classifications from Council's Road Management Plan



22. Appendix 5 – Community Consultation: Decorative Lighting

A summary of the community's feedback relating to non-standard lighting and the general desire to retain this style of lighting can be found below:



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Version	Author	Date	Description of changes
V1a	Keith Harwood	25/2/2019	First Draft
V1b	Keith Harwood	26/3/2019	Final Version
V1c	Keith Harwood	1/4/2019	Added glossary

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Ironbark Sustainability is a specialist consultancy that works with government and business around Australia by assisting them to reduce energy and water usage through sustainable asset and data management and on-the-ground implementation.
Ironbark has been operating since 2005 and brings together a wealth of technical and financial analysis, maintenance and implementation experience in the areas of building energy and water efficiency, public lighting and data management. We pride ourselves on supporting our clients to achieve real action regarding the sustainable management of their operations.

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1. Introduction

In 2018, Maroondah City Council developed a DRAFT Public Lighting Policy. The DRAFT Policy aims to provide guidance on the design, installation and management of public lighting within the municipality. It is Council's intention for the DRAFT Policy to promote a consistent approach to public lighting in Maroondah that reflects best practice and contributes to the sustainability and amenity of the municipality.

In late 2018 and early 2019 Council sought feedback from the community about the content and direction of the DRAFT Policy. One of the most common themes of the feedback related to Council's DRAFT policy position of replacing non-standard decorative street lights with standard street lights.

Many of the submissions received via the consultation process did not support the removal of existing decorative lighting. In response to this, Council has commissioned the development of this documents, which seeks to examine possible alternatives or solutions, and identify any potential changes that could be made to the DRAFT policy position.

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2. Overview of Non-standard Street Lighting

2.1 Defining Street Lighting

All street lighting contains the same basic parts. Descriptions of these basic parts are found below.

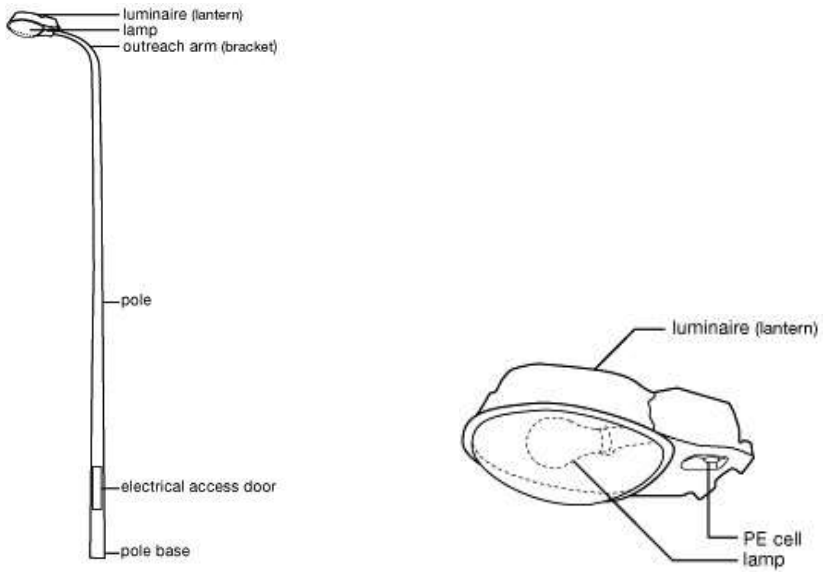

Figure 1: Pole and luminaire diagrams

Luminaire (lantern) – A device that distributes, filters or transforms the light emitted by a lamp or lamps and which includes all the items necessary for fixing and protecting these lamps.

Lamp (globe) – The lamp emits light and is located within the luminaire (lantern).

Photoelectric (PE) Cell – A device that is normally incorporated in a luminaire that detects outside light levels to automatically switch the luminaire on and off as required.

Bracket- (outreach arm) – the supporting connection from the pole to the luminaire.

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2.2 What is Non-standard street lighting

Non-standard street lighting provides developers with the opportunity to move away from a purely utilitarian form of street lighting and contribute to a streetscape that reflects a more bucolic or heritage aesthetic. The various styles, paint colours and accompanying pole types can be combined to clearly differentiate one development or precinct from the other and thus contribute to the unique identity of a neighborhood.

Figure 2: Examples of non-standard street lights (left and centre) and a standard street light (right)

2.3 Standard vs. Non-Standard Lighting

Besides the obvious aesthetic differences, the main differences between non-standard and standard street lighting relates to the ownership and maintenance structure.

Standard street lights are owned and managed by AusNet, whereas non-standard street lights are owned by Council and managed by AusNet. These differences in ownership structure impacts the obligations of AusNet in terms of how it operates and maintains non-standard street lights.

The financial implications of this ownership/management structure are discussed further in Section 3.2.1.

2.4 Council's Non-standard Street Lights

Two types of non-standard street lights are currently present in the City of Maroondah. These are top-entry luminaires as shown in Figure 3 and post-top luminaires as shown in Figure 4.

Figure 3: Example top-entry luminaire

Figure 4: Example post-top luminaire

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3. Council's Existing DRAFT Policy Position

3.1 Overview

Council's existing DRAFT policy position states that:

- Council will not stock non-standard luminaires and poles for maintenance of unmetered public lighting.
- [Council]… will consider options for the replacement of non-standard unmetered street lighting with standard street lighting.

It should be noted that Council's existing DRAFT policy positon does not explicitly state that it will undertake a program to transition existing non-standard unmetered street lighting to standard street lighting.

In addition to the above listed DRAFT policy positions, it should also be clarified that Council's DRAFT Public Lighting Guidelines states that new non-standard unmetered street lighting is not permitted in new developments. This will ensure that there is no growth in the number of non-standard street lighting assets within the municipality. It will also eliminate future conflict where/if Council seeks to replace non-standard unmetered street lighting with standard street lighting.

3.2 Why is Council Exploring Moving to Standard Assets?

Council's DRAFT policy position is predicated on a number of factors that combine to make non-standard street lighting assets an increasingly costly and risky option moving forward when compared to standard equivalents. These factors are detailed below.

3.2.1 Tariff Structure

Standard street lights are owned and managed by AusNet. Council pays an annual service charge to AusNet to maintain the light and pole over its life. Under this arrangement, the service charge covers regular maintenance (scheduled lamp and PE cell replacement, visor cleaning) and the replacement of failed assets, be it a faulty luminaire or a damaged pole.

In contrast, non-standard street lights are considered the property of Council. Whist Council still pays an annual service charge to maintain the light and pole over its life, failed assets are not covered by under this charge. Instead, Council is responsible for purchasing replacement poles and lights as well as for paying for the associated labour to carry out the replacement.

So, whilst a non-standard and standard street light of the same lamp type and wattage is charged out to Council for the same annual fee (approx. $18 in 2018), the following additional costs apply for non-standard street lights upon failure:

- A luminaire that fails and needs to be replaced costs Council in the order of $1,000 for parts and labour.

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- A pole that fails and needs to be replaced costs Council in the order of $3,500 for parts and labour.

3.2.2 Upcoming need for Replacement: Minimata Convention & Luminaire Age/Condition

The signing of the Minimata Convention is currently being considered by the Australian government. If adopted this would prohibit the import, export and manufacture of certain mercury added products including the mercury vapour lamps commonly found in Council's non-standard street lights. The adoption would mean that mercury vapour lamps cannot be imported after 2020. Whilst AusNet will be able to draw down on lamp stockpiles after this date, once they are exhausted Council's non-standard street lighting will need to be replaced upon lamp failure. it is expected that all mercury vapour luminaires in Australia will need to be replaced by 2024 at the latest due to regulations that require lamps to be in service for no longer than 4 years.

Further to this, luminaires typically last 20 years. Many of the non-standard luminaires are now reaching this age. It is therefore expected that their condition will warrant an increased rate of replacement in the coming few years.

The fact that Council will be forced to replace non-standard lighting assets at an increasing rate over the coming years means that an opportunity exists to assess more economically viable replacement options using standard assets. In many cases, the capital costs associated with moving to standard assets can be seen as a cost saving because they would be $500 to $1,000 cheaper than non-standard assets depending on whether just the luminaire or both the luminaire and pole are replaced.

On top of this, moving to standard assets significantly reduces ongoing maintenance costs as discussed in Section 3.2.1.

3.2.3 Limited AusNet Approved Options

Currently, a limited range of AusNet approved non-standard LED street lights are available to Council. This limits the ability of Council to provide aesthetically equivalent energy-efficient post-top luminaires should it seek to upgrade non-standard assets with like-for-like equivalents.

As it currently stands, approved non-standard LED street lights are available for Council's top-entry luminaires but not for its post-top luminaires (see Section 0 for details on Council's existing non-standard street lights).

Currently, no LED lamp retrofit option exists that would allow the existing mercury vapour lamp to be replaced with an LED equivalent without the need to remove the entire luminaire.

3.2.4 Compliance

Recent analysis has identified poor lighting levels (when assessed against AS/NZS 1158.3.1) in select residential areas where non-standard lighting is present. Transitioning to standard street lighting, which has significantly better performance in terms of light distribution, would allow Council to deliver a higher quality of lighting to the community.

4. Upgrade Options

A range of options exist for Council when upgrading non-standard street lighting in the future. The following section provides a summary of each of these options. The upgrade options are broken up into two broad sub-categories:

- Those that result in a transition to standard assets that deliver reductions to ongoing maintenance and replacement costs; and
- Those that result in a retention of the existing aesthetics that non-standards assets provide.

Table 1 below provides a brief overview of costs and benefits of each upgrade option.

Table 1: Overview of Upgrade Options

Option	Capital Cost	Complexity	Aesthetic Appeal	Lighting Quality	Ongoing Cost	Ready to Progress
Options to Transition to Standard Assets						
1: Convert to standard luminaires and poles	$$$$	Very high	Medium	High	$	Yes
1a: Convert to standard luminaires and painted poles	$$$$	Very High	Medium	High	$$	Yes
1b: Convert to standard luminaires and poles to meet Standards	$$$$$	Very high	Medium	Very High	$$	Yes
2: Convert to standard luminaires, retain poles	$$	Medium	Very-low	High	$$$	Yes

Table 1 (Continued): Overview of Upgrade Options

Option	Capital Cost	Complexity	Aesthetic Appeal	Lighting Quality	Ongoing Cost	Ready to Progress
Options to Retain Existing Aesthetics						
3: Replace all luminaires with aesthetic equivalents	$$$	Medium	Very high	Moderate	$$$$$	Currently not possible for all lights
4: Retrofit with LED lamps	$	High	Very high	Unknown (testing required)	$$$$$	Currently not possible

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4.1 Transition to Standard Assets

A number of options exist if Council elects to transition to standard assets. These are detailed below.

4.1.1 Option 1: Convert to Standard Luminaires and Poles

This option would see both the pole and luminaire converted to standard assets as shown in the image below.

This scenario is the most expensive option due to the upgrade of both lights and poles. The process from both a DNSP and Council perspective also has high complexity. While it is expected that many of the pole replacements will be straight forward in nature, specific locations will require the use of non-destructive excavation where under-ground assets are in close proximity; re-instatement of pavement where required; and re-wiring of pole to pit where required to meet standards.

The aesthetic outcome is rated as medium because while the standard poles and lights will not have the same aesthetic appeal as the decorative lights and poles, the upgrade of both lights and poles at the same time will provide consistency in the look of the street lights.

Figure 5: Example of a standard luminaire and pole

The lighting quality outcome is rated as high because standard luminaires are able to achieve a maximum spacing that is 15-20m further than non-standard luminaires at the same mounting height. This means that a large portion of existing light-level non-compliances (which have been identified as an issue) could be addressed simply by converting to standard luminaries.

From an ongoing cost perspective, this option would present Council with the lowest of all the scenarios as it reduces both energy usage and maintenance/repair costs.

This option is able to be progressed within the current regulatory environment.

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4.1.2 Option 1a: Convert to Standard Luminaires and Painted Poles

As per Option 1, but with the inclusion of painted standard poles. Painted poles would provide the ability to retain some of the aesthetic value of the existing non-standard assets with black or green paint instead of plain galvanised poles.

Painted poles would not be serviced by AusNet in the same way as galvanised poles. Upon failure, painted poles would be replaced with galvanised poles and it would be Council's responsibility to ensure these are painted. Because of this, ongoing costs are slightly higher than using galvanised poles.

Figure 6: Example of a painted standard pole

4.1.3 Option 1b: Convert to Standard Luminaires and Modify Pole Spacing to meet Australian Standards.

As per Option 1, however due to preliminary studies indicating that there are compliance issues with existing non-standard lighting assets, some pole locations may need to be modified to ensure a better level of lighting. This will increase the number of poles/luminaires required in certain areas adding to both the capital costs and ongoing costs.

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4.1.4 Option 2: Convert to Standards Luminaires, Retain Poles

This option would see luminaires converted to a standard asset with the existing non-standard pole retained.

The capital costs for this option are considered low because pole replacement is excluded and standard luminaires are considerably cheaper than non-standard luminaires.

The process with AusNet is relatively straightforward because there is a known, standard DNSP process. However, most lights will require spigot adaptors and/or require bespoke solutions to accommodate a standard luminaire and some lights may not be able to be replaced at all. This adds some complexity to the process and is likely to contribute to an already poor aesthetic outcome.

Aesthetically, this option is considered is very low due to the makeshift look of the final conversion.

The lighting quality outcome is rated as high because standard luminaires are able to achieve a maximum spacing that is 15-20m further than non-standard luminaires at the same mounting height. This means that a large portion of existing light-level non-compliances (which have been identified as an issue) could be addressed simply by converting to standard luminaries.

Figure 7: Example of a standard luminaire installed on a non-standard pole

From an ongoing cost perspective, this option would still present Council with ongoing costs relating to pole maintenance and replacement. Luminaire costs, however would be significantly reduced.

4.2 Retain Existing Aesthetic

A number of options exist if Council elects to retain the existing aesthetic when upgrading its non-standard street lighting assets. These are detailed below.

4.2.1 Option 3: Replace Luminaires with Energy Efficient Aesthetic Equivalents

This option involves the replacement of existing non-standards luminaires with aesthetically equivalent energy efficient luminaires. Existing poles would be retained.

This option is straightforward from a process point of view because there is a known, standard AusNet process. While the cost per light is not the cheapest option, it is cheaper compared with those that involve the replacement of poles. The aesthetic outcome is high for this scenario because the like-for-like replacement will result in an indiscernible difference in the appearance of the luminaire.

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There are, however, limitations to the number of luminaires that can be replaced under this scenario because there are currently no energy efficient post-top non-standard luminaires approved by AusNet. As such, some luminaires would have to be retained and eventually upgraded to standards assets if no aesthetically equivalent luminaires are approved in the near future.

From an ongoing cost perspective, this is considered very high. Whilst it will see energy costs reduced, the ongoing cost issues related to non-standard assets will remain.

4.2.2 Option 4: Retrofit with LED Lamp

This option involves retrofitting the existing mercury vapour lamp found inside each non-standard luminaire with an LED lamp. The existing luminaire and pole would be retained, making this a relatively cheap option.

Although LED retrofit lamps exist in the market, they are not yet approved by AusNet. Considerable complexity may exist in getting LED retrofit lamps approved by AusNet due to the testing that is required as well as the level of satisfaction that is required from AusNet that the LED lamps will not increase their maintenance obligations. This would require investment from a lamp supplier with no guarantee of success. As such it is unclear whether a lamp supplier would be willing to commit to the approval process.

Figure 8: Example of an LED retrofit lamp

Further to this, the way in which LED retrofit lamps operate within each luminaire from the perspective of light-distribution and thus compliance with Australian Standards is uncertain. This will necessitate the requirement of photometric testing and subsequent detailed lighting design to ensure lighting levels are not being compromised via a retrofit program. This will impose even more costs to the process, much of which would likely be borne by Council via the facilitation of a trial.

Another consideration for this option is the remaining useable life of the luminaire that the lamp is being retrofitted into. Typically, street lights are thought of as having a life expectancy of 20 years. Therefore, retrofitting luminaires that only have a few functional years left will diminish the cost effectiveness of a lamp retrofit project. This is due to the simple fact the entire streetlight body will need to be replaced in a few years, thus wasting the majority of the retrofit's functional lifespan. Therefore, the age of the existing luminaire will need to be considered if preparing for a project of this nature. Considering that the expected lifespan of a decorative street lighting fixture is 20 years and the payback of an LED lamp retrofit is close to 5 years, only non-standard luminaires 15 years or younger should be considered for this option. A full luminaire replacement should be considered for all decorative lighting older than 15 years.

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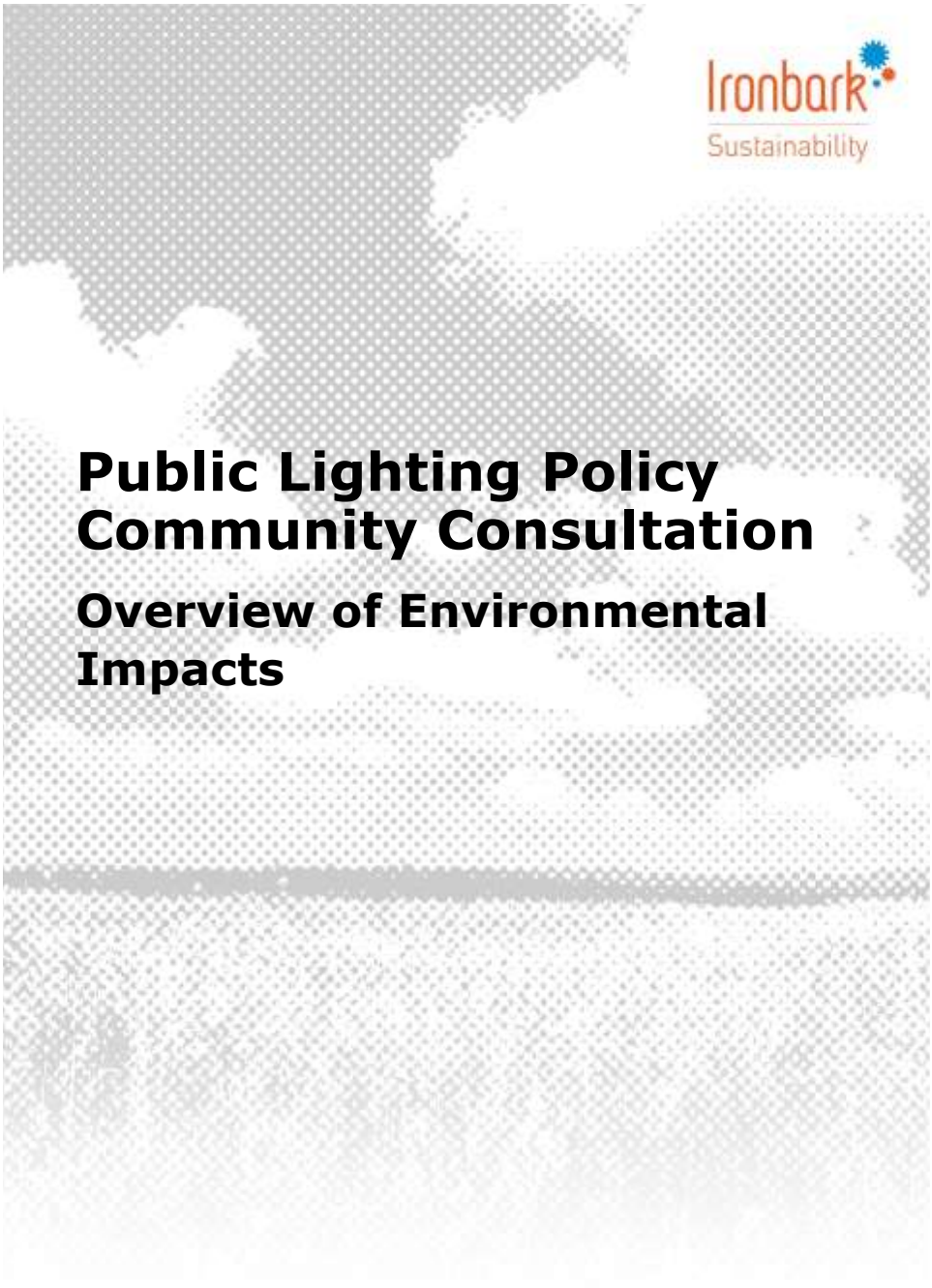
5. Recommended DRAFT Policy Changes

There are a number of uncertainties that make it difficult to definitively determine the best option for Council to proceed. It is recommended that a final policy positon is not developed until the following actions are carried out:

- Advocate to AusNet and relevant lighting suppliers for the approval of a non-standard post-top LED luminaire
- Advocate to AusNet relevant lighting suppliers for the approval of an LED retrofit lamp and better understand the cost implications to Council
- Should an LED retrofit lamp be approved, carry out sufficient due diligence (potentially via a Council-led trial) to ensure lighting levels are not compromised.
- Source more accurate cost data from AusNet for large-scale pole upgrade programs to better understand the cost implications of options 1, 1a and 1b.
- Carry out a detailed cost-benefit analysis of each option. This analysis should take into account the information obtained via the above listed actions as well as asset age data obtained from AusNet Services.

23. Appendix 6 – Community Consultation: Environmental Impacts

A summary of the community's feedback relating to the impact of artificial light at night on the community and the environment can be found below:



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V1a	Keith Harwood	25/2/2019	First Draft
V1b	Keith Harwood	26/3/2019	Final Version

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1. Introduction

In 2018, Maroondah City Council developed a Draft Public Lighting Policy. The Policy aims to provide guidance on the design, installation and management of public lighting within the municipality. It is Council's intention for the Policy to promote a consistent approach to public lighting in Maroondah that reflects best practice and contributes to the sustainability and amenity of the municipality.

In late 2018 and early 2019 Council sought feedback from the community about the content and direction of the Policy. One of the most common themes of the feedback related to a requirement within Council's Draft Public Lighting Guidelines that specifies that light sources on metered and un-metered lighting schemes must have a correlated colour temperature (CCT) at or around 4000K. The main reason for this feedback relates to concern that a colour temperature value of 4000K will have negative impacts on the health of humans.

More broadly, the community, including members of the International Dark Sky Association have implored Council to place more emphasis on mitigating the impact of artificial light at night on the natural environment as well as human health.

In response to this, Council has commissioned the development of this document, which seeks to examine possible alternatives or solutions, and identify any potential changes that could be made to the Draft Public Lighting Guidelines.

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2. Council's Existing Policy Position

2.1 Overview

Council's existing requirement - that that light sources on new metered and un-metered lighting schemes must have a correlated colour temperature (CCT) at or around 4000K- is based on a number of factors. These include:

- Council's distribution network service provider (DNSP), AusNet Services, has not made available a lamp technology that deviates from a correlated colour temperature (CCT) at or around 4000K for P-Category street lights.
- Council's distribution network service provider (DNSP), AusNet Services, has not made available an energy efficient lamp technology that deviates from a correlated colour temperature (CCT) at or around 4000K for V-Category street lights
- The relevant Australian Standards for luminaires (SA/SNZ TS 1158.6) states a "recommended" colour temperature of 4000K for street lighting.
- That previous research has suggested that light sources with a warmer CCT of <3000K result in an increase in vehicle stopping distances when compared to a neutral CCT of 4000K
- That 4000K is a more desirable colour temperature for facial recognition in CCTV camera footage.

Council acknowledges the importance of limiting the effect of all artificial light at night, regardless of CCT, and seeks to manage this within its Policy and Guidelines via:

- Lighting to the levels required (not higher).
- Reducing light spill through well-designed luminaires and lighting schemes.
- Only allowing luminaires with upward waste light ratios (UWLR) of less than 1%
- The use of glare shields where appropriate.
- The use of timers to switch lighting schemes off when not needed or not appropriate.
- The use of smart lighting technology that will allow lighting schemes to be dimmed when patronage drops.

Council has also provided scope/flexibility within its Public Lighting Guidelines to deal with unique scenarios that may require special treatment either via modified CCT or general lighting controls. This is evident via the following clauses:

- "In some cases, lighting (or some types of lighting) can be harmful to biodiversity (in particular insects and nocturnal animals). Lighting in these areas should incorporate controls and/or techniques to minimise this impact."
- "A CCT of less than 4000K (neutral white) may be considered appropriate for certain precincts (e.g. areas where outdoor dining occurs), however the issues raised in other sections of the Guidelines should be considered, the choice of CCT should be consistent with Council's CCTV Policy, and the CCT used should be consistent throughout a given space."

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3. Policy and Guidelines Improvements

3.1 Correlated Colour Temperature

Based on the existing feedback, Council will consider the following adjustments to its Draft Guidelines and Policy documents in relation to CCT.

- The provision of an acceptable range of 3000K to 4250K CCT for all new metered public lighting whilst maintaining the requirement for a minimum CRI of 80;
- The acknowledgment that it will advocate for the approval of a broader range of correlated colour temperatures by DNSP, AusNet;
- Providing further clarity on the situations where lower colour temperatures might be preferred in Council owned metered lighting schemes. E.g. all parks and gardens, all areas directly adjacent to nature reserves; and
- Providing further clarification about how consistency of colour temperature is implemented within the framework of a broader range of acceptable colour temperatures. E.g. ensuring that distinct areas are lit with a single colour temperature.

3.2 Where to Light

Council's current position states firmly that it will only install new lighting where it is required. With this basic first hurdle to pass when considering a new lighting scheme, Council has provided clear guidance on where it considers lighting as necessary and where it considers lighting as inappropriate. As such, no further additions to the Draft Guidelines and Policy documents are considered necessary.

3.3 Light Spill

Council has addressed the control of light spill via a number of clauses within its Draft Guidelines document.

- Reducing light spill through well-designed luminaires and lighting schemes.
- Only allowing luminaires with upward waste light ratios (UWLR) of less than 1%
- The use of glare shields where appropriate.

Council will consider expanding on the existing level of detail by including:

- Example diagrams of lighting optics that act to reduce light spill along narrow paths and at bends.
- Example diagrams of luminaire "types" to provide clearer guidance to users of the document around luminaire selection

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- Example scenarios where glare shields and/or nuanced optics may be suitable

Council will also consider playing an advocacy role for the approval of a greater range of approved light spill controls for unmetered street lighting. This applies in particular to V-Category street lighting where no light spill controls except for full cut-off luminaires are approved.

3.4 Light Control (dimming and timers)

Council has afforded considerable scope for the use of dimming and timers to ensure Council-owned metered lighting schemes do not over-light a space during times of lower patronage and that lights can be turned off when the usage of a space is minimal and/or undesired. As such no further additions to the Draft Guidelines and Policy documents are considered necessary.

For unmetered street lights, however, there is no existing framework to allow dimming or switching. Council will consider advocating for the approval of smart lighting technology by AusNet, as well as opportunities to act an industry leader by participating in trials of smart lighting technologies. Learnings from trials as well as any eventual long term use of smart lighting may result in a revolutionary reframe of how streets and roads are illuminated over the course of an evening.