

## Coll Lighting Management Plan

This document was written at the request of Coll Dark Skies Group, who are seeking international recognition for the exceptional quality of their skies from the International Dark-sky Association (IDA). The lighting measures contained herein will apply to all future lighting installed on Coll. A full audit of current outdoor lighting on Coll (see Coll Lighting Audit, separate) has been assessed against this LMP, resulting in a compliance rate of 82%, so that presently Coll satisfies all IDA criteria, pending the formal adoption of this document by Coll Community Council and the local planning authority, Argyll and Bute Council.

### Section 1: Introduction

This Lighting Management Plan (LMP) has been devised, principally, to control different forms of stray light. First, and foremost, is upward light which can obscure night-time astronomical observations when it reflects off air-borne particles of water or dust. The effect is commonly known as sky glow.

In addition to sky glow, astronomers do not like to see direct visible sources of light either, and luminaires with a light source greater than 1000 lumens should be “fully shielded” i.e. a completely flat glass window mounted horizontally (Fig 1.1).



Figure 1.1 Fully shielded, or full cut-off, luminaire

Upward light and source intensity limitation are only two aspects of stray light control explained in two complementary technical publications on the limitation of obtrusive light, namely:

- ◆ The Institution of Lighting Professionals (ILP) (formerly ILE) ‘Guidelines for the Control of Obtrusive Light’
- and
- ◆ The Commission Internationale de l’Eclairage (CIE) Technical Report 150:2003 ‘Guide on the limitation of the effects of obtrusive light from outdoor lighting installations’.

In order to control stray light, this LMP contains seven policy statements that should be adhered to when installing new outside lighting. These statements are detailed throughout the LMP, but appear here for easy reference:

Table 1.1: Policy Statements

Policy Number	Policy Statement	Page in LMP
1	Luminaires using lamps greater than 1000 lumens should be installed as “Fully Shielded”.	5
2	Residents should limit the overspill light at their property boundary to no more than 0.1 lux.	5
3	All residential and business occupiers should switch off or reduce their exterior lighting quantity at 10pm.	6
4	All new lighting should be designed and installed to provide lower glare or intensity values than that recommended by the ILP for an E1 night time Environmental Zone.	6
5	All design submissions for new lighting should show compliance with the zero candela intensity at 90° and above, and domestic luminaires should be selected from units having some form of upward light control.	7
6	An Island Buffer Zone (the sea), with the exclusion of the inhabited islands, to be maintained as Environmental Zone E0 for a distance of 20 miles beyond the zone E1 areas.	8
7	Through this LMP it will be possible for Argyll and Bute Council to provide a basis for discussion with neighbouring communities on various options to help reduce upward light transmission.	10

## 1.1 Technical Preamble

It is not possible to produce a document on light control without introducing some light technical parameters and when used they will be defined as required with an appendix summary of technical definitions.

Detailed explanations of basic lighting terms can be found in Appendix A but in this document the three lighting terms most commonly used for expressing values of light are:

lumen	Describes the total amount of light given off by a bare lamp (abbreviation: lm (sometimes klm for 1000lm))
candela	Describes the intensity (I) of light in a particular direction (abbreviation: cd)
illuminance	Describes the amount of light falling on a surface (units: lux)
luminaire	The term given to the structure holding the lamp and optic reflector
lamp	The 'bulb' that gives off the light
full cut off	The lamp & reflector is well up in the fitting - the glass protection is completely flat and installed with the glass horizontal
shielded	The lantern is fully cut off but has additional shielding to ensure that the light is limited to only where the light is required and can not stray on to unwanted areas.
ILP	Institution of Lighting Professionals
IDA	International Dark-sky Association

In addition to direct upward light limitations Dr Christopher Baddiley has shown in 'Towards Understanding Skyglow' (ILE:2007) that obtrusive glare from street lighting units, at or near the luminaire horizontal axis, can also diminish the astronomers' observations so the source horizontal intensity is also used in this LMP as a further means of providing both public nuisance reduction and better astronomical observations.

Reference is therefore made to limiting intensity values emanating from lighting units. The traditional simplistic means of displaying intensity distribution information is by means of a polar diagram with angular intensity values. The polar diagram in Figure 1.2 is a traditional way of illustrating a line of maximum intensity through the major and minor axis of a street lighting luminaire. For clarity Figure 1.2 shows only the major axis distribution for a street lighting luminaire i.e. the intensity of light emitted out of each side of the luminaire together with three angles where intensity limitations will be later applied to control horizontal and upward light, and a further two downward angles which are used in BS 13201 to control disability glare but do not form any control limitations in this LMP.

**The values shown in Figure 1.2 are typical of the most strict light control values with the values at and above 90° equalling zero candelas. This condition is ideal in mitigating unwanted upward light.**

Another technical way of describing the limitation of upward light from luminaires is called the Upward Light Ratio, which is a measure, in percentage terms, of the zonal flux in two upward zones, namely between 90° and 100° and between 100° and 180°, however this method is not yet implemented in European or UK recommendations.

In addition to the IDA term of "fully shielded" other non-technical terms like high beam, semi cut-off, cut-off, full cut-off and aero-screened have been used in the UK to categorise a luminaire's light distribution. These luminaire category terms disappeared from the lighting industry usage in Europe and the UK some 30-40 years ago but sometimes still appear in UK planning publications. These old terms have therefore been combined, in this LMP, with more accurate technical descriptions with recommended limitations on intensity values in Section 2.

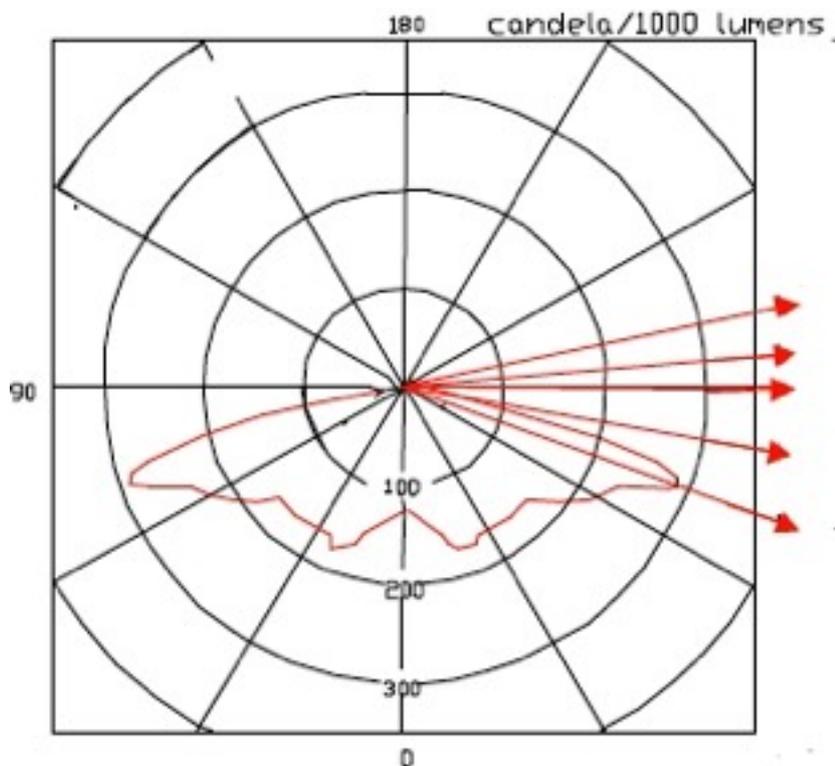


Figure 1.2 - Polar Diagram of typical street lighting luminaire Also shows the angles and maximum intensity values for a “fully shielded (cut-off)” luminaire

**$I_{max}$  above  $95^\circ = 0$  candela**

**$I_{max}$  above  $90^\circ = 0$  candela  
 $I_{max}$  at  $90^\circ = 0$  candela**

**$I_{max}$  at  $80^\circ = 100$  cd/klm**

**$I_{max}$  at  $70^\circ = 350$  cd/klm**

Tables in this document extracted from BS publications will show all 5 angles with restrictions relative to glare control but **in this LMP the important angles will be the intensity of zero at  $90^\circ$  and above.**

## 1.2 Task Illuminance

Over a period of time most working tasks, and sports activities, have been analysed and researched. Recommendations have been relative to the quantity and quality of light required to carry out the task in comfort and safety. It is important to:

- Provide the correct lighting levels for the task or sport game and grade playing level.
- Provide the lighting only when needed.
- Recognise that providing light in excess of the recommendations not only increases an unnecessary addition to sky glow but it also wastes energy and increases the carbon footprint.

Some recommended lighting levels relative to rural situations are included in this LMP for reference information and to assist in providing initial benchmarks for defining appropriate light levels.

The road network on Coll and BSEN13201-2:2003 - ‘Code of practice for the design of road lighting’ (parts 1 and 2) and the European CEN Standards are appropriate. For task lighting on other outdoor work places reference should be made to BSEN 12464-2:2007 – ‘Light and Lighting – Lighting of work places’ (Part 2: Outdoor work places) but a few of the typical island area tasks are contained in Section 4.

**It is important to note here that if there is no task in operation there should be no light and that the values given should be reduced if “white” light sources are used.**

## 1.3 Environmental Zones in the UK

Both documents cited above support the concept of setting out environmental zones based on the night time ambient light in the area. They then go on to recommend differing degrees of stray light control for each of 4 environmental zones. In previous years the most onerous limitations were in the zone of darkest ambience namely Zone 1 but the revised edition of the ILP guidelines (2011) includes an even more severe restriction in a new zone numbered “E0” where all lighting within the zone must be installed so that no light spills beyond the property boundary.

**Table 1.2: Environmental Zones in the UK**

Zone	Surrounding	Night Environment	Typical Examples
E0	Natural	Intrinsically dark and typically uninhabited	Dark sky reserve core zones, dark sky parks
E1	Natural	Dark and typically inhabited	National parks, AONBs, Dark sky reserve buffer zones
E2	Rural	Low district brightness	Village or relatively dark outer suburban areas
E3	Suburban	Medium district brightness	Suburban residential or small town centre areas
E4	Urban	High district brightness	Large town or city centre areas

#### 1.4 Coll Dark Sky Island Zones

Coll is predominantly natural landscape, with only one village of any size, Arinagour. Therefore Coll falls into Environmental Zone E1 as outlined in Table 1.2 and a full description of light limiting factors for this and other adjacent environments will follow in Sections 2 & 3.

The International Dark Sky Association (IDA) promotes the concept of creating three zones to the dark sky area with a central area of zero light sources known as the Core Zone. However in the case of an island the inner core (the island itself) will be the brightest light part, as most - if not all - of the surrounding sea will be unlit. This LMP refers to the island of Coll as the "Island Core Zone", the surrounding sea as the "Island Buffer Zone", which protects the island, and the adjacent inhabited islands and mainland as the "External Zone".

## Section 2: Light Limitation Policy - Photometric Method for Large Developments

### 2.1 Light Limitations within the Island Core Zone

Although there are many variations on a theme there are principally 3 different luminaire styles: Heritage (Figure 2.1), Bulkheads (Figure 2.2), and Floodlights (Figure 2.3).



Figure 2.1 Heritage Light



Figure 2.2 Bulkhead Light



Figure 2.3 Floodlight

Heritage and bulkhead style luminaires should be fitted with lamps less than 1000 lumens even although they may have an upper hood purportedly limiting some upward light. A luminaire such as shown in Figure 2.1 or 2.2 with an 18W compact fluorescent lamp (“energy saving light bulb”) can provide a vertical illuminance value of 0.1 lux at least 22 metres from the source.

#### **Policy Statement Number 1**

**Luminaires using lamps greater than 1000 lumens should be installed as “Fully Shielded”.**

The IDA recommend that the spill light at a property boundary is not greater than 0.1 lux, which is about 1/3 of the light from a full moon. Illuminance can be measured with a light meter but a rule of thumb guide which links the lamp lumen usage to property size is included in Section 3.

As well as providing careful control of spill light it is equally important to avoid overlighting an area.

Sections 2 & 3 of this LMP addresses maximum lux levels in the different Environmental Zones.

#### **Policy Statement Number 2**

**Residents should limit the overspill light at their property boundary to no more than 0.1 lux.**

Most domestic heritage or bulkhead style luminaires are designed and labelled with a maximum tungsten filament lamp wattage of 60 watts (11watts compact fluorescent), both producing less than 1000 lumens, and although they have very little light control can generally be classified as IDA compliant for the moment. The lower the wattage the better the compliance. In some residences the luminaires may be located in a door porch area. This approach provides a good method of limiting stray upward light. Additionally some residents may have installed 8 watt, or less, compact fluorescent lamps, which are often all that is necessary to provide some light round a doorway in the intrinsic darkness of Coll.

In Environmental Zone terms Coll lives with and enjoys intrinsic darkness and as shown in Table 1.2 equivalent to Zone E1. Accordingly the Island Core Zone should be maintained in this pristine condition. Where new or replacement external lighting is required the most onerous light control conditions should be applied to maintain this condition. To assist in this objective Table 2.1 contains recommendations on luminous intensity limits for new luminaires, with a lamp output greater than 1000 lumens, installed on the island. For domestic style luminaires with no intensity data Section 3 contains a lumen limit evaluation process.

**Table 2.1: Intensity Limitation in Island Core Zone**

Zone	Glare Class	Maximum Luminous Intensity (cd/klm)				Non-technical description
		at 70°	at 80°	at 90°	at 95°	
Island Core Zone	G6	350	100	0	0	Fully shielded installation where luminaire is flat-glass and horizontal.  For all luminaires > 1000 lumens

Luminous intensity from a luminaire is derived from photometric information, which has been measured under laboratory conditions. These measured values describe the luminaire’s light distribution in numeric electronic format (commonly known as I-tables in IES, TM14 or ELUMDAT format).

From the I-table for a particular luminaire and its installed angle of elevation the intensity of light at different elevation angles can be computed and classified in glare classes, namely G1 to G6. G1 is the most relaxed and G6 is the most restrictive and this is the recommended restriction, with selective relaxation, which should be applied in the Island Core Zone as shown in table 2.1.

In addition to the intensity controls presented in table 2.1 further light limitation measures are contained in table 2.2, below, to mitigate any obtrusive light in an E1 Environmental Zone and the two tables should be considered in tandem at the design stage for all new exterior lighting in the Island Core Zone.

**Table 2.2: Obtrusive Light Limitations for Exterior Lighting Installations**

Zone	Upward Light Ratio %	Light Intrusions (into windows) E <sub>vertical</sub> (lux)		Source Intensity I (cd)		Maximum Luminance L (cd/m <sup>2</sup> )
		Pre-10pm	Post-10pm	Pre-10pm	Post-10pm	Pre-10pm
E1	0	2	0	2500	0	0
Harbour Area	0	2	0	2500	2500	0
Arinagour	0	2	0	2500	0	2.5

After 10pm most lighting should be extinguished or reduced as activity levels decline. Although very few residents leave external lighting on longer than presence detection there are a few situations where lights are left on all night, sometimes by accident.

**Policy Statement 3**

**All residential and business occupiers should switch off or reduce their exterior lighting quantity at 2200 hours.**

While tables 2.1 and 2.2 provide maximum intensity limits, it is desirable that in many cases lower intensity lights are used instead.

**Policy Statement 4**

**All new lighting should be designed and installed to provide lower glare or intensity values than that recommended by the ILP for an E1 night time Environmental Zone.**

Although existing lighting can be refitted, or lamps replaced, to improve the nighttime environment, the best time at which to consider outside lighting is at the planning stage, and all new planning applications should make reference to this lighting management plan so that all future lights installed are compliant.

**Policy Statement 5**

**All design submissions for new lighting should show compliance with the zero candela intensity at 90° and above, and domestic luminaires should be selected from units having some form of upward light control.**

Most domestic luminaires provide very little light control and very few are measured photometrically in the same manner as commercially available luminaires. Accurate intensity or illuminance values cannot therefore be predicted by computer calculations and a different method of calculation is required. Section 3 therefore contains a method recommended by the IDA which provides a guide to the number of lumens based on the footprint size of the property for all new domestic style lighting. Care for the night time environmental control should be part of the process when selecting all new domestic equipment.

**2.2 Light Limitations within the Island Buffer Zone**

As indicated in Section 1.4 Coll is surrounded by an open sea area with limited potential for being developed. The darkness of the sea is only broken by occasional flashing navigation channel markers and is therefore acting as a natural buffer round the Island Core Zone.

The only development likely to disturb this dark buffer will be the possibility of either an offshore tidal power station or fish farm. In either case it should be an easy task to adopt the light restriction recommendations included in this report at the design stage and ensure that suitable light control fixtures are installed and only used when it is absolutely essential. Table 2.3 lists light limit recommendations for the Island Buffer Zone. Any externally visible lighting left running all night, as could be the case on a fish farm, will destroy the intrinsic darkness of the sea around Coll and the other Islands.

**Policy Statement Number 6**

**The Island Buffer Zone (the sea), with the exclusion of the inhabited islands, to be maintained as Environmental Zone E0 for a distance of 20 miles beyond the Island Core Zone boundary.**

**Table 2.3: Intensity Limitation in Island Buffer Zone**

Zone	Glare Class	Maximum Luminous Intensity (cd/klm)				Non-technical description
		at 70°	at 80°	at 90°	at 95°	
Island Buffer Zone out to 20 miles from Coll	G6	350	100	0	0	Fully shielded installation where luminaire is flat-glass and horizontal, for all luminaires, regardless of lumen output.

### 2.3 Light Limitations within the External Zone

The Island Buffer Zone outlined in Section 2.2 deals only with the sea beyond the shore of Coll out to a distance of 20 miles. Within this radius are several inhabited islands and some of mainland Scotland. All land beyond the shore of Coll but within 20 miles is considered to be in the External Zone. No inventory was undertaken in the External Zone but a pictorial overview is included in the following sub sections for each adjacent island.

This LMP can be used as a guide to assist any communities in the External Zone who wish to help preserve the skies over Coll.



These are the areas within the external zone:

- ◆ Tiree (2km distant from Coll)
- ◆ Mull (within 20km of Coll)
- ◆ The Small Isles, Much, Eigg and Rum (within 40km of Coll)
- ◆ Sunart, mainland Scotland (within 40km of Coll)

No direct light sources within the External Zone are visible from Coll, however the lights from some small villages have the potential to impact negatively on the nightscape of Coll. Table 2.4 lists light limit recommendations to be raised with the communities within the External Zone.

**Table 2.4: Intensity Limitation in External Zone**

Zone	Glare Class	Maximum Luminous Intensity (cd/klm)				Non-technical description
		at 70°	at 80°	at 90°	at 95°	
External Zone to 5 miles beyond Island Core Zone	G6	350	100	0	0	Fully shielded installation where luminaire is flat-glass and horizontal, for all luminaires brighter than 1000lm
External zone to 10 miles beyond Island Core Zone	G5	350	100	10	0	Part cut-off installation
External zone to 20 miles beyond Island Core Zone with lamps greater than 20000lm	G6	350	100	0	0	Fully shielded installation where luminaire is flat-glass and horizontal, for all luminaires brighter than 20,000lm

In addition to the intensity controls presented in table 2.4 further light limitation measures are contained in table 2.5, below, to mitigate any obtrusive light in the External Zone and the two tables should be considered in tandem.

**Table 2.5: Obtrusive Light Limitations for Exterior Lighting Installations**

Zone	Upward Light Ratio %	Light Intrusions (into windows) E <sub>vertical</sub> (lux)		Source Intensity I (cd)		Maximum Luminance L (cd/m <sup>2</sup> )
		Pre-10pm	Post-10pm	Pre-10pm	Post-10pm	Pre-10pm
External Zone to 5 miles beyond Island Core Zone	0	2	0	2500	0	0
External zone to 10 miles beyond Island Core Zone	2.5	5	1	7500	500	5
External zone to 20 miles beyond Island Core Zone with lamps greater than 20000lm	0	5	1	7500	500	5

### **Policy Statement 7**

**Through this LMP it will be possible for Argyll and Bute Council to provide a basis for discussion with neighbouring communities on various options to help reduce upward light transmission.**

## **2.4 Additional Considerations for all Zones**

Luminaires are designed to have light distributions which are appropriate for specific applications. Even though a luminaire has a Dark Sky Fixture Award it can produce sky glow, light intrusion or glare if it is installed improperly. By following the recommendations relating to viewed intensity and vertical illuminance limits at lighting design stage this should mitigate the obtrusive nature of stray light.

Industry standard software, complete with obtrusive light evaluation criteria, eg Philips Calculux, is available as a free download from their web site. Some luminaire manufacturers also provide a design service but this may be limited in application and may not include obtrusive light analysis.

All planning applications involving external lighting should be encouraged to follow the 12 point Planning Application Checklist in Table 2.6 below, whether it is in the Island Core Zone or in the External Zone to ensure that viewed intensity and obtrusion are mitigated accordingly.

### **2.4.1 Overlighting**

Over-lighting an area is just as obtrusive and wasteful as pushing light into the night sky. Designing for, and providing, the correct task illuminance on the ground is just as important as controlling stray light.

### **2.4.2 Switching Regime**

Many commercial premises have labels attached to light switches to say “switch off lights when room is not in use” and some buildings have energy management systems which automatically detect occupation and adjust accordingly. External lighting should be similarly treated, not only to limit energy usage but also to reduce the impact on the night sky.

Section 2.1 introduced the concept of a time (10pm) after which exterior lighting should be switched off or reduced in number. Many domestic exterior luminaires can be purchased with a combined passive infra-red (PIR) presence detector and photoelectric switch unit (PECU) to do the same work as the commercial building management system. A time delay switch is just as good and it has the added advantage over PIR detection in that the luminaires will not be turned on by cats, dogs or other wildlife movement.

**Table 2.6: Planning Application Checklist**

<b>Good Lighting Design</b>	
✓	Survey of surrounding area environment
✓	Identification of critical viewpoints or receptors
✓	Analysis of task lighting level recommendations and game level if sports lighting application
✓	Establish environmental light control limits
✓	New lighting design quality objectives
✓	Calculated measurement of: Task working area(s) Overspill area(s)
✓	Obtrusive light calculation of: Property intrusion Viewed source intensities Direct upward light output ratios
✓	Compare design achievement with baseline values
✓	Schedule of luminaire types, mounting height and aiming angles
✓	Schedule of energy usage and lumens per square metre
✓	Schedule of luminaire profiles
✓	Layout plan with beam orientation indication and site

### Section 3: Light Limitation Policy - Non-photometric Method for Domestic Lighting

#### 3.1 Domestic Lighting Limitations

Some luminaire manufacturers / suppliers, especially in their budget range of DIY lighting, cannot provide photometric intensity tables. This precludes the use of computer algorithms to check either the essential information about fundamental illuminance values or check for obtrusive light situations.

At design and planning application stages for commercial development the answer is simple. Do not propose the use of such equipment. At installation stage do not substitute a non-photometrically measured equivalent look-a-like.

Domestic residential exterior lighting does, however, require a method better than a global 1000 lumen limit as indicated in earlier sections. Budget range DIY equipment usually takes the form of a simple area floodlight with a high wattage tungsten halogen lamp. They are popular because they are cheap, easy to install, and are often combined with photo-electric (PECU) switches to prevent daytime operation and with passive infra red (PIR) detectors to switch on and off automatically on presence detection.

In the majority of cases these fittings, or luminaires, are installed typically on garage or porch fascias at about 2-3 metres above ground level, and arranged to direct their main beams towards the property boundary operating on the approach of vehicles or people. This high beam arrangement can result in glare and light intrusion into adjacent properties. This type of installation (see Figure 3.1) is not in keeping with the light control required in a rural setting and as from the effective date of implementation of this LMP no new floodlights of this type will meet the IDA Dark Sky requirements. If more examples like this are installed the island may lose its status.



*Figure 3.1: Incorrectly fitted floodlight*

Appendix B contains examples of exterior lighting equipment which could be considered when purchasing new exterior lighting. As described previously a lamp output limit of 1000 lumens in luminaires with poor light control is considered to be non-compliant. However Table 3.1 provides a more accurate lamp lumen limit per square metre of building(s) footprint on each residential plot of land. In Table 3.1 the words "site structure" means the total square metre measurement of house, garage, shed and out buildings and this should be the starting point of any non-photometered assessment.

Lamp lumens is a consistent value and although difficult to find on some packaging may in the future supersede the lamp wattage. Lamp watts can vary with the efficacy of the lamp. Table 3.1 has therefore been constructed using the lamp lumens as the base from which to start. The tables which follow 3.1 namely Table 3.2 – Table 3.5 show the equivalent lamp wattages for different lamp types in luminaires with a differing quality of light control.

**Table 3.1: Total Lumen Limit for Domestic Lighting**

	Environmental Zone				
	E0 Island Buffer	E1 Island Core	E2*	E3*	E4*
Total Lumens for domestic exterior lighting	0	750lm plus 4.5lm per m <sup>2</sup> of site structures**	2250lm plus 4.5lm per m <sup>2</sup> of site structures	4500lm plus 4.5lm per m <sup>2</sup> of site structures	6000lm plus 4.5lm per m <sup>2</sup> of site structures
Full cut-off luminaires Each lamp lumen maximum		1000lm	1650lm	2400lm	3200lm
Part cut-off luminaires Each lamp lumen maximum		750lm	1200lm	1650lm	2400lm
No light control luminaires Each lamp lumen maximum		480lm***	750lm	750lm	750lm

\* Environmental Zones E2-4 do not relate to any conditions in Coll, and are shown merely for completeness in case other areas in Argyll and Bute Council wish to follow suit, if appropriate to those areas.

\*\* Site structures is the sum of the land area of residential buildings, habitable structures, garages, recreational buildings and storage structures on each property plot.

\*\*\* The maximum lumens (and watts on table 3.2 - 3.5 following) for each lamp in this section relates to replacing lamps in existing lighting units only. No new luminaires with no light control should be considered, especially in environmental zones E1 and E2.

**For example, a house of 255m<sup>2</sup> would provide for a total of 1897 lumens which can be distributed as one or more luminaires up to the total allowance.**

### 3.2 Lamp Wattages

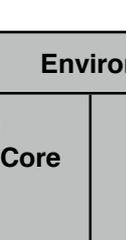
Different lamps give out varying amounts of lumens per watt of power consumed. Table 3.2 - 3.6 show the five most common types of lamps used for domestic purposes, and the lumen / watt limits in each zone.

**Table 3.2: Compact Fluorescent Lamps**

	Environmental Zone				
	E0 Island Buffer	E1 Island Core	E2	E3	E4
Full Cut-Off Luminaires each lamp maximum watts	0	20W (1350 lm)	24W	32W	42W
Part Cut-Off Luminaires each lamp maximum watts	0	11W (900 lm)	20W	24W	32W
No light control Luminaires each lamp maximum watts *	0	9W* (600 lm)	12W*	12W	12W

\* These figures relate to replacing lamps in existing luminaires only; no new lights with little or no light control should be considered.

**Table 3.3: Tungsten Halogen Lamps**

	Environmental Zone				
	E0 Island Buffer	E1 Island Core	E2	E3	E4
Full Cut-Off Luminaires each lamp maximum watts	0	60W (840 lm)	100W	150W	200W
Part Cut-Off Luminaires each lamp maximum watts	0	0	60W	100W	150W
No light control Luminaires each lamp maximum watts *	0	0	0	0	0

\* These figures relate to replacing lamps in existing luminaires only; no new lights with little or no light control should be considered in environmental zones E0-E2.

**Table 3.4: Incandescent / Candle / Capsule Lamps**

	Environmental Zone				
	E0 Island Buffer	E1 Island Core	E2	E3	E4
Full Cut-Off Luminaires each lamp maximum watts	0	2x35W Halostar (415 lm each)	2x60W	See table 3.1	See table 3.1
Part Cut-Off Luminaires each lamp maximum watts	0	60W (710 lm)	See table 3.1	See table 3.1	See table 3.1
No light control Luminaires each lamp maximum watts *	0	40W* (420 lm)	40W	40W	40W

\* These figures relate to replacing lamps in existing luminaires only; no new lights with little or no light control should be considered in environmental zones E0-E2.

**Table 3.5: LED Lamps**

	Environmental Zone				
	E0 Island Buffer	E1 Island Core	E2	E3	E4
Full Cut-Off Luminaires each lamp maximum watts	0	12W (650 lm)	See table 3.1	See table 3.1	See table 3.1
Part Cut-Off Luminaires each lamp maximum watts	0	7.5W (470 lm)	See table 3.1	See table 3.1	See table 3.1
No light control Luminaires each lamp maximum watts *	0	6W (337 lm)	See table 3.1	See table 3.1	See table 3.1

\* These figures relate to replacing lamps in existing luminaires only; no new lights with little or no light control should be considered in environmental zones E0-E2.

**Table 3.6: Ceramic / Metal Halide Discharge Lamps**

	Environmental Zone				
	E0 Island Buffer	E1 Island Core	E2	E3	E4
Full Cut-Off Luminaires each lamp maximum watts	0	20W (1500 lm)	35W	370W	5500W

**Part cut-off or no light control luminaires should NOT be considered with this lamp.**

### 3.3 Light Control Examples

There is a huge range of domestic lighting available, but only careful selection and installation will result in a light that is compliant.

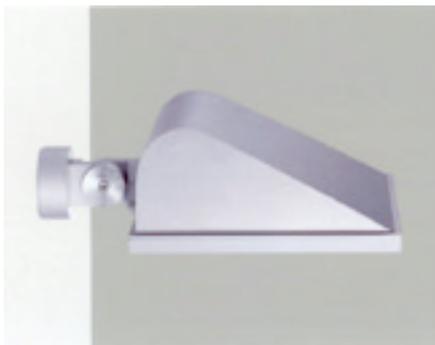
#### 3.3.1 Full Cut-Off (Fully Shielded) Examples



*Figure 3.2 SILL420  
Full range of compact  
fluorescent and low wattage  
metal halide*



*Figure 3.3 Mains LED  
15 LEDs*



*Figure 3.4 ERCO Parscoop  
42W fluorescent = 3200lm  
70W metal halide = 5000lm  
Acceptable replacement for  
tungsten halogen lamp*



*Figure 3.5 Full cut-off wall light*

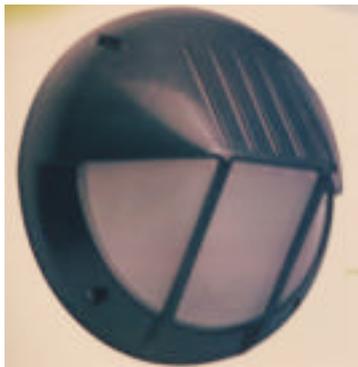
### 3.3.2 Part Cut-Off or No Light Control Examples



*Figure 3.6 Heritage light, poor light control  
Lamp no brighter than 40W candle lamp or 9W compact fluorescent*



*Figure 3.7 Bulkhead light, no light control  
Lamp no brighter than 40W candle lamp or 9W compact fluorescent*



*Figure 3.8 Bulkhead light, poor light control  
Lamp no brighter than 60W candle lamp or 11W compact fluorescent*



*Figure 3.9 Halogen security light, poor light control  
No halogen lamps without full cut-off should be installed*



*Figure 3.10 LED Security lights, poor light control  
Lamp no brighter than ???W*

## Section 4: Work Task Lighting

The preferred method of designing lighting is by following the performance method of task illuminance selection process from either BS EN12464-2:2007 "Light and Lighting – Lighting of work places – Part 2 Outdoor Work Places", and a few examples have been extracted and shown in Table 3.1 for easy reference, or from BS EN 12193:2007 "Light and Lighting. Sports Lighting" (see also the CIBSE Sports Lighting Guide).

**Table 4.1: Illuminance for Typical Tasks**

Ref.No.	Type of Area, Task or Activity	$E_{av}$ (lux)	$U_o$	$GR_L$	$R_a$	Remarks
Values during task operation time only. No task - no light						
<b>Public footpaths</b>						
	Public footpaths (pedestrian only)	1	0.25	50	60	
	Public footpaths next to roads	1	0.4	50	60	
<b>Farms</b>						
5.5.1	Farm Yard	20	0.10	55	20	
5.5.1	Equipment shed (open)	50	0.20	55	20	
5.5.3	Animals sorting pen	50	0.20	50	40	
<b>Quays and Harbours</b>						
5.4.1	Waiting Quays at canals and locks	10	0.25	50	20	
5.4.2	Gangways for pedestrians	10	0.25	50	20	
5.4.6	Coupling of hoses pipes and ropes	50	0.40	50	20	
<b>Power, electricity, gas, and heat plants</b>						
5.11.1	Pedestrian movement in safe area	5	0.25	50	20	
5.11.3	Overall inspection	50	0.40	50	20	
5.11.6	Repair of electric devices	200	0.50	45	60	
<b>Summary guide when no task equivalent can be found</b>						
	Very low risk	5	0.25	55	20	
	Low risk	10	0.4	50	20	
	Medium risk	20	0.4	50	20	
	High risk	50	0.4	45	20	

Key to table abbreviations:  $E_{av}$  = Maintained average illuminance;  $U_o$  = Overall uniformity;  $GR_L$  = Glare Rating limit (for internal work visibility benefit and not a visibility measure from outside the site);  $R_a$  = minimum colour rendering index

Most of the recommended values shown in Table 4.1 have been based on the premise that a lamp with a low colour rendering index will be used as shown in the column headed 'Ra'. The colour rendering index of a standard high pressure sodium lamp (SON) (yellow coloured light) is about 20 but the colour rendering index of ceramic metal discharge lamp (CMD) (true white light) is in the order of 65.

## **Section 5: Excluded Lighting Applications and Special Permit Applications**

The following applications will be prohibited from any part of the Island Core Zone, Island Buffer Zone or External Zone falling between the boundary of the Island Core Zone and 10 miles beyond. Special Use Permits will not be issued for:

- ◆ Aerial Laser Shows
- ◆ Sky Tracking Searchlights
- ◆ High intensity light sources greater than 200,000 lumens
- ◆ Sports complexes requiring an average playing surface greater than 75 lux.

Short Time Usage Special Permit are required for the following applications (but not limited to):

- ◆ Sports facilities with column mounted luminaires.
- ◆ Construction site lighting.
- ◆ Churches, public monuments or buildings.
- ◆ Theme and amusement parks.

The Special Permit Zone will be deemed to include the Dark Sky Island Core Zone only. To obtain a lighting permit, applicants shall demonstrate that the proposed lighting installation application:

- ◆ Contains an analysis of the 12 Good Design Practice Checklist points in Table 2.6, AND
- ◆ Contains a statement that shows every reasonable effort to mitigate Sky Glow and Light Intrusion has been addressed and accompanied by a computer calculation indicating average task illuminance, uniformity, horizontal values of overspill beyond the property line and vertical illuminance values of light intrusion on adjacent properties.
- ◆ Employs lighting controls to reduce the quantity of lighting at the project specific 'switch-off' time which has been established in the Special Permit (usually 10pm)
- ◆ Complies with all light limitation factors outlined in this LMP.

**Appendices:**

**Appendix A: Definitions**

**Appendix B: Luminaire Profile Examples for Environmental Zone E1**

**Appendix C: Domestic Lighting Equipment Profiles**

**Appendix D: Domestic Lamp Wattages and Lumen Outputs**

**Appendix E: Property Self Audit Guide**