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LIGHTING

# Report on Wairarapa Combined District Plan Lighting Provisions for Wairarapa Dark Sky Reserve

**Prepared for:**
## South Wairarapa District Council

Project 23823
24 May 2020
Revision No. 2

Document Control

| Rev. | Issue | Date | Status/Revision | Prepared by | Reviewed |
|---|---|---|---|---|---|
| 0 | Draft | 12 March 2020 | For review | GW | BR |
| 1 | Updated | 01 May 2020 | For review | GW | GW |
| 2 | Updated | 24 May 2020 | Final | GW | GW |

**Approval**

Name Glen Wright - Principal

Signature 

Contents

# Introduction

## Context

South Wairarapa District Council (SWDC), along with Carterton and Masterton District Councils, is supporting an application by the Martinborough Dark Sky Society (MDSS) for the Wairarapa to be certified as an International Dark Sky Reserve by the International Dark Sky Association (IDA).

An international dark sky reserve is an area of public or private land possessing an exceptional or distinguished quality of starry nights and nocturnal environment that is specifically protected for any one or more of the following: cultural, natural, educational, scientific or public purposes.

There are 12 Dark Sky Reserves across the world. There is currently only one dark sky reserve in New Zealand located within the Aoraki Mackenzie Valley. If the Wairarapa was to become a dark sky reserve, it would be the world's largest. There are also two dark sky Sanctuaries within New Zealand, being Stewart Island and Great Barrier Island.

Light pollution is the biggest threat to gaining certification, as light pollution hinders the ability for people to view the night sky. To qualify as a dark sky reserve, light pollution within the region must be controlled.

The IDA has guidelines that a reserve is required to meet before it can gain certification. This includes restrictions on new lighting, requiring light shielding, limits on light levels, light spectrum and lighting times. There is therefore a need to control lighting within the district to a level that can satisfy the IDA guidelines.

To control light pollution within the district the Councils are looking to prepare a plan change to amend the lighting provisions contained within the Wairarapa Combined District Plan (WCDP). Amended provisions would ensure that new lighting complies with IDA guidelines which would control light pollution and its adverse effects on the visibility, brightness and clarity of the night sky.

This review does not consider whether the current WCDP lighting provisions provide adequate protection of residential amenity. We understand such a review will form part of an upcoming review of the WCDP.

Stephenson & Turner as appropriately qualified lighting engineers have carried out an assessment of the current WCDP lighting provisions and the IDA International Dark Sky Reserve requirements and provide recommendations for revisions to the WCDP lighting provisions.

## Scope of Review

The scope of our review:

1. A review of the WCDP to provide an assessment of the level of guidance and control provided for the protection of quality of views of night sky.
2. A review of the IDA requirements for an International Dark Sky Reserve.

3. A review of other documents that look to control light pollution to meet IDA requirements. (For example, the lighting provisions within the McKenzie District Plan and how they satisfy the IDA requirements for their Aoraki Mackenzie International Dark Sky Reserve).
4. Technical input as to the necessary standards and requirements within the WCDP to control lighting to meet IDA requirements for an International Dark Sky Reserve.
5. Technical input as to any specific activities (i.e. sports fields) that may require targeted district plan standards and requirements to meet IDA requirements for an International Dark Sky Reserve.
6. Technical input into developing WCDP Assessment Criteria for consideration by the Council when considering resource consent applications for lighting which does not meet the proposed new permitted activity standards and requirements.

# Dark Sky Lighting Effects and Lighting Management Provisions

## Effects of lighting on the Dark Sky - Skyglow

Skyglow or the brightening of the night sky is the primary effect that must be minimised to provide optimum night sky viewing. Brightening of the night sky has the effect of reducing the apparent brightness of stars and hence this reduces the quality of views of night sky. Skyglow comprises two separate components as follows;

a) Natural skyglow, that part of the skyglow that is attributable to radiation from celestial sources and luminescent processes in Earth's upper atmosphere.

b) Artificial skyglow, that part of skyglow that is attributable to man-made sources of radiation (e.g. outdoor lighting), including light radiation that is emitted above the horizontal and light radiation that is reflected from the surface of the earth.

The IDA provides requirements for the management of artificial skyglow from artificial lighting in order to be a dark sky reserve.

## IDA International Dark Sky Reserve Program Guidelines

With reference to the IDA's International Dark Sky Reserve Program Guidelines dated June 2018.

In order to be considered for Dark Sky Reserve Certification the area of land must be at least 700km² and consist of;

- A "core" area which meets minimum requirements for quality of sky and darkness.
- A "buffer" area which supports the core area's dark sky values and receives similar benefits.
- The "core" and the "buffer" collectively make up the dark sky reserve.

- The Aorangi Forest Park is the “core” of the dark sky reserve.
- The area outside of Aorangi Forest Park, all the way to the South Wairarapa, Carterton and Masterton district boundaries are the “buffer” of the dark sky reserve.

Additionally, the core must;

- Provide an opportunity for regular public nighttime access, with or without supervision.
- Must provide an exceptional dark sky resource, relative to the communities and towns that surround it.

A comprehensive Lighting Management Plan (LMP) is a minimum requirement for all dark sky reserves, the LMP must be adopted by at least 80% of population and 80% of designated area of protection (core and buffer). The regulations contained in the LMP must apply to all private and public landowners within the area of protection. Some exceptions may apply but are individually subject to IDA approval.

To meet this requirement within the Wairarapa District the Councils are looking to prepare a plan change to amend the lighting provisions contained within the Wairarapa Combined District Plan (WCDP). Amended provisions would ensure that the minimum lighting management provisions required by IDA are included in the WCDP

## IDA International Dark Sky Reserve Minimum Lighting Management Provisions

The minimum lighting management provisions that the IDA requires/recommends are based on Five Principles for Responsible Outdoor Lighting and are based on simple ideas; limit light at night to where and when it is needed, don’t overlight, and be sensitive to environmental concerns. These Five Principles are summarised in the following table.


The primary objective of the lighting management provisions recommended by IDA is to prevent the brightening of the night sky, which has the effect of reducing the apparent brightness of stars and quality of views of night sky.

The IDA expects them to guide the selection, placement, installation and operation of all new and replacement/retrofitted light in the Dark Sky Reserve. These lighting management provisions should be implemented as much as is practicable for both public and private installations.

The IDA preference is that the use of outdoor light at night should only be strictly, where it is needed, and in the appropriate amount for a specific task. The purpose of outdoor light that is allowed should be specifically to ensure public safety.

## IDA Lighting Management Provisions within the Core

The IDA has very restrictive lighting management provisions for the “core”. As the core is fully within the Aorangi Forest Park it is expected that these provisions would be regulated by the Department of Corrections through their inclusion in their Aorangi Forest Park Management Plan and therefore these provisions do not require inclusion in the WCDP.

Within the core the installation of outdoor lighting is permitted only in instances where the administrating authority determines that a public safety hazard exists that can only be mitigated through the use of outdoor light at night. Otherwise the default policy should be not to light.

## Shielding

All outdoor light fittings whose light source has an intensity of equal to or greater than 500 lumens shall be fully shielded. Light fittings who have an intensity of less than 500 lumens may be left unshielded for special purposes, such as historical preservation. The approved special uses must be stated in the LMP.

“Fully shielded” is defined such that that the light source is screened and, when mounted, its light directed in such a way that none is emitted at or above the horizontal plane passing through the lowest light-emitting portion of a light fitting. Light emitted just above horizontal (horizontal to 20° above horizontal) is a significantly higher contributor to skyglow than light emitted at higher angles.

Light fittings controlled by motion-activated switches which limit the duration of illumination to less than five (5) minutes after activation are exempt from this shielding provision

## Tilted Light fittings

All outdoor light fittings whose light source has an intensity of equal to or greater than 500 lumens shall be mounted and tilted such that no light is directed at or above the horizontal plane passing through the lowest light-emitting portion of the light fitting. . Light emitted just above horizontal (horizontal to 20° above horizontal) is a significantly higher contributor to skyglow than light emitted at higher angles.

Light fittings controlled by motion-activated switches which limit the duration of illumination to less than five (5) minutes after activation are exempt from this shielding provision

## Light Colour Temperature

Light is part of the electromagnetic spectrum. The human eye perceives visible light in the region of 280 nanometers (nm) to 780nm of the electromagnetic spectrum.  Visible blue light extends from 424nm to 500nm.

Blue spectrum light is more strongly scattered by the night sky, increasing the levels of sky glow at night. Therefore, if the amount of blue light emitted by a light fitting is reduced its effect on skyglow is significantly reduced.

As a rough indicative measure, the lighting industry uses correlated colour temperature (CCT), measured in Kelvin (K) to describe the perceived colour of the light produced by a light source. A lower CCT generally, corresponds to a relatively lower proportion of blue light. For example a 3000K light source generally has 25% less blue light than a 4000K light source.

Outdoor light fittings shall be chosen to minimise the amount of blue light emitted into the nighttime environment.

In no case shall the outdoor light fittings have a light colour temperature exceeding 3000K.

Within the “core”, the light colour temperature is limited to 2700K maximum, with amber to warm-white preferred.

## Illuminated Signs

Internally illuminated signs are prohibited in the “core”.

In all other areas internally-illuminated signs, and signs illuminated by electronic means such as LEDs and similar lighting, shall be installed and operated according to the following requirements:

1. Use of such signs from one hour after local sunset to one hour before local sunrise is prohibited. Such signs will be equipped such that they are extinguished automatically at these times.
2. Displays must be single-color on a black background in design.
3. Luminance of such signs after sunset may not exceed 100 candelas per square metre.

## Lighting Levels

Lighting within the “core” will be designed in consideration of the very low levels of ambient lighting. This means that less lighting is required than in a similar situation in a bright urban setting with high levels of ambient lighting.

While the relevant New Zealand Standards should be adhered to in designing any lighting scheme for the safety of users, special consideration and lighting techniques should be utilised to protect the night sky.

Within the “core” the following table gives the maximum lighting levels that will be used unless a demonstrated need for higher lighting levels exists.

| **Application** | **Lighting level (lux)** |
|---|---|
| Building entry | 0.3 lux |
| Trailheads | 0.5 lux |
| Parking lot | 10 lux (amber) / 1 lux (2700K) |
| Restroom entry | 0.5 lux |
| Entrance station | 10 lux (amber) / 1 lux (2700K) |
| Roadway | 0 lux |
| Signage | 0.5 lux |
| Flag | 0 lux |

Target levels not to be exceeded by more than 25%

For the “buffer zones” minimum lighting levels (lux) required for the nighttime activity should be used, with avoidance of unnecessary over-lighting.

## Curfew

In the “core” dusk-to-dawn lighting is not generally allowed. All outdoor lighting shall be extinguished between the hours of 10pm and one hour before sunrise, except in cases where visitor or staff presence or traffic dictates otherwise.

## Adaptive Controls

To the greatest practical extent possible, all lighting should make appropriate use of adaptive controls to limit the duration, intensity, and/or extent of outdoor lighting. A total ON/OFF solution is preferred, but in specific cases light could remain ON at 10% of their nominal output.

The motion-activated switches shall limit the duration of illumination to less than five (5) minutes after activation.

## Temporary Lighting

Allowable installations of outdoor lighting in the “core” for temporary purposes, shall be limited to the minimum number of nights required to complete the task that the lighting illuminates. Staff responsible for such installations will follow these guidelines to the greatest practical extent, and will endeavour to limit as much as possible off-site impacts of such lighting.

## Light Painting

Within the “core” inappropriate, high-intensity light painting of landscapes, the use of floodlights or searchlights (other than for search and rescue), and similar uses of outdoor lighting is prohibited.

## Sports Field Lighting

There is no existing sports field lighting within the “core”, the use of sports lighting within the “core” should be prohibited.

With reference to IDA – Criteria for Community-Friendly Outdoor Sports Lighting v1.0, the following is a summary of the IDA requirements for outdoor sports lighting within a Dark Sky Reserve.

1. Target illuminance for on field illuminance are to be appropriate for the application per IESNA RP-6-15 Sports and Recreation Area Lighting and only Class III and IV are permitted

| FACILITY | CLASS | | | |
|---|---|---|---|---|
| | I | II | III | IV |
| Professional | X | | | |
| College | X | X | | |
| Semi-Professional | X | X | | |
| Sports Clubs | X | X | X | |
| Amateaur Leagues | | X | X | X |
| High School | | X | X | X |
| Training Facilities | | | X | X |
| Elementary School | | | | X |
| Receational Event | | | | X |
| Social Event | | | | X |

Class I: Facilities with spectator capacity over 5,000
Class II: Facilities with spectator capacity under 5,000
Class III: Facilities with some provision for spectators
Class IV: Facilities with limited or no provision for spectators

In New Zealand it is standard practice when designing outdoor sports lighting to refer to the Australian Standard AS 2560 Guide to Sports Lighting series of standards which are equivalent to IESNA RP-6-15, within AS 2560 “Level 2” typically referred to as “Training Standard Lighting” and “Level 3” typically referred to as “Competition Standard Lighting” are the predominant required illumination levels. To limit over-lighting, the design may vary by no more than 10% above the average target illuminance level.

2. All light fittings must be designed such as to not emit direct light above the horizon, unless required for the activity (i.e. aerial sports) being played. In those cases, only 8% of the total (directly) applied lumens as modelled may be in this zone.
3. Spill light not to exceed the permitted activity standard at the boundary.
4. Glare, luminous intensity from any light fitting for any viewing angles at 1.5m height, at a distance of 45m beyond the field shall not exceed 1000 candela.
5. Provide lighting controls for the following;
    a. Automatic shut-off at locally established curfew time, not to be later than 11pm.
    b. On site manual and/or remote control system shall also be provided to allow for the lights to be turned on or off at will (before curfew) to ensure only active sports fields are lighted.
    c. Provide readily accessible controls to implement uniform and variable adaptive illumination levels for different task lighting needs on field. For example Level 2 and Level 3 standards of lighting.
    d. A formal policy defining the appropriate level of illumination necessary for the specific activities and curfew times must be established and enforced.
6. The light fitting Colour Temperature (CCT) may not exceed 5700K. Lighting technologies have developed such that it is now possible to illuminate sports fields with 4000K light fittings, which is an improvement over 5700K, with 3000K preferred.

7. The installed field lighting is not to be used for illuminating other area tasks. For example, if parking area lighting is desired. They shall be illuminated by separate light fittings and systems not associated with the sports field illumination needs.

# Existing WCDP lighting provisions

We carried out an analysis of the effectiveness and appropriateness of current WCDP lighting provisions in the protection of quality of views of night sky.

## Wairarapa Combined District Plan (WCDP)

The Wairarapa Combined District Plan (WCDP) applies across the three District Councils of the Wairarapa, namely Masterton, Carterton and South Wairarapa.

Lighting within each district is currently controlled by the provisions within the WCDP. The plan manages lighting through provisions within the 'general rules' of the plan. These provisions apply to all outdoor lighting, regardless of activity / location across the districts.

The provisions relevant to the control of lighting within the districts and our associated review comments are outlined in the table on the following page.

From this review it is our opinion that the current WCDP lighting provisions are inadequate to provide the protection of quality of views of night sky required by IDA for a dark sky reserve.

## Review of WCDP lighting provisions

| Chapter | Provision | Detail | Review Comments |
|---|---|---|---|
| Chapter 5 – Residential Zone | 5.3.3 Explanation | 5th paragraph, 3rd sentence - *The effects of vehicle access, movement and manoeuvrability, noise emissions, artificial light levels and signage may also need to be controlled to address potential effects on safety and amenity.* | Includes requirement for artificial light levels to be controlled to address potential effects on safety and amenity.<br>No specific requirement to protect effects on quality views of the night sky. |
| Chapter 6 – Commercial Zone | 6.5.4 Standards for Controlled Activities (a) Carterton Character Area | *(10) Under verandah lighting must be provided and shall be sympathetic in scale and design to traditional or heritage qualities.*<br>*(12) No sign shall be illuminated by any means other than directional lighting.* | No specific requirement to protect effects on quality views of the night sky. |
| Chapter 19: General Amenity Values | 19.3.2 GAV1 Policies | *(e) Manage the intensity, location and direction of artificial lighting to avoid light spill and glare onto adjoining sites and roads, and to protect the clarity and brightness of the night sky. Implemented through Method 19.3.4(a), 19.3.4(b) 19.3.4(c) and 19.3.4(g).* | We recommend this policy is revised to include a policy reference to the Dark Sky Reserve and implementation method extended to entirety of new lighting provisions 19.3.4:<br>*(e) Manage the intensity, location and direction of artificial lighting to avoid light spill and glare onto adjoining sites and roads.*<br>*(f) Within the Dark Sky Lighting Management Area, manage the light colour temperature, shielding and hours of operation of outdoor artificial lighting to mitigate skyglow to protect the clarity and brightness of the night sky.*<br>*Implemented through Method 19.3.4.* |
| | 19.3.3 Explanation | 4th paragraph – *Residential amenity is particularly sensitive to noise, artificial light and other site-specific adverse effects. These effects can seriously impact upon the health* | No specific requirement to protect effects on quality views of the night sky. |

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| | | *and create considerable animosity between neighbours. The policies and methods have been established to protect residents from such adverse effects.*<br>7th paragraph – *Artificial lighting, particularly in residential areas, can adversely affect the ability to sleep. The two main causes are the general loss of night sky from the cumulative effects of urban lighting, and the nuisance caused by single sources that emit high levels of glare. Again such effects can be mitigated through compliance with standards on light emission levels across property boundaries.* | 7th paragraph – This sentence is a bit mixed up, we recommend the wording is revised.<br>*Artificial lighting standards, are directed at two main adverse effects: first, residential amenity and the ability to sleep and second, the general loss of night sky from the cumulative effects of outdoor lighting. Again such effects can be mitigated through compliance with standards on light emission levels across property boundaries.* |
| | 19.3.4 Methods | *(a) Performance standards for permitted activities to maintain general amenity values throughout the Wairarapa.*<br>*(b) Assessment of environmental effects through the resource consent process for activities that do not comply with performance standards.*<br>*(c) Conditions on resource consent to control adverse effects of activities.*<br>*(g) Liaison with Road Controlling Authorities to promote the use of shields and other devices on streetlights to direct light downwards.* | (a), add protection of the night sky:<br>*(a) Performance standards for permitted activities to maintain general amenity values and quality of views of night sky throughout the Wairarapa.*<br>(b), note that a resource consent is required for any departure from lighting performance standards.<br>(c), is appropriate.<br>(g), inclusion of this clause implies that the lighting standards apply to streetlights. Therefore, the impact of lighting provisions on road lighting needs to be considered. |
| Chapter 21- General Rules | 21.1.11 Glare and Artificial Light - Permitted Activity | *(a) The emission of light (including glare) meets the following standard:*<br>*(i) A maximum artificial light level of 8 lux (lumens per square metre)* | No specific rules to protect effects on quality views of the night sky.<br>Provisions required to minimise skyglow to protect the brightness and clarity of the night sky. |

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| | | *measured at 1.5m above ground level at the site boundary.* | |
| Chapter 22 – Assessment Criteria | 22.1.17 Artificial Light | *(i) The extent to which the light will adversely affect adjoining allotments.*<br>*(ii) The impact of light direction on the safe and efficient operation of the road network.*<br>*(iii) The extent to which the light(s) are necessary for reasons of security, public amenity, or safety.*<br>*(iv) The hours during which the lighting will operate.*<br>*(v) Proposed methods to avoid, remedy or mitigate potential adverse effects including the height, orientation, angle, and shielding of the light source.* | There are no assessment criteria for considering the effects of artificial light on the quality of views of night sky. Therefore, we recommend the addition of the following criteria:<br>*(vi) The extent to which the light will adversely affect skyglow and the quality of views of night sky.* |

# Reference Documents

In carrying out this review and providing lighting provision recommendations we have referred to lighting standards, Operative District Plans, lighting management plans and IDA annual reports for other Dark Sky Reserves and Sanctuaries. The following provides an outline of standards or provisions that are relevant to meeting the IDA minimum requirements for Lighting Management Provisions for an International Dark Sky Reserve.

## Australian / New Zealand Standard AS/NZS 4282:2019 Control of the obtrusive effects of outdoor lighting

There is a combined Australian/New Zealand standard AS/NZS 4282:2019 released in 2019 and therefore can be considered to very relevant to today's regulatory requirements and lighting technologies which include LED lighting.

The "Preface" to this standard states that *the objective of this standard is to provide a common basis for assessment of the likely effects of developments that involve the provision of outdoor lighting.*

The "Foreword" to this standard states that *The requirements and recommendations of this Standard are based on surveys of interested parties i.e. local government, electricity utilities and the lighting industry; on studies of people's reaction to obtrusive light; on the extent of spill light from lighting installations; and on precedents for the control of regulatory control of obtrusive light.*

*Several aspects of potential obtrusiveness are considered, viz, light falling on surrounding properties, the brightness of luminaires in the field of view of nearby residents, glare to users of adjacent transport systems, the effects on astronomical observations and the impact on protecting dark environments..*

Relevant guidance from this standard includes;

a) Because skyglow is caused both by reflected and direct light from the installations, restricting design illuminances to the minimum necessary for the application will provide additional mitigation.

b) High correlated colour temperature light sources should be avoided as light at the blue end of the spectrum increases light scatter.

c) The standard provides recommended limits for skyglow based on the calculation of Upward Light Ratio lighting technical parameters that can be applied to control obtrusive effects of skyglow.

## Mackenzie District Plan

There is currently only one dark sky reserve in New Zealand located within the Mackenzie Valley, Aoraki. This reserve is located within the boundaries of the Mackenzie District and to achieve its IDA Dark Sky Reserve Certification the lighting provisions within the Mackenzie District Plan (MDP) were updated with the current operable MDP being March 2015.

Relevant guidance from the MDP is accessed in the following table;

| MDP Section | MDP Part | MDP Content | Comment and recommendations |
|---|---|---|---|
| Section 12 – Signs, outdoor lighting and aerial distractions | Relevant Objectives and Policies | 1. The need for controls on signs and outdoor lighting in the District is important to ensure that the potential effects of these do not adversely affect the amenity of the District. | We agree the need for controls on signs and outdoor lighting. |
| | | 2. The type, nature and location of lighting can adversely affect people's ability to view the night sky. This issue is of great significance due to the existence of the University of Canterbury Mt John Observatory. | We agree with this statement and recommend that reference is made to the significance due to the existence of the International Dark Sky Reserve Certification. |
| | | 3. Avoidance of unnecessary light pollution in the Mackenzie Basin. | We agree, an objective of the WCDP plan change is avoidance of unnecessary light pollution in the Combined Wairarapa District. |
| | | 4. Preservation of the ability to view the night sky. | We agree, an objective of the WCDP plan change is preservation of the ability to view the night sky. |
| | 13 Outdoor Lighting | Provides outdoor lighting rules, relevant comment includes;<br><br>5. Rule 13.a provides Permitted Activity Standards applicable to the area shown on the Outdoor Lighting Restriction map (an area around the Mt John Observatory, covers approximately 50% of the Mackenzie District). | These Permitted Activity Standards only apply to a "Outdoor lighting restriction" area which covers approximately 50% of the Mackenzie District. In the WCDP plan change it is proposed to include the districts of to South Wairarapa and Carterton in a 'Dark Sky Management Area', to reflect the area of the proposed Wairarapa Dark Sky Reserve. |
| | | 6. Rule 13.a.i, *Shielding: All outdoor lighting shall be shielded from above in such a manner that the edge of the shield shall be below the whole of the light source.* | We agree, similar rule should be included in the WCDP. |

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| | | 7. Rule 13.a.ii, *Filtration: All outdoor lights shall have a filter to filter out the blue or ultraviolet light, provided the light source would have more than 15% of the total emergent energy flux in the spectral region below 440nm. The filters used must transmit less than 10% of the light at any wavelength less than 440nm. This therefore includes, but is not limited to, fluorescent, mercury vapour and metal halide lamps.* | We believe this provision is too technical for most and with new lighting predominantly LED the use of light colour temperature limit of 3000K and below is far simpler as the light colour temperature is printed on the box of LED products. Recommend light colour temperature lighting provision is included in WCDP. |
| | | 8. Rule 13.a.iii, *No person shall illuminate or display the following outdoor lighting between 11.00pm and sunrise in the designated area:*<br>a. *Searchlights.*<br>b. *Illumination of public recreation facility.*<br>c. *Outside illumination for aesthetic purposes of any building by floodlight.*<br>d. *Any outdoor illumination in which light is produced by high-pressure sodium, metal halide, mercury vapour lighting or fluorescent lighting, unless these lamps were installed prior to 1 January 1979 in the Business or Residential Zones in Lake Tekapo or 1 March 1986 in all other zones.* | The objective of this rule is to ensure unnecessary lighting and lighting that uses light sources that have higher skyglow impact are not used between 11.00pm and sunrise. We agree with curfews on unnecessary lighting and recommend curfews on unnecessary lighting are included in the WCDP.<br>The use of “sunrise” in the curfew definition will require automatic controls via astronomical time clocks which are available at a higher cost than traditional time clocks. Use of “6.00am” in lieu of “sunrise” will allow simple time clock control to be used. Rule 13.a.iii.d, is a retrospective rule requiring existing installations to be altered to comply, we do not recommend the inclusion of any lighting provisions in the WCDP that have retrospective impact on existing installations. |
| | | 9. Rule 13.b, applies to all other lighting in the Mackenzie District and states *all outdoor lighting shall be a permitted activity provided all fixed exterior lighting is directed away from adjacent properties and roads.* | It is our opinion that this rule provides little actual protection of the dark sky. |
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| | Section 18 Outdoor Lighting | Provides outdoor lighting assessment matters to be considered when reviewing Resource Consent applications, relevant comment includes;<br><br>Rule 18.a, *The type and use of outdoor lighting proposed*. | We agree, similar criteria should be included in the WCDP Assessment Criteria for Discretionary Activities. |
| | | Rule 18.b, *Type of illumination*, focused on consideration of emissions at short wavelengths (consideration of blue light content). | We agree, similar criteria should be included in the WCDP Assessment Criteria for Discretionary Activities. |
| | | Rule 18.c, *The total power of lamps*. | We believe this would be better defined as light fitting total lumen outputs and maximum luminous intensities. Similar criteria should be included in the WCDP Assessment Criteria for Discretionary Activities. |
| | | Rule 18.d, *Proposed location with respect to distance from the observatory*. | For WCDP the distance to the Aorangi Forest Park which is the “core” of the Dark Sky Reserve is important. Similar criteria should be included in the WCDP Assessment Criteria for Discretionary Activities. |
| | | Rule 18.e, *Duration, time and frequency of proposed lighting.* | We agree, similar criteria should be included in the WCDP Assessment Criteria for Discretionary Activities. |
| | | Rule 18.f, *Whether it is proposed to shield lights to prevent light shining directly above the horizontal*. | We agree, similar criteria should be included in the WCDP Assessment Criteria for Discretionary Activities. |
| | | Rule 18.g, *Whether is proposed to filter out blue and ultraviolet light*. | We agree, similar criteria should be included in the WCDP Assessment Criteria for Discretionary Activities. |
| | | Rule 18.h, *The effect of the proposal on research activity carried out at Mt John Observatory*. | For WCDP WCD Assessment Criteria for Discretionary Activities consideration on the effect on the dark sky should be considered. |

In summary the MDP includes many lighting provisions that we recommend are included in the WCDP plan change.

## IDA Aoraki Mackenzie International Dark Sky Reserve Annual Report

An IDA requirement for IDA International Dark Sky Reserve certification, is for the reserves management to provide an annual report to the IDA, this report can be considered to be a "report card" for the reserve, it provides commentary on their dark sky activities, achievements, quality of night sky views achieved and how regulatory controls are working. The following are some relevant guidance;

1. They propose to launch a scheme to certify commercial enterprises inside the reserve which can demonstrate having dark sky friendly exterior lighting.
2. The most important development is the agreement between New Zealand Transport Agency (NZTA) and the Mackenzie District Council that the 85% NZTA subsidy for new LED streetlights can be used for low colour temperature (2200K) LED lights.
3. Aoraki Mackenzie International Dark Sky Reserve Website: www.darkskyreserve.org.nz/
4. No new territory was added to the reserve this year. Discussions are occurring to investigate an expansion to the Reserve to include the whole of the Mackenzie District.
5. Updating the Mackenzie District Plan and its lighting ordinance to cover LEDs is further delayed as the Plan undergoes legal and procedural challenges in other areas of the District Plan.
6. The MDC have recently employed a compliance officer to enforce rules including light spill, glare and colour.

# Recommendations for new lighting provisions

To ensure that the quality of views of night sky are not adversely affected by artificial lighting and to meet the IDA's regulatory requirements for lighting management provisions we recommend that the current lighting provisions within the WCDP are amended.

## Street lighting

Many lighting standards and Operative District Plans exclude the effects of street lights from their rules and standards.

This is generally because street lighting would not meet the lighting standard limits but is deemed as necessary for all-night safety and security for the public at large.

Further consideration is required on this matter, including discussions with Council roading experts and NZTA before proposing any lighting standards that may impact on the ability to provide appropriate street lighting.

# Lighting provisions

## Review of Lighting Management Provisions

In the following tables we have listed artificial lighting applications/installations that we expect to exist or be required within the South Wairarapa, Carterton and Masterton Districts and considered the IDA lighting management provision requirements.

In considering the IDA lighting management provisions we considered:

- How it would be enforced (WCDP, DOC, NZTA, voluntary)
- Can it be readily complied with and compliance verified?
- Impact on safety
- Impact on people's amenity, namely their ability to carry out activities outdoors after dark
- Effects on spill light and glare
- Impact on businesses (cost, property security, presence)
- Availability of suitable light fittings and any associated increased cost
- Will it result in a significant number of resource consent applications because the lighting provision cannot be readily meet?

## Review of IDA Lighting Management Provisions – Dark Sky Reserve Buffer

| Lighting Applications | Lighting Effect | IDA Lighting Control Provision Considered | Comment and recommendations |
|---|---|---|---|
| General Outdoor Lighting Standards | Colour Temperature (CCT) | All outdoor light fittings whose light output is equal to or greater than 500 lumens, its light colour temperature shall be 3000K and below, with 2200K (amber) preferred. | Compliant light fittings are readily available. IDA requirement. Include this provision in WCDP. |
| | Shielding | All outdoor light fittings whose light output is equal to or greater than 500 lumens, when installed shall not emit any light at or above the horizontal. | Compliant light fittings are readily available, but a number of commonly used light fitting types will not comply. IDA requirement. Include this provision in WCDP. |
| | Light level | Lighting levels should be the minimum levels required for the task. | A subjective provision, difficult to control. IDA requirement. Provision in WCDP assessment criteria for consideration for discretionary activity. |
| Illuminated signs and | Light level | Between sunset and sunrise (nighttime) sign luminance must not exceed 100 candela per square metre. | This maximum level of 100 cd/m² is low with AS/NZS 4282, Table 3.5 recommended a limit of 250 cd/m for a sign within a suburban area. IDA requirement. Include this provision in WCDP but allow up to 250 cd/m² assessment criteria for discretionary activity. |
| | Operation time | Shall not operate between 11pm and 6am, except, where the illuminated sign is used to signal that a business on the site is open for business, the operating time can be extended to match the business operating time. | It is our opinion that this will have little impact on advertising as there would be few people around during curfew. IDA requirement. Include this provision in WCDP. |
| Outdoor sports lighting | Colour temperature | Limit colour temperature of light emitted from light fittings to 5400K and below, with 3000K preferred. | Floodlights currently used for outdoor sports lighting typically have a colour temperature of 5400K to 5700K. The latest LED floodlights are available in 4000K. IDA requirement. Include this provision in WCDP but reduce from 5400K to 4000K. |

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| | Illuminance level | Outdoor sports lighting shall be designed to the illumination levels recommended in Australian Standard AS 2560 Guide to sports lighting, all parts.<br>Maximum permitted illumination level to be that recommended for “Level 3” competition standard.<br>The lighting designs initial levels shall not exceed the recommended average service level by more than 50%. | Note that initial lighting levels can be expected to be 10-30% higher than the design level as the design will allow for depreciation or light output reduction over the life of the installation. IDA requirement. Include this provision in WCDP. |
| | Glare | Luminous intensity from any light fitting for any viewing angles at 1.5m height, at 45m beyond the field shall not exceed 1000 candela. | From our sports lighting design experience, we believe this limit can be readily meet with the appropriate light fitting selection and lighting design. IDA requirement. Include this provision in WCDP. |
| | Operation time | Shall not operate between 10pm and 7am | We would not expect this provision to impact on the use of the lighting as this sporting activity should not occur outside these hours unless it is sufficiently away from dwellings from a noise disturbance perspective. IDA requirement. Include this provision in WCDP. |
| | Controls | Shall be provided with the following lighting controls;<br>a) Automatic curfew controls to ensure the lights are off between 10pm and 7am.<br>b) Local control to turn lights on and off.<br>c) If the lighting has a lighting level for competition, it shall also have a lower lighting level for training. | IDA requirement. Include this provision in WCDP. |

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| | Lighting no field areas | The installed field lighting is not to be used for illuminating other area tasks. For example, if parking area lighting is desired. They shall be illuminated by separate light fittings and systems not associated with the sports field illumination needs | IDA requirement. Include this provision in WCDP. |
| | Pole height | To mitigate the effects of sports field lighting it is important to use poles of an appropriate height so that floodlights do not require the floodlights to be tilted to an extent that they are projection light above the horizontal. | Include provision in WCDP that allows an 18m pole height for lighting of sports fields. |
| Street lighting | Light level | Design in accordance with AS/NZS 1158<br>Design in accordance with M30<br>Lighting levels recommended in the above, not to be exceeded by more than 25% | Provision meets IDA requirement for not over-lighting streets. We expect this provision can be met for new installations. Discuss with NZTA and Council Roading Sections if provision should be included in WCDP? |
| | Shielding | Light fitting when installed shall not emit any light above the horizontal | IDA requirement. Discuss with NZTA and Council Roading Sections if provision should be included in WCDP? |
| | Colour temperature | Limit colour temperature of light emitted from light fittings to 3000K and below | IDA requirement. Discuss with NZTA and Council Roading Sections if provision should be included in WCDP? |

## Review of IDA Lighting Management Provisions – Dark Sky Reserve Core

The IDA requires additional more restrictive lighting management provisions for the “core”. As the core is fully within the Aorangi Forest Park it is expected that these provisions would be regulated by the Department of Conservation through a memorandum of understanding within the Council and the Martinborough Dark Sky Society, these provisions do not require inclusion in the WCDP.

The following review only identifies lighting management provisions that are additional to those for the “buffer”.

| Lighting Applications | Lighting Effect | IDA Lighting Control Provision Considered | Comment and recommendations |
|---|---|---|---|
| Lighting within Dark Sky Reserve "Core" | Colour Temperature | Limit colour temperature of light emitted from light fittings to 2700K and below, with amber preferred.<br>3000K maximum for all portable lights | Similar to buffer provision but 2700K rather than 3000K. Include this provision in DOC LMP for Aorangi Forest Park |
| | Shielding | Light fittings when installed shall not emit any light at or above the horizontal. | Same as buffer provision. Include this provision in DOC LMP for Aorangi Forest Park |
| | Lighting Levels | Recommended target average lighting levels:<br>Building entry 0.5 lux<br>Trailheads 0.3 lux<br>Parking lot 10 lux (amber) / 1 lux (2700K)<br>Restroom entry 0.5 lux<br>Entrance station 10 lux (amber) / 1 lux (2700K)<br>Roadway 0 lux<br>Signage 0.5 lux<br>Flag 0 lux<br>Target levels not to be exceeded by more than 25% | More specific requirements than buffer provisions. Include this provision in DOC LMP for Aorangi Forest Park |
| | Adaptive controls | All outdoor light fittings whose light output is equal to or greater than 500 lumens shall have motion activated switches. Maximum activation time (5) minutes. | More specific requirements than buffer provisions. Include this provision in DOC LMP for Aorangi Forest Park |
| | Curfew | All outdoor lighting shall be extinguished between the hours of 10 PM and one hour before sunrise. | More stringent requirement than buffer provisions, it applies to all lighting and curfew is 1 hour earlier. Include this provision in DOC LMP for Aorangi Forest Park |
| | Temporary lighting | Temporary lighting permitted for the duration of the task and limited to the area of the task | Not included in buffer provisions. Include this provision in DOC LMP for Aorangi Forest Park |

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| | Visitor lighting | The use of visitor outdoor light fittings whose light output is equal to or greater than 500 lumens is prohibited.<br>The use of UV and blue lights (e.g. anti-mosquito lamp) is prohibited.<br>The strobing of torches is prohibited.<br>Vehicles lights are permitted only while driving. | Not included in buffer provisions. Include this provision in DOC LMP for Aorangi Forest Park |
| | Light Painting | The use of floodlights and searchlights (other than for search and rescue) is prohibited. | Not included in buffer provisions. Include this provision in DOC LMP for Aorangi Forest Park |
| | Illuminated sign | Internally illuminated and LED signs are prohibited. | More stringent requirement than buffer provisions. Include this provision in DOC LMP for Aorangi Forest Park |

# Assessment Criteria

## Scope

To provide guidance on the appropriate assessment criteria to be considered when the lighting proposed in a resource consent application does not meet the proposed amended lighting provision permitted activity standards, we recommend the addition of the following assessment criteria;

1. The type and use of outdoor lighting proposal.
2. Proposed location with respect to distance to the Aorangi Forest Park which is the “core” of the Dark Sky Reserve.
3. Duration, time and frequency of use of the proposed lighting.
4. Will the artificial lighting provide a positive/beneficial visual appearance or highlight? For example; highlighting a buildings heritage.
5. What are the light colour temperatures of the light emitted from all light fittings? 3000K and below have a reduced effect on the dark sky.
6. If the light colour temperature from light fittings exceeds 3000K, then;
    a. the light fitting must not emit more than 25% of its total spectral power at wavelengths greater than 550 nanometers, or
    b. is there justification of why a 3000K or lower light colour temperature cannot be used.
7. The lumen output (lumens) and maximum luminous intensity (candela) and its angle relative to the horizontal when installed.
8. The extent to which light will be directed upward into the sky both directly and in-directly through reflection off surfaces.
9. Are the illumination levels the minimum required/recommended for the task? Are the illumination levels significant?
10. To what extent will it contribute additional sky glow? Will it put the Dark Sky Reserve Certification at risk?
11. Is there any opportunity to offset any new increase in effects by reducing the effects of existing lighting.

# Impact of Proposed Lighting Management Provisions

## Impact on Safety

These lighting provisions are not expected to impact on public or road user safety, outdoor lighting is still permitted, it is the way this lighting is provided that changes. It is expected that

less lighting will be continuously operating at night with motion detection being more widely implemented. Through the elimination of light fitting glare and over lighting you can provide safer visual conditions.

Roads will still be lit but will use more appropriate luminaires and lighting levels. In the past there were some studies that concluded a level of better driver visibility under 4000K lights than 3000K lights, but a recent NZ study[1] but this is often outweighed by the better environmental conditions offered by 3000K lights. Globally 3000K is being adopted by the majority, with 4000K being retained for highways.

## Impact on People's Amenity

These lighting provisions are not expected to impact on a person's ability to carry out activities outdoors after dark, they will just need to have the appropriate light fittings and installation design.

## Impact on Sports

These lighting provisions introduce lighting design criteria that will require good lighting design and light fittings. The height of lighting poles may need to increase depending on the distances that lighting is required to be projected. Appropriate light fittings are not expected to be of any significant additional cost. Better lighting conditions for the users can be expected through better uniformity and confining the light to where it is needed.

The lighting controls required are common sense controls that should be provided for all outdoor sports lighting anyway.

## Impact on Businesses

These lighting provisions can mean that you can no longer simply light a yard or building perimeter by installing a couple of large bright floodlights to throw light in many directions and skyward. Lighting design and light fitting selection will require more consideration and possibly additional installation costs to do the job properly.

The 11pm – 6am curfew on illuminated signage will prevent the lighting of signs through the middle of the night, but with lower people movements at these times we expect that the reduction in marketing exposure would be very minor. Note that when a retail business is open during curfew lighting of its signs is permitted.

## Availability of Suitable Light Fittings

These lighting provisions put a restriction on the types of light fittings and the way they can be installed when the light fittings have a light output of 500 lumens or more. Light fittings of less than 500 lumens output and light fittings on motion detection controls (with a maximum activation time of 5 minutes) are exempt from these lighting fitting restrictions.

Light fittings with a 3000K light colour temperature are readily available in the lighting market and should not be at a premium cost over higher light colour temperature light fittings. It is a

[1] LED Streetlighting: Environment & Safety Impacts, Frith, Jackett & Chisnall

situation where the local light fitting suppliers will need to change what they stock to comply with the new provisions.

Similarly, for the requirement for light fittings that do not project light above the horizontal the local light fitting suppliers will need to change what they stock to comply with the new provisions. This restriction in light projection above the horizontal may result in installations that require an increase in the number of lights to light the same task area, but they may well be less powerful and have a lower total electricity consumption.

The definition of the requirements for light fittings has been kept to simplified to be readily understood, lighting suppliers could assist selections by ensuring that all stocked light fittings have there output (in lumens) and light colour temperature (in K) clearly shown. They could also identify appropriate light fittings as “Dark Sky Compliant”.

## Resource Consents

These lighting provisions should result in better considered outdoor lighting installations but they do result in an increased level of restriction on what can be done and therefore there may be a resulting increase in Resource Consent applications and compliance monitoring where these permitted activity standards cannot be meet.

## Positive Effects

In addition to the improvement in the quality of views of the night sky these lighting management provisions can be expected to also provide a reduction in spill light and glare from new outdoor lighting installations which will have a positive effect on residential amenity.