HANGKLIP VILLAGES CONSERVATION OVERLAY ZONE ("HCOZ")

1. SPATIAL DELINEATION.

The conservation zone consists of the villages of Betty's Bay (Plans 25 and 26), Pringle Bay (Plan 21) and Rooiels (Plan 27), demarcated in the Overstrand Municipality Spatial Development Framework of 2020, and as revised from time to time.

2. PURPOSE: CONSERVATION OF THE RURAL CHARACTER OF THE BETTY'S BAY, PRINGLE BAY AND ROOIELS VILLAGES FOR AREAS OF COMMON CONCERN, IN A CONSERVATION OVERLAY ZONE.

The character of the villages of Betty's Bay, Pringle Bay and Rooiels can be described as follows:

Betty's Bay, Pringle Bay and Rooiels are conservation communities, situated in the buffer zone to the Kogelberg Biosphere (KBR).

The Villages advocate, as communicated to property owners through their respective community organisations, conservation of their natural eco-heritage, which has been established and maintained over decades. The Villages emphasise that, only through a strong community spirit, can the natural splendour of the Villages in the buffer zone to the KBR be maintained and conserved.

The property owners of the Villages strive to conserve their natural character in a twofold manner:

Co-operating in a community spirit with each other on conservation areas of common concern, and;

Working with the Overstrand Municipality (OM) to ensure that regulations enhance the character of the Villages.

3. METHODOLOGY

Conservation areas of concern, as identified from time to time by the Villages through their community organisations, are grouped with their respective conservation methods.

These conservation areas are:

a) Pringle Bay Conservancy
b) Hangklip Conservancy
c) Rooi Els Conservancy
d) Bettys Bay Conservancy

4. STREET LIGHTS AND LIGHTING.

4.1. BACKGROUND

In the attached Villages publication (Schedule A), "*ROOIELS / PRINGLE BAY / BETTY'S BAY OUTDOOR LIGHTING: MEASURING PARAMETERS AND ASSOCIATED LIMITS*", it is explained that, under the subject of lighting, geographic areas of different environmental zones are internationally generally described into four categories.

Considering these, it is concluded that the Rooiels/Pringle Bay/Betty's Bay area fall into the following two categories, the worst case scenario being Category E2

E1: Intrinsically dark areas - National Scenic Areas, areas for astronomical observation;

E2: Areas of low district brightness – For people who want to have a rural living condition including having a low night-time ambient brightness, rural or small village locations.

The above referenced Schedule A also explains the lighting parameters and their measurement.

4.2. CONSERVATION THROUGH COMMUNITY SPIRIT.

4.2.1. Property owners are encouraged to prevent light pollution from their premises by:

Facing external lights on premises downwards to avoid spillage over boundaries.

In place of static lights, the use of sensor-operated external lights (that are switched off when the lights are not activated) is encouraged.

4.2.2. Street lights shall not be erected in the respective villages unless individual votes in favour, by sixty-six (66%) of registered property owners in the respective village, have been documented.

4.2.3. To facilitate communication with affected erf owners, illustrative correspondence, in the three official Western Cape languages, is attached in Schedule B for use by individual erf owners, community organisations and the OM.

4.3. CONSERVATION THROUGH REGULATIONS

In the regrettable event of an erf owner not responding to a written communication as in paragraph 4.2.3, the following recourse is available:

4.3.1. AS A PUBLIC NUISANCE BY-LAW IN TERMS OF THE CONSTITUTION OF 1996.

4.3.1.1. The Constitution distinguishes public nuisances in Section 156 which reads as follows:

"Section 156. Powers and functions of municipalities

1. A municipality has executive authority in respect of, and has the right to administer -
   a) the local government matters listed in Part B of Schedule 4 and Part B of Schedule 5; and
   b) any other matter assigned to it by national or provincial legislation.

2. A municipality may make and administer by-laws for the effective administration of the matters which it has the right to administer."

2.1.1. Schedule 5 reads as follows:

"Schedule 5: Functional areas of exclusive provincial legislative competence

Part B

The following local government matters to the extent set out for provinces in section 155(6)(a) and (7):

…….

……..

……

…….

Control of public nuisances."

THEREFORE:

4.3.1.2. Any light installed on a premises shall be so positioned and if necessary screened, to ensure that it does not spill over boundaries, thereby causing a nuisance to the public.

4.3.1.3. Any member of a village at large who considers itself affected may request a measurement by the OM as set out in paragraphs 4.3.1.4 and 4.3.1.5.

4.3.1.4. For the purpose of paragraph 4.3.1.2 the following is deemed to cause a nuisance to the public:

4.3.1.4.1. Any light, with a **Source Intensity (Luminous Intensity)** measurement that exceeds 500cd, measured in any street or on any public place or from any point on any boundary of any other premises;

4.3.1.4.2. **Any light, with an Intrusion (Illuminance)** measurement that exceeds 3 Lux measured in any street or on any public place or from any point on any boundary of any other premises; and

4.3.1.4.3. **Any light, with an Upward Light Ratio** of more than 2.5%, in any street or on any public place or from any point on any boundary of any other premises.

4.3.1.5. The following technical requirements shall apply for measurements:

LIGHTING PARAMETER	MEASUREMENT SI UNIT	LIMIT
Source Intensity (Luminous Intensity) Direct line of sight of the light emitted from luminaires is probably the principal source of obtrusive lighting complaints. This is light radiated directly from the luminaire and the recommended limiting values are:-	CANDELA (cd)	Preferably 0 cd but not more than 500 cd Using a Light Meter, measuring the Illuminance at a point 10m away from the source, the Illuminance should not be more than 5 lx to ensure intensity of 500 cd. Thus, at 20m from the source, the Illuminance should not be more than 1.25 lx to ensure 500 cd. Refer to Appendix 1 for a graph showing the relationship between distance from source and Intensity of 500cd with Lux as input value.
Light Intrusion (Illuminance) Light intruding through property windows can be predicted by calculating values on a vertical grid representing a window. The recommended limits are additive to what is already present – these need to be zero if the current levels exceed the limits	LUX (lx)	Preferably 1 lx but not more than 3 lx at any point on the boundary of a plot/erf.
Upward Light Ratio The upward light ratio will vary depending on the tilt angles and light distribution. Many quality luminaires produce a 0% upward light ratio at zero degrees of tilt but will produce an upward light ratio of 2.5% with 10º of tilt. Some luminaires can produce as much as 50% upward light ratio at tilt angles greater than 40º and if this was the case then the lighting installation could be classed as being an obtrusive and inefficient lighting solution	%	Preferably 0% but not more than 2.5%

For Conversion Tables refer to: https://www.compuphase.com/electronics/candela_lumen.htm

4.3.1.6. The provisions of the OM "By-Law Relating to Streets, Public Places and Public Nuisances" of 5 September 2008 shall apply mutatis mutandis to paragraphs 4.3.1.2 to 4.3.1.5.

4.3.1.7. The OM shall ensure that the municipal legal requirements for promulgation of this public nuisance by-law, contained in the HCOZ, are complied with.

4.4. AS A BUILDING REGULATION IN TERMS OF THE CONSTITUTION OF 1996 .

4.4.1. Part B of Schedule 4 of the Constitution empowers a municipality to promulgate building regulations and section 29 of the National Building Regulations and Building Standards Act, no 103 of 1977 regulates the promulgation of building regulations by local authorities.

THEREFORE:

4.4.2. Existing and new external lights on a premises shall be required to be faced downwards before any building plans for the premises are approved, and existing external lights of premises shall be required to be faced downwards and not spill over boundaries when in use.

4.4.3. Sensor-operated external lights shall be used for lights that are not switched off when not in use.

4.4.4. Any light installed on a premises shall be so positioned and if necessary screened, to ensure that it does not exceed the measurement in paragraph 4.4.5.

4.4.5. For the purpose of paragraph 4.4.4 any light may not exceed a measurement as described in paragraphs 4.3.1.4 and 4.3.1.5.

4.4.6. Any member of a village at large who considers itself affected may request an inspection and measurement by the OM.

4.4.7. The provisions of the National Building Regulations and Building Standards Act, no 103 of 1977 shall apply mutatis mutandis to paragraphs 4.4.2 to 4.4.6.

4.4.8. The OM shall ensure that the legal requirements per Section 29 of the above Act for promulgation of this building regulation, contained in the HCOZ, are complied with.

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SCHEDULE A

ROOI ELS / PRINGLE BAY / BETTYS BAY OUTDOOR LIGHTING: MEASURING PARAMETERS AND ASSOCIATED LIMITS

INDEX

GLOSSARY OF TERMS

TERM	DEFINITION
Light	(or luminous flux) is electromagnetic radiation visible to the eye and is measured in *lumens (lm)*
Efficiency	of a light is measured in *lumens per watt (lm/W)*
Illuminance	is a measure of the amount of light falling on a surface and is measured in *lumens per square metre* or *lux (lx)*. The illuminance of direct sunlight is around 100,000 lux, normal daylight is 5,000 to 10,000 lux and moonlight around 0.25 lux
Luminance	the eye sees the light radiating or reflecting from an object which is termed the *luminance* and is measured in *candelas per square metre (cd/m2)*
Intensity	or luminous intensity is the strength of the light in a given direction and is measured in *candela (cd)*
Glare	uncomfortable brightness of a light source when viewed against a darker background. The luminous intensity gives an indication of the level of glare likely
Trespass	best measured by illuminance in the vertical plane of a window or building boundary

1) BACKGROUND

Under the subject of lighting, a geographic area is categorized as one of four different environmental zones, internationally generally described as follows:

E1: Intrinsically dark areas - National Scenic Areas, areas for astronomical observation;
E2: Areas of low district brightness – For people who want to have a rural living condition including having a low nighttime ambient brightness, Rural or small village locations;
E3: Areas of medium district brightness – For residential areas where people would enjoy the convenience of commercial activities nearby, Urban or small-town locations
E4: Areas of high district brightness - Large town or City Centre with high levels of nighttime activity.

Considering the above, it is concluded that Rooi Els/Pringle Bay/Bettys Bay area (the Study Area hereafter) falls into the first two categories, the worse case scenario being Category E2.

Parson Brinkerhoff (ref to paragraph 2(v)) defines the **Nuisance** effect of lighting to residence as follows:

(i) Light Trespass:

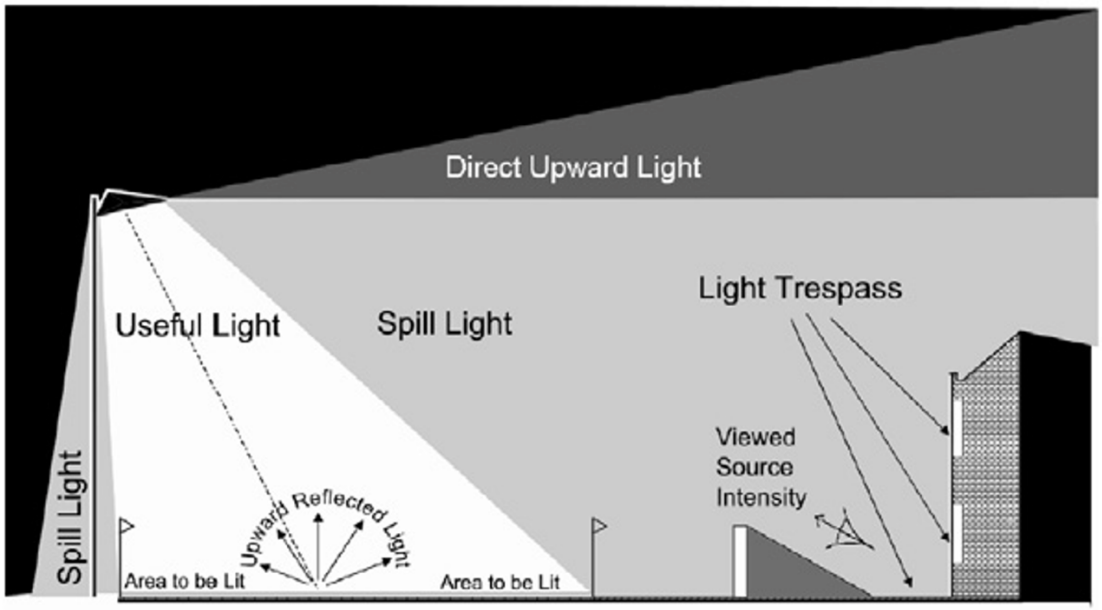
This includes the effects due to spill light entering a residential premise, e.g. a house, an apartment unit, hotel, hostel, hospital ward, etc., during the hours of darkness. The spill light may cause annoyance, stress, discomfort and reduced sleep quality, etc. The commonly used term to describe this obtrusive light effect is 'Light trespass' although sometimes this term may have wider meanings including the effects of glare from bright light sources and signs.

(ii) Glare from bright luminaires:

Glare is caused by the direct view of bright luminaires from normal viewing directions causing annoyance, distraction or discomfort. CIE (Commission Internationale de l'Eclariage (International Commission on Illumination)) and many other authorities assess this effect separately from the general effects of light trespass although glare may also be caused by spill light entering the resident's premises. …..

(iii) Glare from over-lit building facades and over-bright signs and billboards:
Other than causing light trespass, over-lit building facades and over-bright signs and billboards close to residential units can also cause glare to residents.

The above-mentioned is graphically depicted in the following diagram.



From the above-mentioned it is evident that the effect of "spill light" and "direct upward light" are the two components of a light source that needs to be controlled through relevant by-law(s) to ensure minimizing the nuisance effect of lighting.

What is of further importance to the study area, id the effect lighting may have on fauna. Documentation (Refer to paragraph 2(v)) describes the effect of artificial lighting on wildlife as follows:

a) Light pollution resulting from the increasing illumination of the planet by mankind is having an increasing influence on wildlife (Rich and Longcore, 2006)2. The ecological consequences of artificial night lighting are becoming increasingly worrying for nocturnal species of animal across the UK and Europe.
b) Increased lighting can affect the behaviour of fauna in both a detrimental and beneficial way and therefore can be interpreted as a disturbance to their natural behaviour. Possible disturbance might include:
    - *Predation risk* - increased light levels has the potential to increase the predation of insects and mammals, for example kestrels have been observed hunting bats flying under well lit underpasses;
    - *Fragmentation of habitats* - increase of lighting may lead to fragmentation of habitats, producing small isolated colonies. This may then affect the long term survival of populations due to reduced gene pool;
    - *Effects on life cycle* - increased lighting can affect intricate life cycle triggers for example, it has been noted that certain bird species lay their eggs 2-3 weeks earlier in urban areas compared to rural. This could in turn lower survival rates **in** young due to cooler temperatures and reduced food sources;
    - *Barrier* - nocturnal mammals are likely to be disturbed by the presence of bright artificial lighting and could be deterred from using established foraging and breeding areas, and;
    - *Enhancement* - street lights with a high UV component are

beneficial to insectivorous bat species because they attract insects and therefore increase foraging opportunities within that environment.

2) RELEVANT GUIDELINES.

To derive at proposed parameters for lighting in the Study Area a desktop study was performed. Documentation referenced in paragraph 5 were studied.

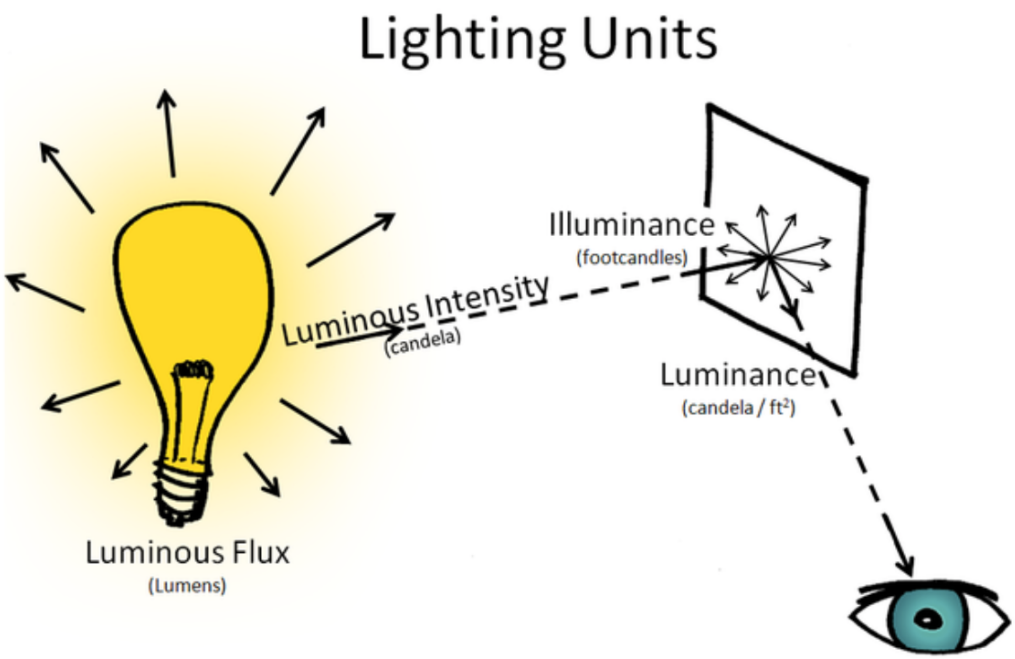
A proposed technical framework for Pringle Bay was derived from the above-mentioned. The framework addressing the What, Where, When, and How is discussed in the following paragraphs. Finally, a set of measurables and the associated limits are proposed which should be the basis for compiling a relevant By-Law for Lighting in the Study Area.

3) TECHNICAL FRAMEWORK

In the following paragraphs the What, Where, When and How are discussed and finally measurable parameters are proposed for inclusion in the proposed new By-law(s).

a) WHAT TO MEASURE

Two basic elements of lighting, Luminous Flux and Illuminance are both measurable. The combination of these two elements result in the Luminance of light which is the perceived brightness the human eye interprets. The latter is of importance to define parameters for lighting in the study area. The relationship is shown below:



The lighting industry uses several different units to measure light, depending on what information is needed. Below are a few of the most common units and terms: (https://www.lumitex.com/blog/light-measurement#5)

Flux (Luminous Flux) - Originating from the Latin word 'Fluxus,' meaning *flow,* flux is the amount of energy a light emits per second, measured in **lumens (lm)**.

When it comes to lighting, you need to consider **watts (W)** (energy used) versus **lumens (lm)** (brightness). Or electricity consumption versus light output. Lumens are weighted for human perception whereas watts are not.

- **Lumen** (lm) - The SI unit of luminous flux, this is a unit of light flow.
- **Watt** (W) - The unit of measuring electrical power, this is a radiometric measurement.

Intensity of Light - the Quantity of visible light that is emitted in unit time per unit solid angle is measured as Candelas, defined as follows:

- **Candela** (cd) - The SI base unit of luminous intensity. It is a unit of luminous intensity of a light source in a definitive direction. 1 lumen = 1 candela x steradian (the SI unit of solid angle).

Illuminance - the amount of luminous flux per unit area is measured as Lux and is defined as follows:

- **Lux** (lx) - Lux is a standardized unit of measurement of the light intensity. The SI unit of illuminance and luminous emittance. One lux is equal to one lumen per square meter - formula: Lux - Lm/m^2
- **Footcandle** - A non-SI unit of light intensity. While lux is lm/m^2, a footcandle is lm/ft^2.

Luminance is the intensity of light from a surface per unit area in a given direction.

- cd/m^2
- 1 cd/m^2 = 1 nit
- **Nit** (nt) - A name given for a unit of luminance

For an easier understanding, think of a lamp that produces light.

- The light from a lamp is measured in lumens (measure of light intensity)
- The light that falls on a surface is expressed as lux
- The human eye sees this visually in terms of brightness, or luminance, that is measured in candelas

In practice it is easiest to measure the Illuminance using a calibrated Light Meter.

From a practical point of view, it is suggested that from each critical viewpoint the importance of at least three of the 5 light limitation values (overspill; sky glow; light into bedroom windows; line of sight (source) intensity and overall building luminance should be assessed. The recommended three limitation values to be measured are:

a) Light Intensity
b) Illuminance
c) Overspill

b) WHERE TO MEASURE

Lighting installed by a resident at his/her property, whether outdoors or indoors, which is installed such that it directly or indirectly causes a Nuisance to the neighbor is the subject matter that needs to be addressed.

The one common point between neighbors or adjacent landowners is the boundary between the two plots (erven).

It is thus suggested that the point for taking measurements to determine conformity to the proposed lighting limits is the closest point on the boundary between the subject properties/plots/erven from where the nuisance is perceived.

c) WHEN TO MEASURE

Since the issue at stake is the lighting of premises after sunset, it is suggested that measurements be taken once the sun has set and it has become dark (in terms of definition, the point in time when starlight becomes visible).

For purposes of defining the worst-case scenario, it is also suggested to take measurements between the Waning and Waxing Crescents of the Moon Phases.

d) HOW TO MEASURE
(https://www.lumitex.com/blog/light-measurement#5)

Calculating the intensity of light depends on the light source and the direction in which it radiates light. The amount of light falling on a surface is known as illuminance and is measured in lux as described earlier..

What matters the most in terms of **measuring light intensity** is the actual **number of lumens falling on a particular surface.**

As noted above, flux is the total light output. With watts referring to absolute power and lumens being weighted for human perception.

"Luminance is the amount of light reflected off the surface being Illuminated".

Illuminance is measured as the amount of light striking a surface.

Luminance is what we measure off of the surface the light is striking.

Think of it like this – IL-Luminance, IL, I = Incident Light. Illuminance is measuring the incident light. Luminance is what's leaving the surface – L = leaving. Illuminance measures incident, luminance measures what's leaving.

With what to measure with which instrument:

a) **Photometer**
A photometer is an instrument that measures light intensity. It can be defined as an instrument that measures visible light.

Two types of photometers are:

- **Luminance meters** - determine the visible energy output of a light source
  Luminance measurements are used for products such as traffic lights and automobile tail lights.
- **Illuminance meters** - measure the visible energy falling on an object's surface.

b) **Integrating Sphere**
"An integrating sphere collects electromagnetic radiation from a source completely external to the optical device, usually for flux measurement or optical attenuation."

c) **Spectrometer**
"The basic function of a spectrometer is to take in light, break it into its spectral components, digitize the signal as a function of wavelength, and read it out and display it through a computer."

d) **Light Meter**
A light meter is a device used to *measure light levels*. Light level is the amount of light measured in a plane.

For purposes of achieving measuring the nuisance value of lighting, it is suggested to adopt the use of an Illuminance Meter or Light Meter, measuring the Lux (lx) from an object such as a wall, a pavement, landscaping objects, all of which may contribute to the perceived nuisance of a light source to an observer.

4) PROPOSED PARAMETERS

Common outdoor light levels at day and night can be found in the table below:

Condition	Illumination	
	Foot Candle (ftcd)	***Lux (lx)***
Sunlight	10,000	107,527
Full Daylight	1,000	10,752
Overcast Day	100	1,075
Very Dark Day	10	107
Twilight	1	10.8
Deep Twilight	0.1	1.08
Full Moon	0.01	0.108
Quarter Moon	0.001	0.0108
Starlight	0.0001	0.0011
Overcast Night	0.00001	0.0001

TABLE 1: TYPICAL ILLUMINATION VALUES

Measuring Units of Light Level - Illuminance

Illuminance is measured in foot candles *(ftcd, fc, fcd)* or lux (in the metric SI system). A *foot candle* is actually *one lumen* of *light density per square foot*; *one lux* is *one lumen per square meter*.

- *1 lux = 1 lumen / sq meter = 0.0001 phot = 0.0929 foot candle (ftcd, fcd)*
- *1 phot = 1 lumen / sq centimeter = 10000 lumens / sq meter = 10000 lux*
- *1 foot candle (ftcd, fcd) = 1 lumen / sq ft = 10.752 lux*

To convert Illuminance (Lux) to Intensity (Candela), use the following formula:

FROM: Lumen (Φ_v) **TO** Candela (I_v) **GIVEN** apex angle α:

$$I_v = \Phi_v / (2\pi(1-\cos(½\alpha)))$$

ALTERNATIVELY:

FROM: Lumen (Φ_v) **TO** Candela (I_v) **GIVEN** measuring distance D (m):

$$I_v = E_v \times D^2$$

(Reference: https://www.compuphase.com/electronics/candela_lumen.htm)

Based on the abovementioned it is suggested to adopt the following measures for the Rooi Els/Pringle Bay/Bettys Bay area to control the occurrence of lighting nuisance and light pollution.

TABLE 2: PROPOSED LIGHTING PARAMETERS AND MEASURING LIMITS

LIGHTING PARAMETER	MEASUREMENT SI UNIT	LIMIT
Source Intensity (Luminous Intensity) Direct line of sight of the light emitted from luminaires is probably the principal source of obtrusive lighting complaints. This is light radiated directly from the luminaire and the recommended limiting values are:-	CANDELA (cd)	Preferably 0 cd but not more than 500 cd Using a Light Meter, measuring the Illuminance at a point 10m away from the source, the Illuminance should not be more than 5 lx to ensure intensity of 500 cd. Thus, at 20m from the source, the Illuminance should not be more than 1.25 lx to ensure 500 cd. Refer to Appendix 1 for a graph showing the relationship between distance from source and Intensity of 500cd with Lux as input value.
Light Intrusion (Illuminance) Light intruding through property windows can be predicted by calculating values on a vertical grid representing a window. The recommended limits are additive to what is already present – these need to be zero if the current levels exceed the limits	LUX (lx)	Preferably 1 lx but not more than 3 lx at any point on the boundary of a plot/erf.
Upward Light Ratio The upward light ratio will vary depending on the tilt angles and light distribution. Many quality luminaires produce a 0% upward light ratio at zero degrees of tilt but will produce an upward light ratio of 2.5% with 10º of tilt. Some luminaires can produce as much as 50% upward light ratio at tilt angles greater than 40º and if this was the case then the lighting installation could be classed as being an obtrusive and inefficient lighting solution	%	Preferably 0% but not more than 2.5%

For Conversion Tables refer to: https://www.compuphase.com/electronics/candela_lumen.htm

5) REFERENCES

i) Hangklip Kleinmond Federation minutes 16 July 2014 and tabled at Meeting of the HKF Law Enforcement Forum July 24 2014
ii) HANGKLIP/KLEINMOND FEDERATION OF RATEPAYERS' ASSOCIATIONS: Regulation of Lighting
iii) E-mail communications between PBRA Chairman and Municipal Manager Mr Lackey dated 10 October 2015.
iv) Lighting By-Law (PBRA Minutes 18 Jan 2017)
v) Environmental Bureau: Final Report for Consultancy Agreement No: EG 08-051/2: Study on Overseas Practices in Guiding and Regulating External Lighting (Parsons Brinckerhoff)
vi) Guidance to accompany the Statutory Nuisance Provisions of the Public Health etc (Scotland) Act 2008.

TABLE 3: RELATIONSHIP BETWEEN 500 cd and DISTANCE FROM SOURCE MEASURING ILLUMINANCE

DISTANCE from SOURCE (m)	Light INTENSITY (cd)	Illuminance (Lux) (lx)
1	500	500.0
2.0	500	125.0
5.0	500	20.0
7.0	500	10.2
8.0	500	7.8
9.0	500	6.2
10.0	500	5.0
11.0	500	4.1
12.0	500	3.5
13.0	500	3.0
14.0	500	2.6
15,0	500	2.2
16.0	500	1.9
17.0	500	1.7
20.0	500	1.25
25.0	500	0.8
30.0	500	0.56
35.0	500	0.41
40.0	500	0.31
45.0	500	0.25
50.0	500	0.20