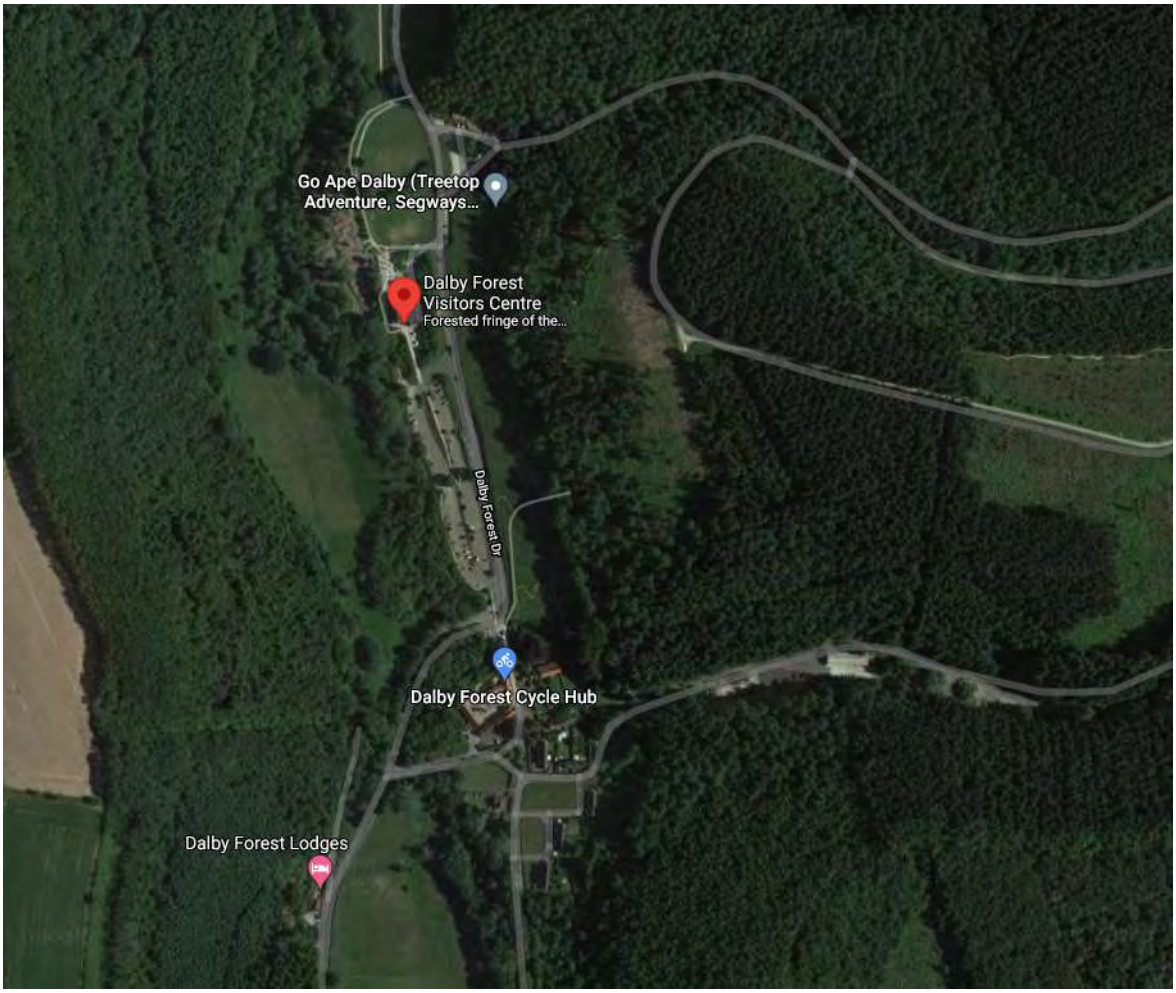

Dark Skies Report

NYMNPA

04/10/2022

For

North York Moors

Stainton Lighting Design Services Ltd

Billingham Reach Industrial Estate

Haverton Hill Road

TS23 1PX

May 2021

Table of Contents

1 Introduction

Dalby Forest Visitors Centre is 6.1 miles North of Pickering off the A170 at Thornton Dale, located on the southern slopes of the North York Moors National Park in North Yorkshire, England.

It is maintained by the UK Forestry Commission. Dalby Forest, along with Langdale Forest and Cropton Forest, forms part of the North Riding Forest Park, found within the North York Moors National Park.

This eco-friendly Visitor Centre is one of the Forestry Commission's first visitor centres with sustainability as its primary focus. Facilities included within are an information desk, Forestry Commission shop, hands-on interactive exhibition area, meeting room, external and internal toilets and Treetops Restaurant with terrace. The Visitor Centre sells maps and booklets about the various walks and cycle trails within the forest and is also the new home of the Dalby Astronomical Centre where events are held throughout the year.

The principle aim of this document is to cover the options available and provide practical advice on mitigating any nuisance or spill light for Dalby Forest replacement lighting proposal. To adhere with Dark Skies viewpoint and guidance the reduction of upward nuisance light to assist in a better view of the night sky is prime importance.

Within this report, we will be considering the environmental impact of the proposed external lighting replacement as follows:

- Alteration to existing functional lighting to main building and surrounding areas.

Future Goals for communities within a Dark Sky Reserve

- Promote eco-tourism and astro-tourism.
- Promote the protection of human health, nocturnal habitats, public enjoyment of the night sky and promotion of the area for professional or amateur astronomy.
- Promote the ideals of the International Dark Sky Association by encouraging other communities to identify a dark sky as a valuable community and tourist asset.
- Promote dark sky and neighbourhood friendly lighting.
- Promote the continuing maintenance of the night sky darkness quality via the production of an annual account of lighting improvements.

2 Methodology

Within this report we have considered the main aspects of the exterior lighting to be as follows:

Firstly, to propose the implementation of a more environmentally friendly, dark skies lighting scheme. There is currently an existing lighting scheme to the site which utilizes several different fittings, mounting heights, locations and functions.

Lighting to the main building and surrounding areas - where the primary function of the lighting installation is to provide a suitable level of illumination to facilitate the use of the visitor centre by both cyclists and pedestrians, provide enough light to feel aware, comfortable and able to leave the Visitor Centre and Bike Hire safely and securely in the hours of darkness.

We understand that safety is key, and the new lighting will do everything it can to help the levels of illumination to the Main building and surrounding areas.

We have endeavored to provide a lighting outline strategy which would assist in the production of a detailed lighting solution. This would take into consideration environmental and geographical conditions and fulfilling the strategy's primary function of minimizing the impact of the proposed lighting to the surrounding environment.

3 Scope

Within the report Stainton Lighting Design Services (SLDS) will outline the key elements of the proposed dark skies lighting scheme for Dalby Forest Visitors Centre, Pickering.

This report will:

- Outline the design ethos and explain the aesthetic aspirations of the schemes
- Identify limitations imposed on the design methodology by the structure and surroundings.
- Provide a brief description of on-site locations, use of the building and key viewpoints.
- Provide information on key areas of activity and illumination.
- Provide site imagery indicating possible installation options and luminaire locations.
- Provide a commentary on the installation of the design options, providing examples of luminaire installations with all significant fixing and mounting arrangements outlined in principle.

3.1 Exclusions

The following items have not been included within the scope of the lighting concept report:

- Electrical power supplies. These are not considered within this report as lights are proposed to be replaced one for one and therefore use existing supplies.
- Lighting control system will be again on a one for one basis utilizing existing controls.
- Planning permissions.

4 Options Report–Dalby Forest Visitor Centre

4.1 Site Description

Dalby Forest is in the Pickering district of the North York Moors National Park, North Yorkshire in England. Dalby Forest is home to an abundance of internationally important wildlife species and is also a designated Dark Sky Discovery Site, where you can experience the magic of seeing the Milky Way with the naked eye.

Glacial valleys to the south create a unique 'rigg and dale' landscape, while the north of the forest sits on an upland plateau. The landscape offers a variety of different trails, whether you are looking for a gentle stroll, challenging bike ride or active run you can do all amid breath taking scenery.

For over 100 years, Dalby Forest have been growing, shaping, and caring for over 1,500 of our nation's forests for the benefit and enjoyment of all, for this generation and the next.

We care for more land and trees than any other organisation in England, shaping landscapes for people, wildlife and timber. We have built over 1,800 miles of walking, running and cycling trails, supplying England's largest amount of sustainably sourced timber, and conserving the homes of thousands of plants and animals.

Forests are vital for the future of our planet. They improve the health and wellbeing of everyone and with careful planning and expert management, our forests will continue to thrive. They help to offset carbon emissions, restore eco-systems and provide people of all ages and abilities with fresh air and spaces to breathe. We are always thinking beyond today, planning and planting forests that will help create a sustainable future.

The visitors centre is situated off the A170, with this being the main entrance to the site. The car parks are allocated for the Visitors' Centre, at the south side of the building, are open plan and not illuminated.

4.2 Existing Lighting

There is existing lighting around the entire site all with different primary functions and consisting of a wide array of fittings.

The hours of operation for the site are generally 09:30 to 17:30, with a locking up procedure including the check of internal lights being switched off. The current system is majority a Passive InfraRed (PIR) system throughout the site.

The existing lighting could be broken down into 'zones' as follows:

- Main Building/Visitor Centre
  - Works Access at Main Building/Visitor Centre
  - Footpath
- Dalby Forest Cycle Hub/Courtyard
  - Cycle Wash Area
- Works Yard & Car Park
  - Warehouse
  - Other Lighting

4.3 Design Methodology and Vision

This section should be read in conjunction with Drawing Numbers SLDS-3665-V1 drawings located within Appendix B of this document.

4.3.1 Aesthetics

The baseline scheme will be to propose a point for point replacement and updated installation, utilising a variety of Zero-degree upward light output ratio (ULOR), warm white no more than 3000 kelvin, LED luminaires. The new lighting proposed will use similar style units to those currently in place but implement a more directional, maintainable and energy efficient luminaire.

4.4 Baseline Scheme

At present there are options available for the replacement installation proposal for Dalby Forest Visitors Centre which will be broken down for each zone in their own individual sections and documents.

Product data sheet identifying possible luminaires to be used can be found in Appendix C.

4.5 Lighting Source Selection

The selection of LED luminaires is partly dictated by current trends within the lighting industry for using energy efficient luminaires. However, using a white light source is also important as the ability to clearly see and distinguish colours and improves the visual acuity of road users and improves users' perception of safety.

Luminaires for the area should be selected and mounted to avoid any nuisance light. Control of the light distribution of installations is necessary in order to limit nuisance light and sky glow. In some cases, lighting can be intrusive at night, e.g. in rural and open areas where lighting can be an intrusion in an otherwise darkened environment.

If floodlight LED luminaires are to be implemented as part of the newly proposed installation for the Dalby Forest Visitors Centre, they should be angled in the downward direction to provide lighting to the task area and limit any spill.

5 Scheme Installation

The scheme will require several varied installation solutions to mount/place all the luminaires in one for one locations or an agreed alternate. There are already several mounting methods in place across the zones within Dalby Forest Visitors Centre and how it has been broken down. The new luminaires, where possible will implement a simpler mounting approach as well as any new methods if they are deemed beneficial to the scheme.

6 Design Comments/Conclusion

The site of Dalby Forest Visitor Centre is quite large in comparison to others like it and consists of 3 different areas of focus for the existing lighting. Therefore, leading to the surrounding and adjoining areas/facilities that need to be taken into consideration when proposing a new dark skies/environmentally friendly lighting scheme for a building such as this.

The mitigation of any nuisance light is key for this upgrade proposal while still providing sufficient illumination to the areas of concern and activity.

The new scheme will utilise directional, well placed and specifically manufactured luminaires so the impact on the surrounding areas will be significantly reduced from the existing scheme, as well as providing a new Zero degree upward light output ratio design. This will be essential to the design, any key viewpoints, and the dark skies specification.

Overall, this document will aim to produce an oversite for the different types of lighting available and all the different approaches to how they can be achieved.

Of all the buildings included in this dark sky report, there is a large amount of variation in existing fitting, purpose, design, age, installation, location and visualization.

Each option detailed is specific to an area and will offer an array of dark sky benefits, while providing an appealing and efficient overall lighting design.

Through the careful integration and selection of equipment, and the suitability of the lighting options, the proposals will have a significant, positive effect upon the surroundings and facilities of Dalby Forest Visitors Centre, while still providing sufficient light and eliminating any existing nuisance light. The schemes should benefit Dalby Forest as well as the North York Moors both on an everyday basis and in the opportunity to promote and celebrate a range of events taking place in the future.

7 Appendix A – Product Information

Please see separate document, North York Moors-Luminaire and Photometry Table combined which will indicate luminaire type, image, name and dimensions. This information is also shown on the individual keys for the sites.

8 Summary

The document mentioned above shows luminaires that are the start of what is hoped to be a growing list of units, specially manufactured with Dark Sky's in mind therefore environmentally protecting the night sky and projecting light in the downward direction to the areas that require illumination.

It is a desire to have a wider range of choices of Luminaires in the near future and will be a developing document as time progresses so is not intended to be an exhaustive nor a limiting list.

When installing lights be it for Commercial, Leisure or Domestic purposes it is an aim that it should only be provided to the areas required, to the level required and with limiting intrusion on neighboring facilities, public, wildlife, flora or fauna. This can be achieved through computer aided design for the larger schemes although, recognizing that domestic use does not fall into this bracket there are some smaller units listed in the mentioned document to help advice and assist on an effective solution to the many varying requirements.

Please also refer to the provided Dark Skies Technical document for any further information.

STAINTON LIGHTING DESIGN SERVICES

Dark Skies Technical Information

For

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Table of Contents

1 Introduction

In this report we will aim to cover all the relevant technical information and content associated with lighting. It will aim to provide an overview into the background of why lighting design is done, the benefits of moving to an LED light source as well as other maintenance factors and recommendations.

2 Technical Lighting Information

2.1 Types of Light Source

To ensure good colour rendering and acceptable colour appearance is provided, it is proposed to utilise luminaires with a warm white LED light source of no more than 3000 kelvin.

Additionally, people in general intuitively prefer white light to yellow light as it is much closer to natural daylight and enables us to see colours in their true shades and achieve a good level of visual acuity.

This is particularly important to play ball sports as determining colour and identifying colour contrast - as is in identifying opposition and team mates as well as assisting in the tracking and identification of the ball. However, good colour rendition and appearance are also useful in car park and road environments to aid object identification, safe movement, facial recognition and perception of safety.

In the last 5 years LEDs have become a viable light source for use in outdoor lighting applications and the technology has improved efficacy (which is measured in lumens per watt) and is a direct indicator as to how much light is emitted from the luminaire for every watt of energy it consumes.

High pressure sodium (SON) is typically around 120 lumens/watts which is extremely efficient. However, the latest generations of LED chip are now in certain circumstances exceeding the 120 lumens/watt figure achieved by SON.

2.2 Lumen Depreciation

This is the term used for how the output of the lamp/light source deteriorates throughout its useful life.

This minimum designed level is expressed as "L" values typically L80 to as high as L95 in real terms the number following the "L" value is the percentage of light output at this point below are some examples.

A Luminaire may have the following figures

L70 @ 100,000 Hours	After 100,00 Hours of operation the LED will be 70% of its initial light output when new.
L80 @ 70,000 Hours	After 70,00 Hours of operation the LED will be 80% of its initial light output when new.
L90 @ 60,000 Hours	After 60,00 Hours of operation the LED will be 90% of its initial light output when new.
L95 @ 50,000 Hours.	After 50,00 Hours of operation the LED will be 95% of its initial light output when new.

As we always design to the level at end of life (maintained levels) once the operating life is known we can select the appropriate lumen depreciation figure.

The actual time to total failure is generally not stated but given the technology is solid state and has no working parts this is expected be a significant length of time.

2.3 Amenity and Car Park Lighting

As the amount of light required to provide appropriate levels for the car parks and access roads is significantly less than sports lighting, the efficacy we can achieve in these application is much better and a very long life can be achieved in the order L90 at a rated life of 100,000 hours.

Given the approximate number of lamp burning hours for the lighting period dusk to dawn per annum is approx. 4,100 hours, usable lamp or chip life is around 25 years.

2.4 Lamp Colour Rendering

This refers to the light source's ability to reveal objects in their true colour as compared to a reference light source and is measured on a scale of 0 to 100 - the higher the value the better the colour rendering properties of the lamp. i.e. pure white light, natural daylight that enables colours to be seen as they would appear in daylight.

The ability of a light source to render colours of objects correctly is quantified by the CIE colour rendering group and the CIE general colour rendering index (Ra):

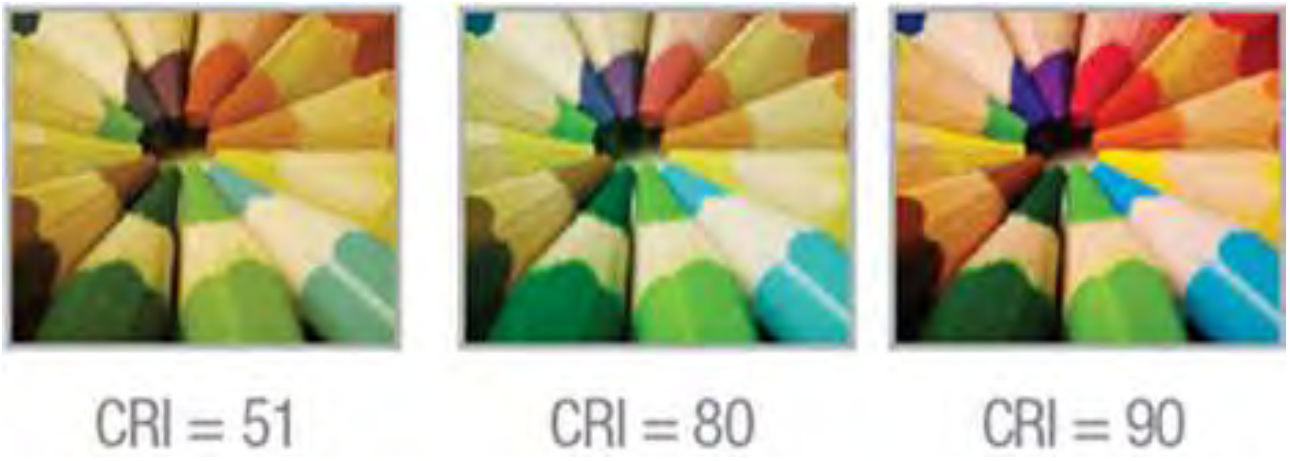
Colour rendering groups	CIE general colour rendering index	Typical Applications
1A	Ra ≥ 90	Critical colour matching
1B	90≥Ra≥80	Accurate colour judgements required for appearance
2	80≤Ra≤60	Moderate colour rendering required
3	60≤Ra≤40	True colour recognition of little significance
4	40≤Ra≤20	Not recommended for colour matching

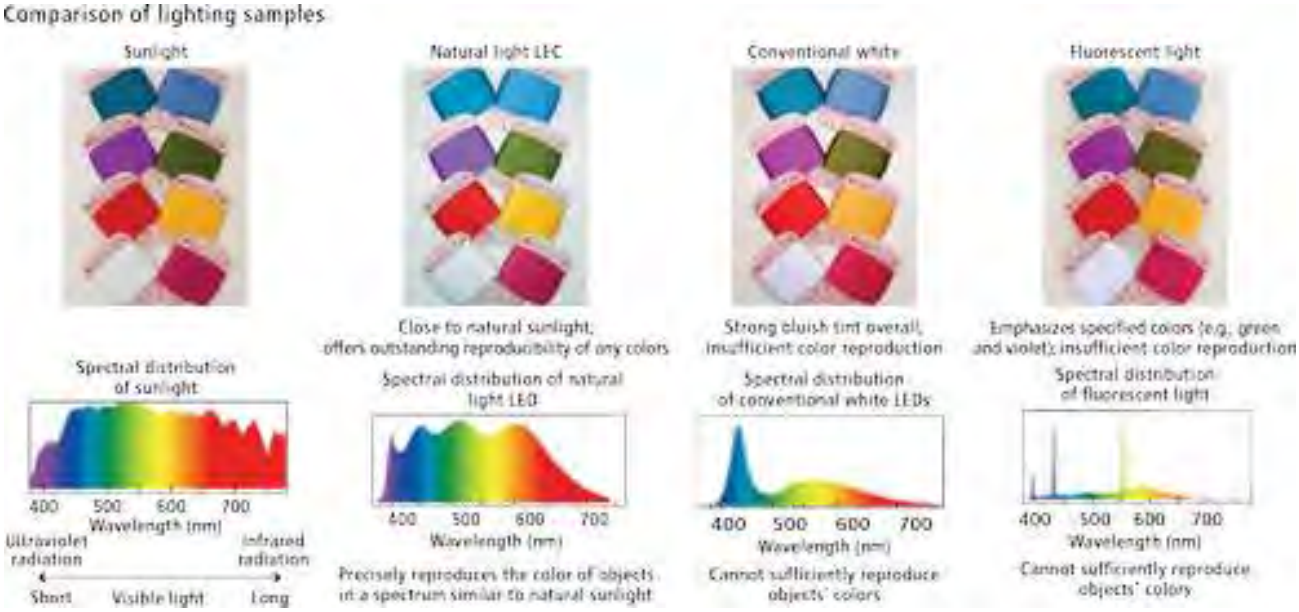
Table - CIE colour rendering index groups

This index is based on how close a set of test colours are reproduced by the lamp under evaluation - relative to how they are reproduced by a reference light source with perfect colour rendering. Perfect matching is given a value of 100.

Below are some images which illustrate the effect of different Ra's on coloured objects.

Below are two groups of images which show the effect of Colour Rendering Index Ra on coloured surfaces





Amenity and Car Park Lighting

As the visual task is different and the identification of small fast-moving objects is not as critical as the absolute ability of the light source to render colour.

There is however still the need to identify colour and to maneuver through the car park or access road as a motorist, or cross safely as a pedestrian, as such good colour rendition is still beneficial. Also, the high colour rendering ability is better suited to widespread use of CCTV systems.

Typical values are:

Low pressure sodium (SOX) yellow appearance	Ra = 0
High pressure sodium (SON) golden yellow appearance	Ra ≥ 25

High pressure sodium (SON-T Comfort) golden white in appearance	Ra ≥ 65
Light emitting diode (LED) used for amenity lighting neutral white appearance (4000K)	Ra ≥ 70
Light emitting diode (LED) used for amenity lighting warm white appearance (3000K)	Ra ≥ 70

The high-pressure sodium lamp has poor colour rendering for the visual task and is still a viable solution for amenity areas and access roads. However, the versatility and efficiency savings which can be achieved using LED make this the preferred solution for the majority of amenity and highway applications.

2.5 Colour Appearance/Colour Temperature

The colour of the light emitted by a 'near white' source is indicated by its correlated colour temperature (CCT). This is a measure of the 'warmth' or 'coolness' of the light emitted by a source and is measured in Kelvin (K). The lower the Kelvin value, the 'warmer' the colour of the light and vice versa.

This becomes a more significant consideration when considering LED as the preferred light source as LED can be specified in a wide range of CCT derivatives - this was not typically the case for other light sources.

The main available CCT in outdoor lighting for LED's are around 5700K (cool white), 4000K (neutral white), 3000K (warm white). This figure must be considered along with CRI as these characteristics are not necessarily linked.

The table below will approximate LED characteristic to common discharge light sources to assist in understanding the difference.

The image below Illustrated the typical variation in artificial light with 1,000K very warm to the left and 10,000K very cold to the right

The 1,000K option will have poor colour rendering properties as the light has too much red content and as such will not reproduce shades of blue and green very

well the 10,000K will give a similar effect as it has too much blue content and as such will not show red colours very well typically. In exterior lighting, typically the best colour rendering is achieved with warm white (3000K) LEDs typically have a minimum Ra of 80-90. Neutral white or cool white (4000K and 5700K respectively) LEDs typically have a minimum Ra of 70.

2.6 Light, Ecology & Health.

When selecting a light source for an outdoor application consideration should be given to the potential effects on the local ecology and general health.

Currently there are many studies being undertaken into the effects of different spectral wavelengths on the human body sleep pattern and ecology - with a lot of emphasis being placed on the amount of "Blue" light emitted by light sources.

Based on current generally accepted studies, effects on humans seem to be influenced by exposure time and proximity to the light source - and not just the level of blue light content.

The table below shows typical blue light from a variety light sources and is taken from a publication produced by U.S. Department of Energy and is titled "Street Lighting and Blue Light - Frequently Asked Questions".

Table 1. Characteristics of Various Light Sources

Row	Light source	Luminous Flux (lm)	CCT (K)	% Blue*	Relative Scotopic Content	Relative Melanopic Content**
A	PC White LED	1000	2700	17% - 20%	1.77 - 2.20	1.90 - 2.68
B	PC White LED	1000	3000	18% - 25%	1.89 - 2.39	2.10 - 2.99
C	PC White LED	1000	3500	22% - 27%	2.04 - 2.73	2.34 - 3.57
D	PC White LED	1000	4000	27% - 32%	2.10 - 2.65	2.35 - 3.40
E	PC White LED	1000	4500	31% - 35%	2.35 - 2.85	2.75 - 3.81
F	PC White LED	1000	5000	34% - 39%	2.60 - 2.89	3.18 - 3.74
G	PC White LED	1000	5700	39% - 43%	2.77 - 3.31	3.44 - 4.52
H	PC White LED	1000	6500	43% - 48%	3.27 - 3.96	4.38 - 5.84
I	Narrowband Amber LED	1000	1606	0%	0.36	0.12
J	Low Pressure Sodium	1000	1718	0%	0.34	0.10
K	PC Amber LED	1000	1872	1%	0.70	0.42
L	High Pressure Sodium	1000	1959	9%	0.89	0.86
M	**High Pressure Sodium**	**1000**	**2041**	**10%**	**1.00**	**1.00**
N	Mercury Vapor	1000	6924	36%	2.33	2.47
O	Mercury Vapor	1000	3725	25%	1.82	1.95
P	Metal Halide	1000	3145	24%	2.16	2.56
Q	Metal Halide	1000	4002	33%	2.53	3.16
R	Metal Halide	1000	4041	35%	2.84	3.75
S	Moonlight	1000	4681 †	29%	3.33	4.56
T	Incandescent	1000	2836	12%	2.23	2.73
U	Halogen	1000	2934	13%	2.28	2.81
V	F32T8/830 Fluorescent	1000	2940	20%	2.02	2.29
W	F32T8/835 Fluorescent	1000	3480	26%	2.37	2.87
X	F32T8/841 Fluorescent	1000	3969	30%	2.58	3.18

* Percent blue calculated according to LSPDD: Light Spectral Power Distribution Database, http://galileo.graphycs.cegepsherbrooke.qc.CA/app/en/home

** Melanopic content calculated according to CIE Irradiance Toolbox, http://files.cie.co.at/784_TN003_Toolbox.xls, 2015

We can see from this table the light sources with the coolest temperature generally are blue-rich, this is unavoidable. To achieve the high CRI, we need blue content as a light source with no blue content cannot render shades of blue. Therefore, for the sports pitch it is almost impossible to select a light source with a low blue content and be able to faithfully perceive the full spectrum of colours.

For this reason, the sports lighting should only be operational whilst in actual use and not be switched on unnecessarily. We would also suggest a voluntary curfew of around 9PM to limit any possible effects the lighting may be perceived to have on the sleep patterns of local residents, or users.

For the access roads and car park lighting we would propose a CCT no greater than 4000K (neutral white) is used and that consideration is given to the use of a warm white solution with a CCT of 3000K, or slightly less if available. This can potentially increase the energy consumption by 7% to 18%, but should add little, or no, capital cost to the proposed lighting. Indeed, users of the site may find that using a warm white light source (in lieu of a neutral white light source),

which will be used virtually every day, creates an improved ambience and feel to the stadium.

Blue-rich light sources can also have an effect on certain insect species attracting them towards the light source. However, given we are promoting the removal of a significant number of poorly-aimed metal halide floodlights, polluting the general environment, and replacing them with new units which, due to the design constraints, will have a significantly reduced environmental impact, this should mitigate against any potential increase in insect influencing factors.

It is a reasonable statement to make that even without the additional measure of using 3,000K luminaires in the car parks and access roads, the general impact of the new scheme can easily demonstrate a reduction in overall impact of artificial lighting beyond the boundary of the site.

Furthermore, as the existing lighting has been in operation for some time in its current form, any potential impact of the lighting on the local ecology has already happened and the ecology could be deemed to have already become adapted.

2.7 Energy Usage

In terms of energy usage, high pressure sodium lighting is generally very efficient.

As an example, the tungsten filament lamp (domestic light bulb) has an output of 10 lumens/watts whilst SON-T plus lamps would be in the order of 120 lumens/watts - approximately 12 times more efficient than a domestic light bulb.

As the lumen output of the lamp is directly related to the designed lighting level, it can be seen to achieve a given lighting level with more lighting points being required if using metal halide lamps as compared with the high-pressure sodium lamps.

This comparison does not, however, give the full picture as there is evidence to support that it is possible where low levels of lighting are required to reduce the lighting level slightly if high colour rendering lamps are used.

In conclusion, the LED lamp is still the first choice for purely functional car park and highway lighting due to its high lumen efficacy, excellent lamp life, and lower whole life costs, and combined with reasonable to good colour rendering.

3 Scheme Risks

3.1 Visual Impact on the Surrounding Area

By using highly controlled optics, and a careful selection of equipment, the impact of the lighting scheme on the environment should be minimal.

The use of LED technology provides a much wider array of optical solutions than would have been available with traditional high intensity discharge lighting. Added to this is the ability to have one 'base' luminaire to which its optical performance is altered by use of secondary 'refracting lens' technologies, and along with the ability of LED to be easily dimmed, allows the final on-site commissioning to make subtle changes to reduce environmental impact without unduly affecting the visual aesthetic.

3.2 Spill Light, Sky Glow & Light Trespass

There will be very little spill light as the majority of luminaires utilise precision optics which ensure the light goes where it is supposed to - rather than being wasted.

All units which are pointed upwards have the ability to be adjusted on site during final commissioning. In addition, some can employ secondary 'refracting lens' technology allowing beam angle and general distribution to be easily altered. Also, a wide array of additional attachments such as horizontal, or vertical, louvers or light shields are available should they be needed.

As none of the fittings are pointed towards any adjacent residential, or commercial, properties, we would not anticipate any light trespass or glare issues.

In relation to adjacent highways, we also do not anticipate any light trespass or glare issues either.

4 Recommendations

4.1 Operational Hours

Given this is a decorative lighting project we would promote the lighting being in operation only between key viewing times such as:

- Sunset until Midnight
  (Scenario A – 2,096 hours per year)
- Sunset until 11pm and 5am until sunrise
  (Scenario B – 2,080 hours per year)
- Sunset until 11pm (Sunday to Thursday) or sunset until 1am (Friday and Saturday) and 5am until sunrise (all week)
  (Scenario C – 2,299 hours per year)

The final switching regime will be determined and agreed in discussion with North York Moors.

5 Stakeholders

As part of the planning process the following key stakeholders should be consulted to ensure the scheme will not impact on their operations or safety:

- North York Moors
- Local Authorities
- Building Operators
- Tenants
- Interested local groups/conservation
- Installation Contractor

There may be other stakeholders who may also require consultation too.

6 Maintenance and Energy

6.1.1 Energy Usage

The newer proposed LED scheme should offer a low degree of energy consumption and maintenance.

6.1.2 Scheme Lifetime

All proposed luminaires are of very high quality and should offer a scheme with long life and high durability.

LED drivers are of all electronic construction and with the potential for long service life. Typical service life for LED drivers is 80,000 to 100,000 hours (19-24 years) with only a maximum of 10% of LED driver failures after this duration.

6.1.3 Maintenance

The scheme will require a degree of regular maintenance including aspects like luminaire cleaning, mechanical inspection of fixings, and general visual inspections. However, in line with previous comments made, we would expect the proposed lighting system should provide many years of service with little, or no, expected luminaire/control gear replacements for many years to come.

6.1.4 Publications Referred To

- Institute of Lighting Professionals publication:
  Guidance Notes for the Reduction of Obtrusive Light (GN01:2011)

7 Glossary and Terms of Reference

Beam Angle

The total angle over which the luminous intensity of a luminaire drops to 50% of the peak beam value.

Colour Rendering

The ability of a light source to render the colours of objects as similar to those under a reference light source, or an acceptable source such as daylight.

Disability Glare

Glare produced directly or by reflection that impairs the visibility of objects without necessarily causing discomfort.

Discomfort glare

Glare which causes a visual discomfort.

Glare

The discomfort or impairment of vision experienced when parts of the visual field are excessively bright in relation to the general surroundings.

Illuminance

The luminous flux density at a surface i.e. the luminous flux incident per unit area. Unit lm-m^2, lux.

Luminance

The average road surface luminance (of a carriageway of a road)

Unit is candelas per square metre (cd/m2)

Lamp flux maintenance factor

The proportion of the initial luminous flux of a lamp that is produced after a set time.

Light trespass

Unwanted light from an installation falling on an area.

Light pollution

Term designating the spillage of a light into areas where it is not desired.

Louvre

A screen geometrically disposed to prevent lamps from being directly visible at a given angle.

Luminaire

Apparatus which distributes, filters or transforms the light emitted by a lamp. It includes all the parts necessary for supporting, fixing and protecting the lamp, but not the lamp itself.

Lux

The SI unit of Illuminance equal to one lumen per square metre.

Sky glow

Localized brightening of the night sky caused by upward light interacting with particles in the air. Upward light comprises light emitted by lighting above the horizontal as well as downward light reflected upwards from illuminated surfaces. This effect is more noticeable on misty nights or when there is a low cloud base.

Spill light

Stray light from a luminaire that incidentally illuminates nearby objects or surfaces in the public environment, this can be a cause of light trespass.

Principal Area (PA)

The actual playing area needed for the performance of a certain sport. Usually this means the actual marked out field area for that sport (for instance football), but in some cases this area comprises an extra playing area around the marked area (e.g. tennis, volleyball, table tennis)

In all tables examples of area sizes are given which are most commonly used for that sport. The particular area dimensions should be checked at the time when designing a lighting installation.

Total Area (TA)

Generally, this comprises the principal area (PA) plus an additional safety area outside the principal area.

Dark Sky Compliant Luminaires for use within the North York Moors National Park

Contents

NYMNPA

04/10/2022

Introduction

This document has been produced by Stainton Lighting Design Services working in partnership and on behalf of the North York Moors National Park in relation to its Dark Sky Status intention.

The Luminaires detailed all give zero upward light output when installed at zero degree's mounting angle. (Horizontal with the ground).

The Luminaires that are detailed here are not the only ones compliant but are an example of units that can be used.

The prices quoted within the document may vary over time with regards to delivery mileage and numbers required but give a basic guide to the purchase price. These costs have been acquired from Exterior Lighting Solutions (ELS) of Killingworth, Newcastle-Upon-Tyne who can be contacted on 0191 256 6123.

Dark Skies Friendly Lighting

Below are some things to considering when looking to change any lighting for dark sky friendly units:

Is the light needed?

Before installing or replacing a light, consider the purpose of the light and what the impact will be on the surrounding area including wildlife and neighbours. Reflective paints or luminous markers can be used as alternatives for marking curbs, steps and paths.

Light only where needed?

Direct light only to where it is needed. Consider pointing any flood lights downwards or change to asymmetric downlights to reduce wasted stray or upward light that can be intrusive to others. If coach style lights must be used, then see advice on light levels and colour temperature.

Light only when needed?

It is rare that lighting needs to be permanently on. Use controls such as timers and or motion detectors to ensure light is dimmed when possible and off when not needed. Light using well positioned sensors is often better for detecting intruders than lights which permanently show what is on offer from a distance and create shadows for criminals to lurk in.

Keep light to a suitable level?

Light should be no brighter than necessary for the task. For unshielded coach style lights, the level should be a maximum of 500 lumens. For other lights with an operational or safety purpose, two lower power shielded down lights are better than poorly angled high-power lights which simply create glare.

Choose the correct colour?

Short wavelength (cool blue) light produces more sky glow and is most harmful to wildlife and human health. Select lights or bulbs that are a maximum of 3000 kelvin and preferably 2700 kelvin.

General Wall Mounted Units

Examples of existing fittings you may find on site



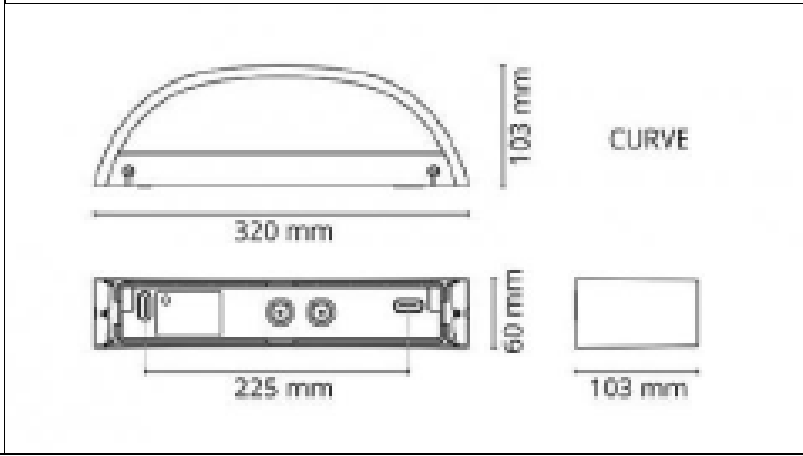
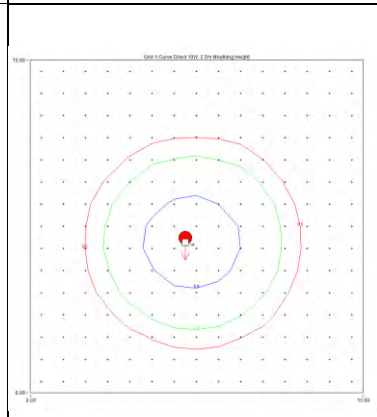
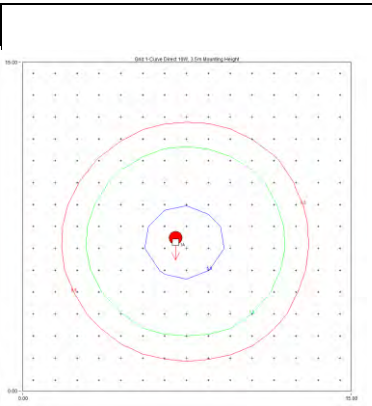
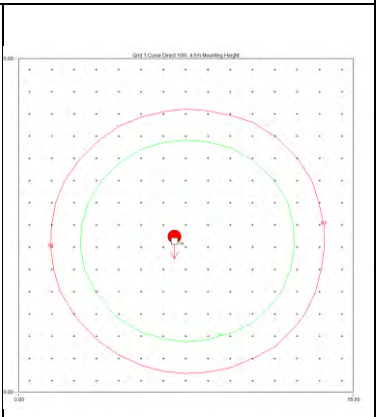











Examples of available fittings that could be used as a Dark Skies compliant replacement						
Type	Image	Quote	Description	Photometric Image		
1S		Curve Direct £85.06 Available in White, Black & Graphite	Curve Direct 2700K 10W 345 Lumen Output CRI of >80. IP65 0% ULOR	10 Watt with 345 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	10 Watt with 345 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	10 Watt with 345 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
						

Type	Image	Quote	Description	Photometric Image		
2S		Edge Direct £85.06 Available in White, Black & Graphite	Edge Direct 2700K 10W 410 Lumen Output CRI of >80. IP 65 0% ULOR	10 Watt with 410 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	10 Watt with 410 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	10 Watt with 410 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
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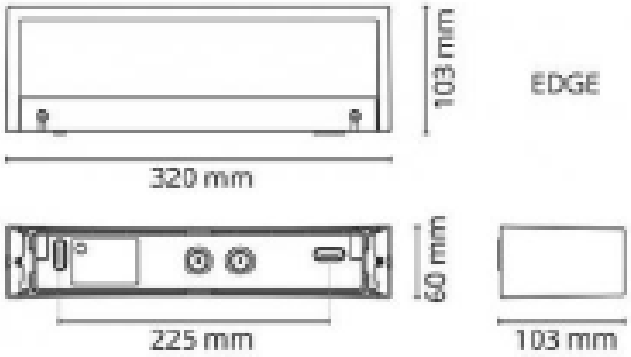
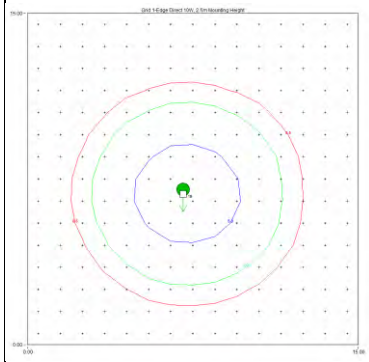
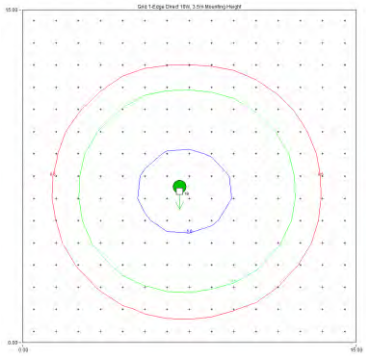
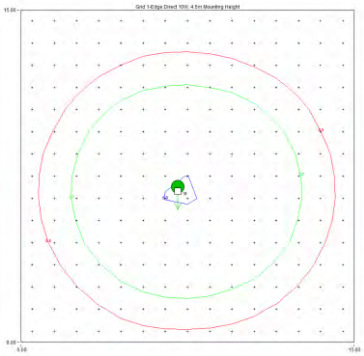
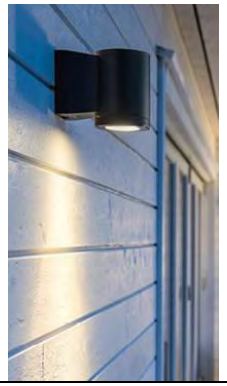
						

Type	Image	Quote	Description	Photometric Image		
3S	 	Metro £47.52 Available in White, Black & Graphite Corner Bracket £5.78	Metro 2700K 4.5W 180 Lumen Output CRI of >80. IP 65 0% ULOR	4.5 Watt with 180 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	4.5 Watt with 180 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	4.5 Watt with 400 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
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	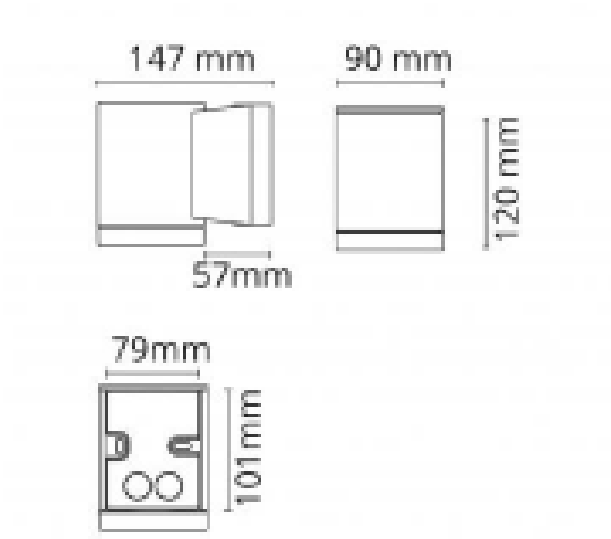			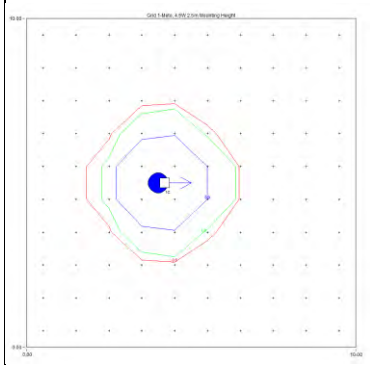	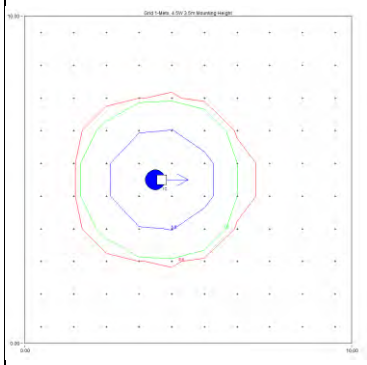	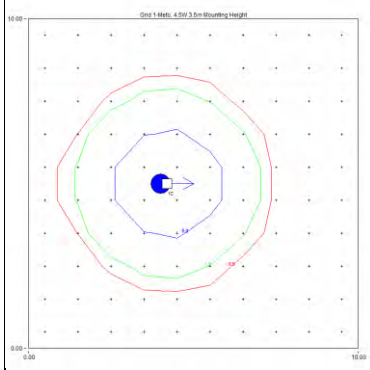

Type	Image	Quote	Description	Photometric Image		
4S	 	Fevik 1100 £99.24 Corner Bracket £32.05	Fevik 1100 3000K 11.5W 14 COB LED 810 Lumen Output CRI of >80 IP65 0% ULOR	11.5 Watt with 810 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	11.5 Watt with 810 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	11.5 Watt with 810 lumen output. Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
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	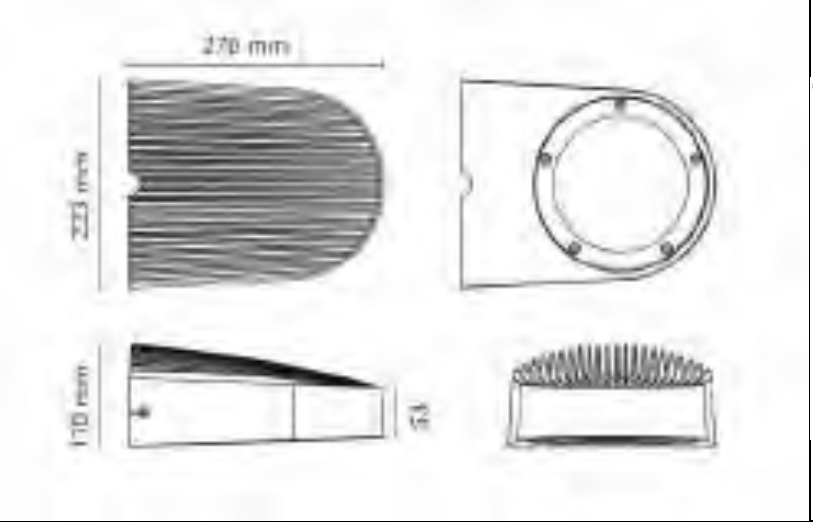			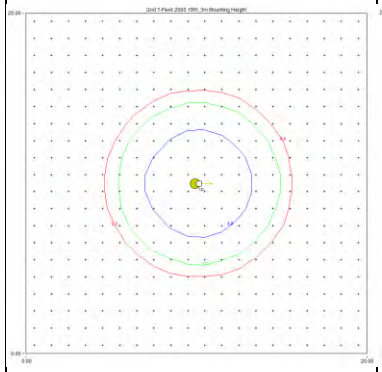	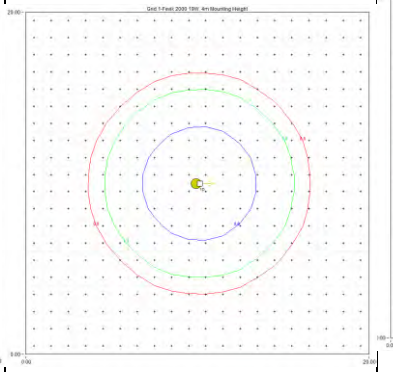	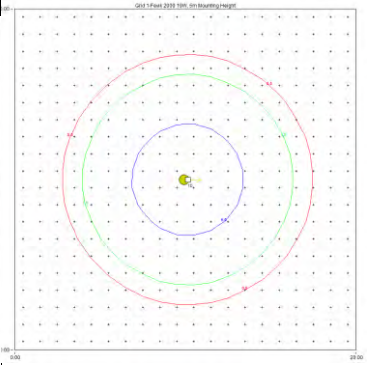

Type	Image	Quote	Description	Photometric Image		
5S		Fevik 2000 £116.82 Corner Bracket £32.05	Fevik 2000 3000K 19W 16 COB LED 1715 Lumen Output CRI of >80 IP65 0% ULOR	19 Watt with 1715 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	19 Watt with 1715 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	19 Watt with 1715 lumen output. Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
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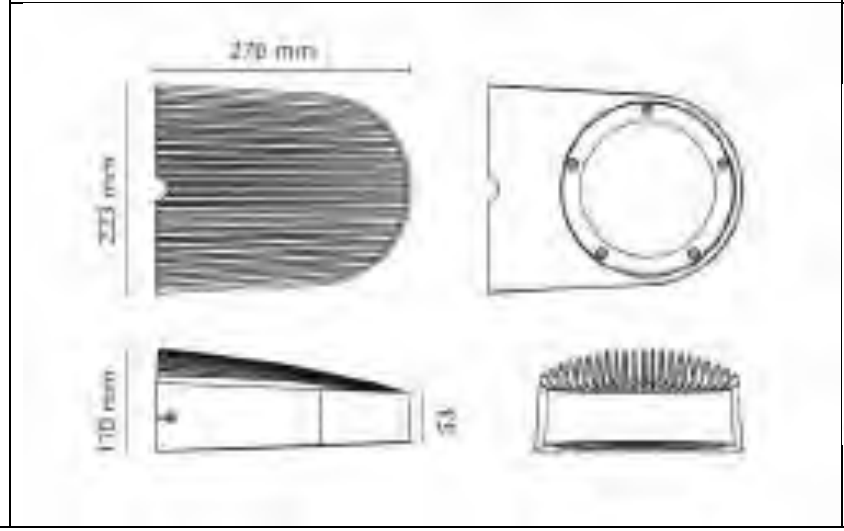
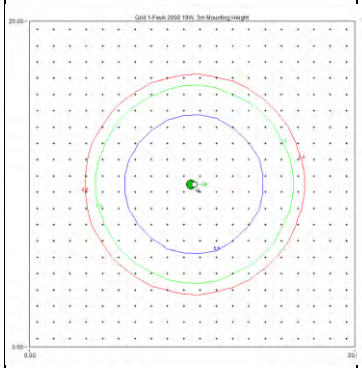
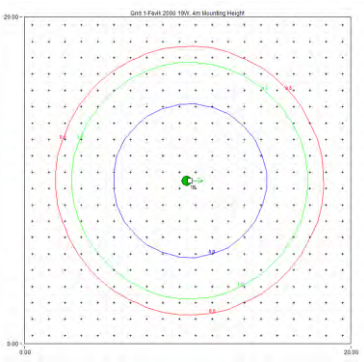
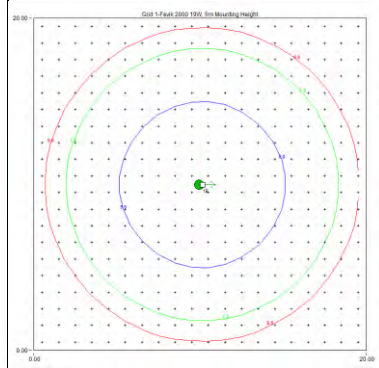
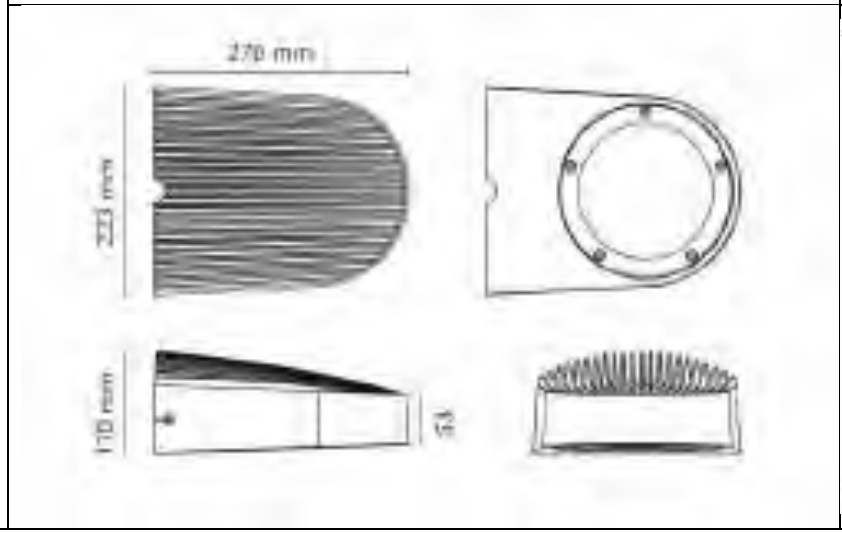
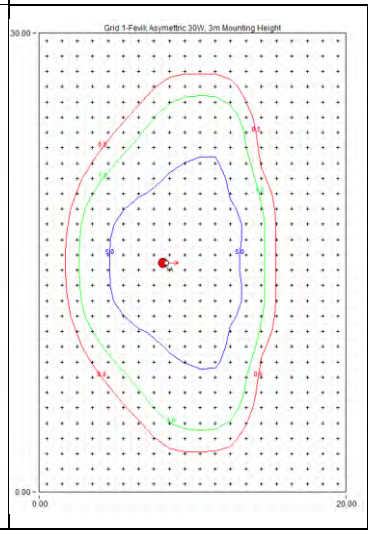
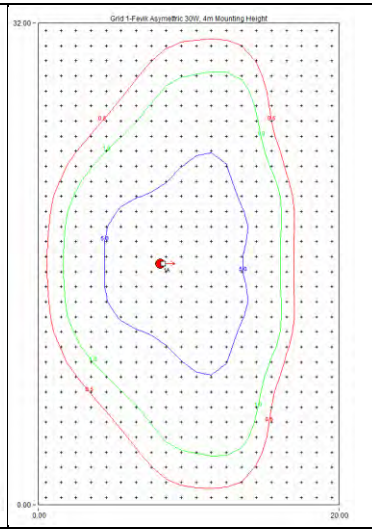
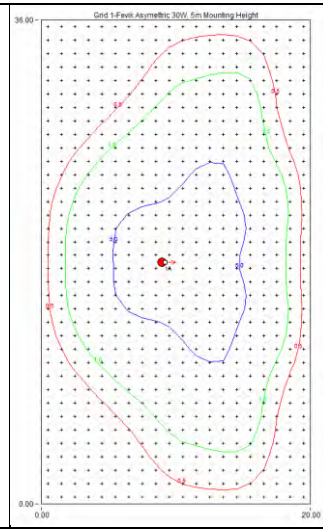
						

Type	Image	Quote	Description	Photometric Image		
6S	 	Fevik Asymmetric £145.44 Corner Bracket £32.05	Fevik Asymmetric 3000K 25W 2320 Lumen Output CRI of >70 IP65 0% ULOR	25 Watt with 2320 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	25 Watt with 2320 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	25 Watt with 2320 lumen output. Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
						

Type	Image	Quote	Description	Photometric Image		
7S		Fevik 3000 £145.44 Corner Bracket £32.05	Fevik 3000 3000K 30W 2535 Lumen Output CRI of >70 IP65 0% ULOR	30 Watt with 2535 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	30 Watt with 2535 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	30 Watt with 2535 lumen output. Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
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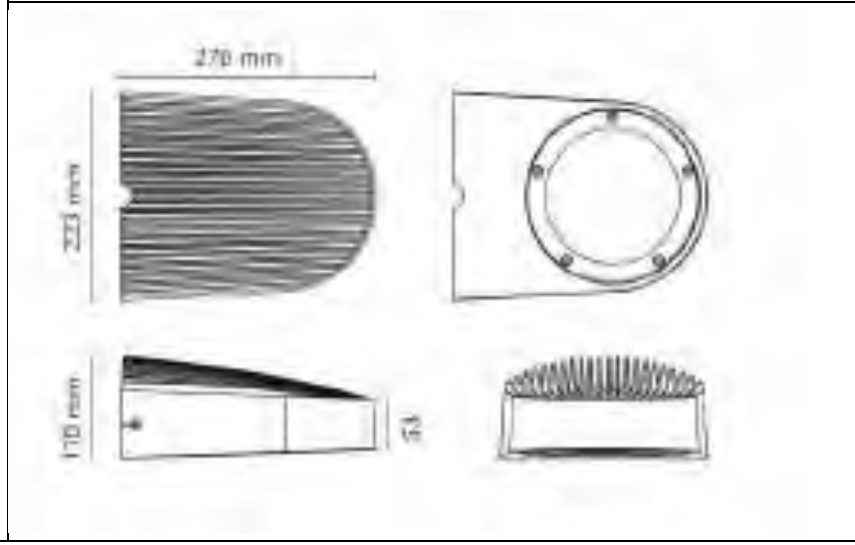
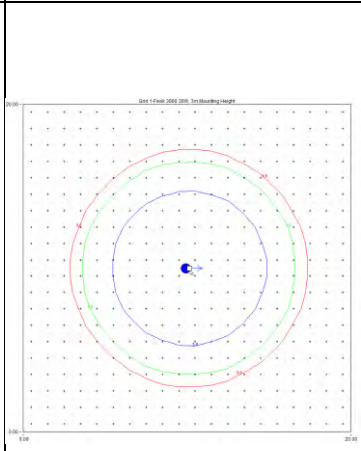
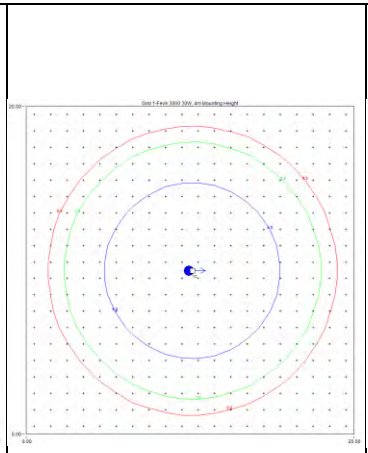
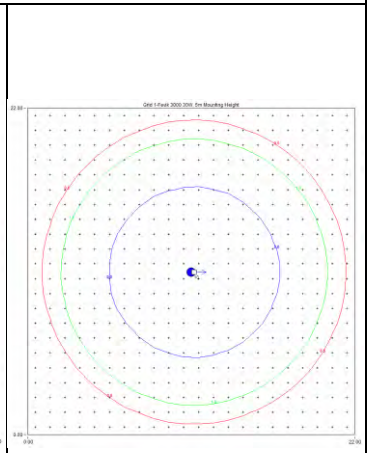
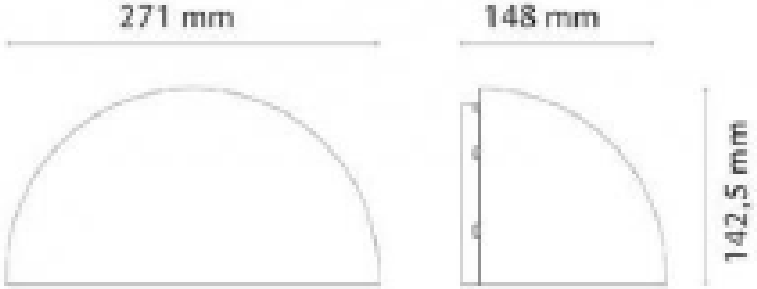
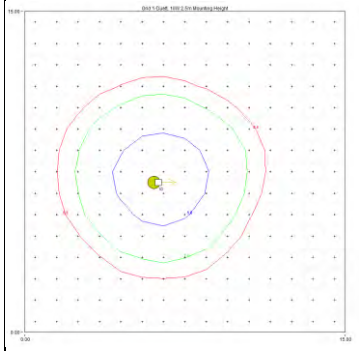
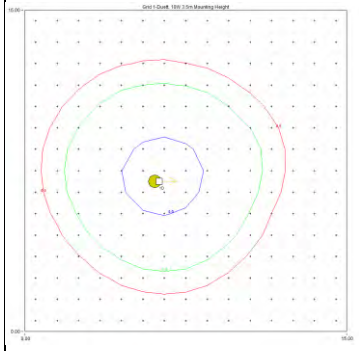
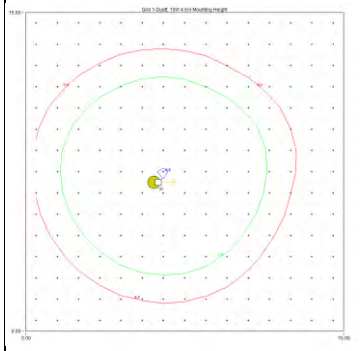
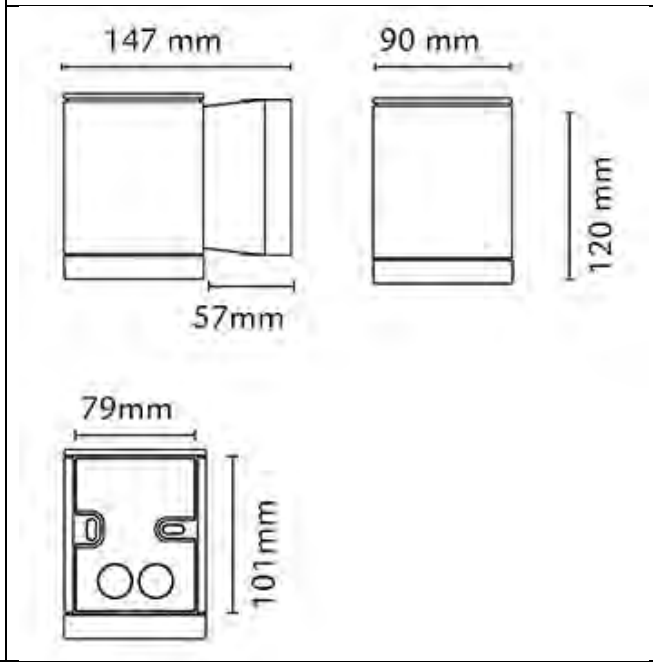
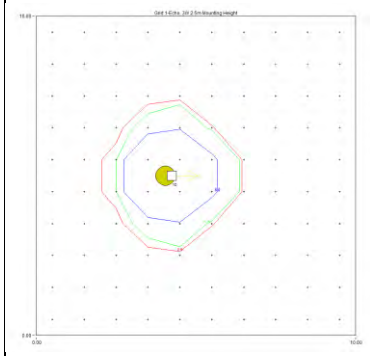
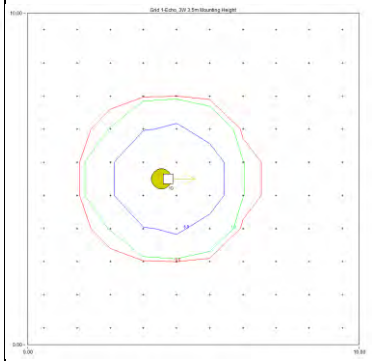
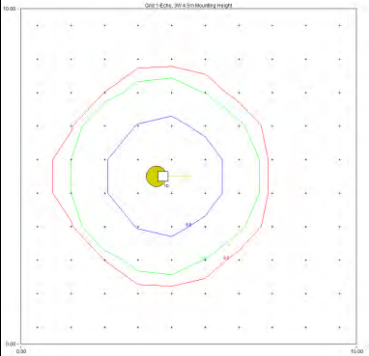
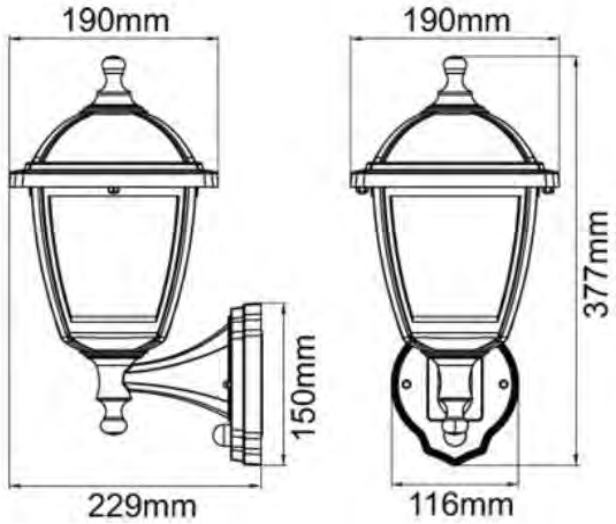
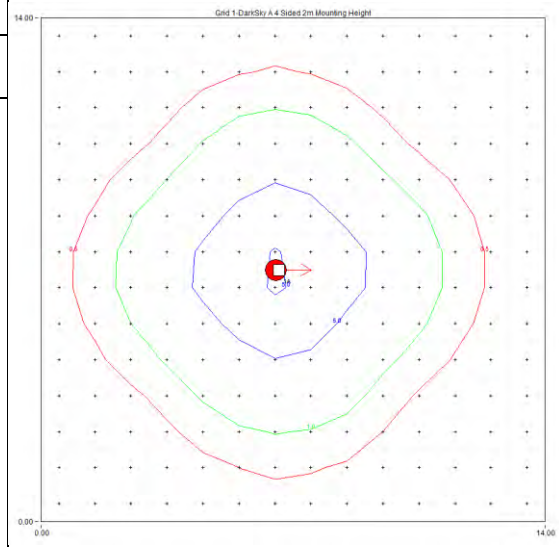
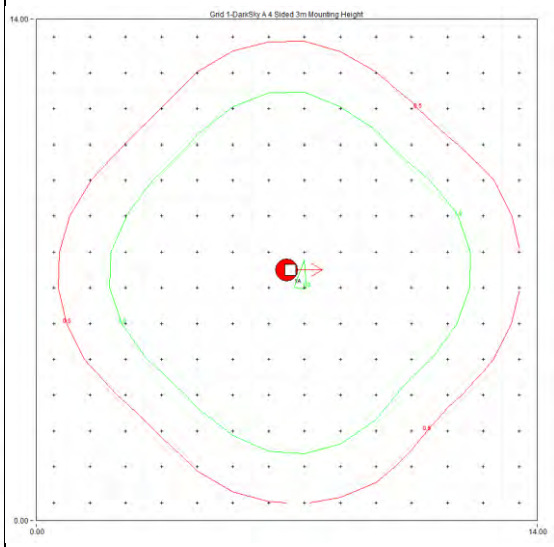
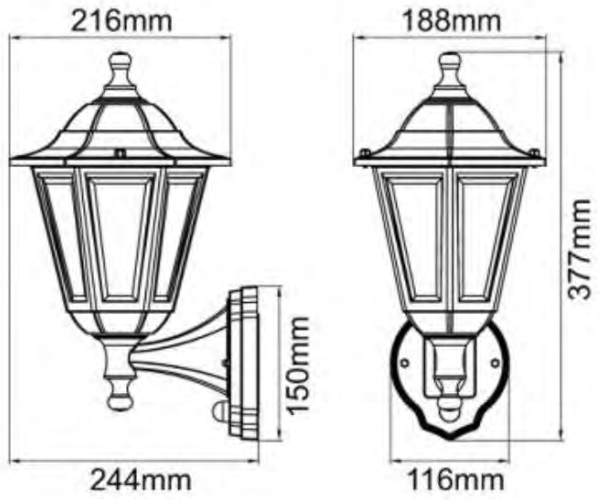
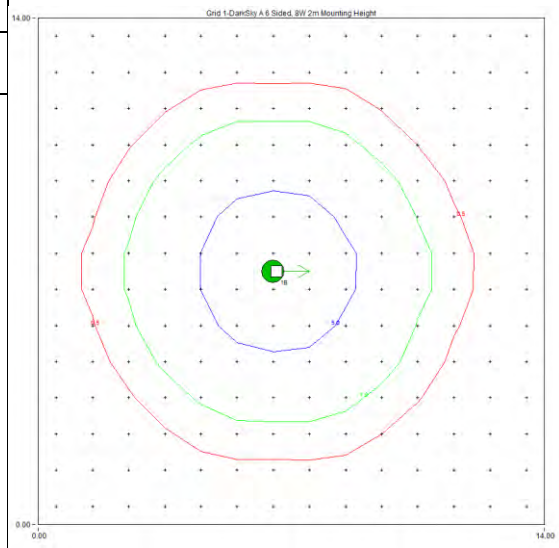
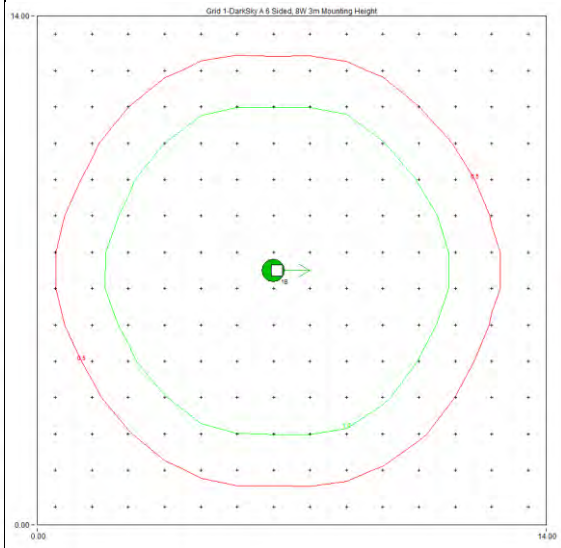
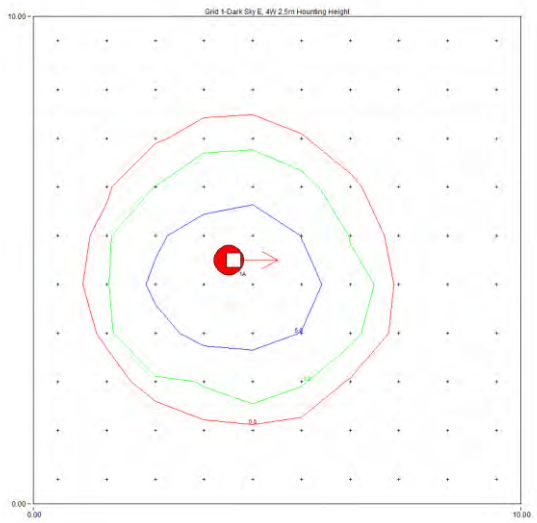
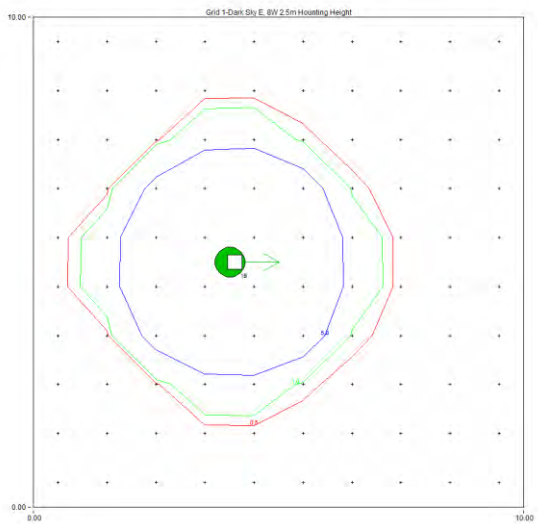
						

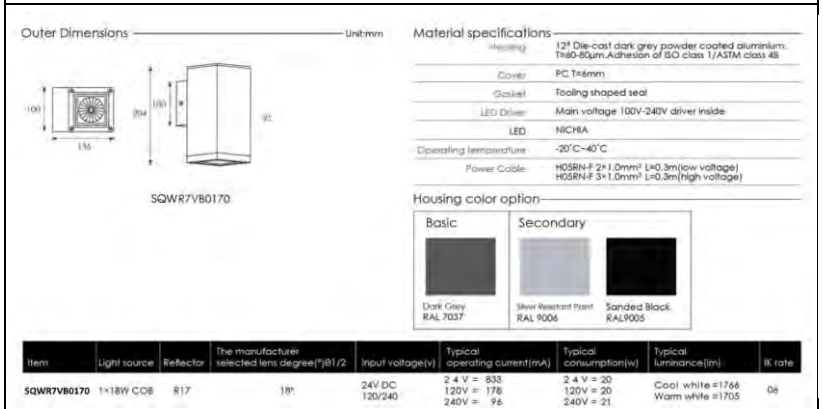
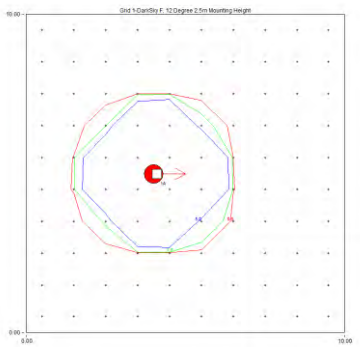
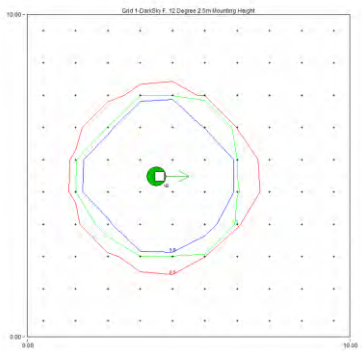
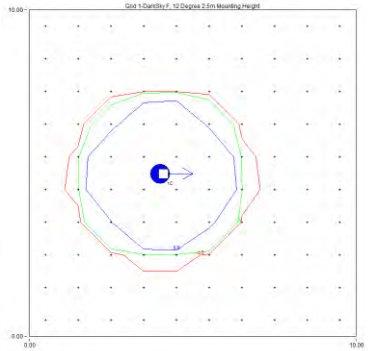
Type	Image	Quote	Description	Photometric Image		
8S	 	Duett £42	Duett 2700K 10W 18W TC-D 350 Lumen Output CRI >80 IP65 (IP44 when mounted as upright) 0% ULOR	10 Watt with 350 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	10 Watt with 350 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	10 Watt with 350 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
						

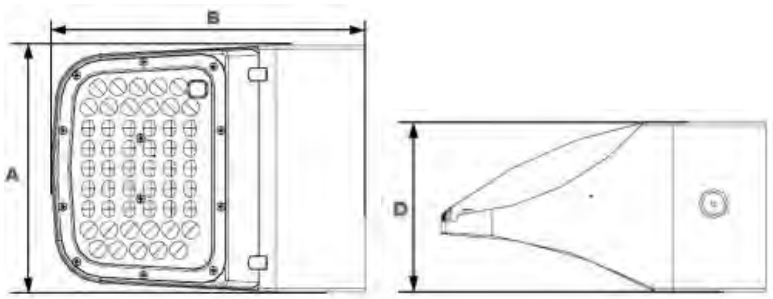
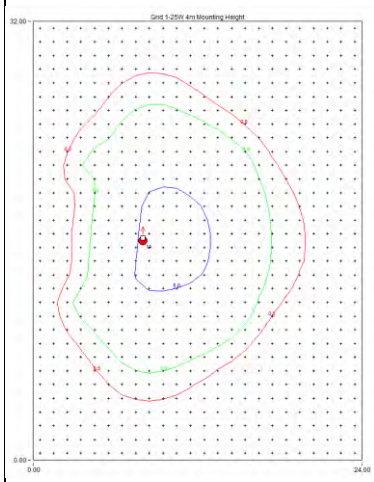
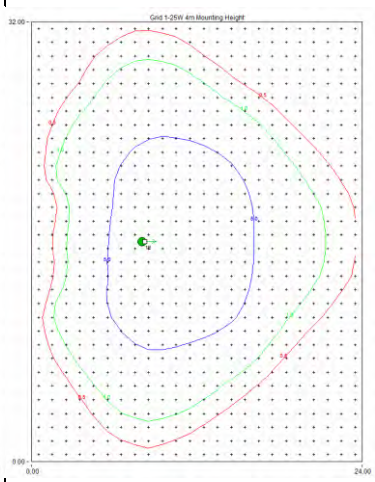
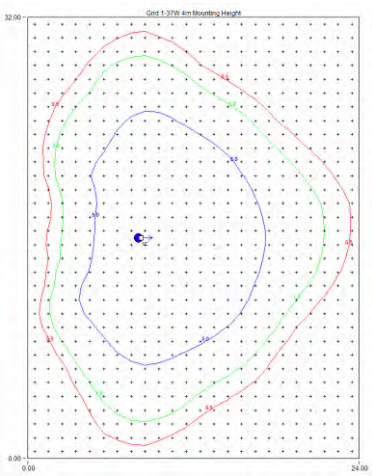
Type	Image	Quote	Description	Photometric Image		
9S		Echo £47.52 Corner Bracket £5.78	Echo 2700 or 3000K 4.5W, 6.2W, 35W, 180 Lumen Output CRI of >80 IP54 0% ULOR	3 Watt with 110 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	3 Watt with 110 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	3 Watt with 110 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
						

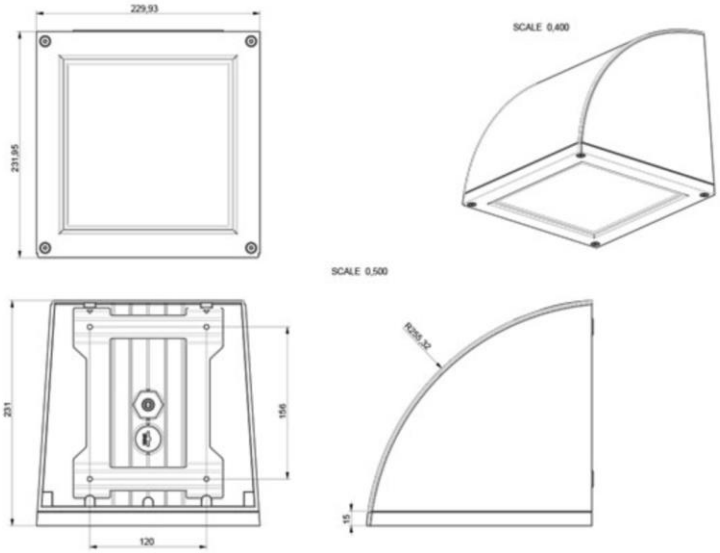
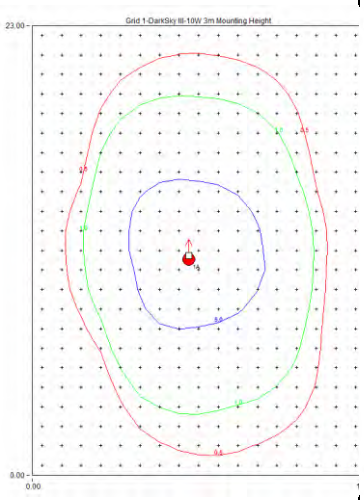
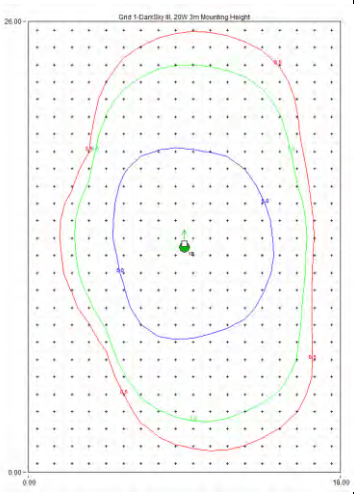
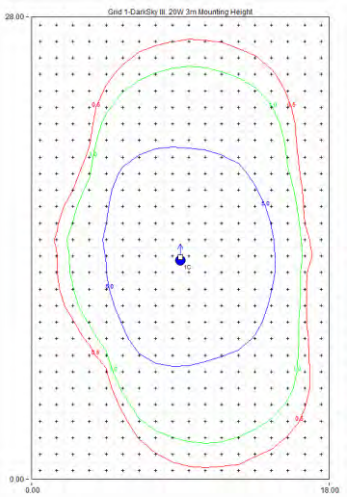
Type	Image	Quote	Description	Photometric Image	
1A		£30.14 £41.36 PIR Available with PIR or Photocell	DARKSKY A 4-Sided 3000K 8W 419 Lumen Output CRI of 85. IP44	8 Watt with 419 lumen output. Mounting height 2m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	8 Watt with 419 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
					

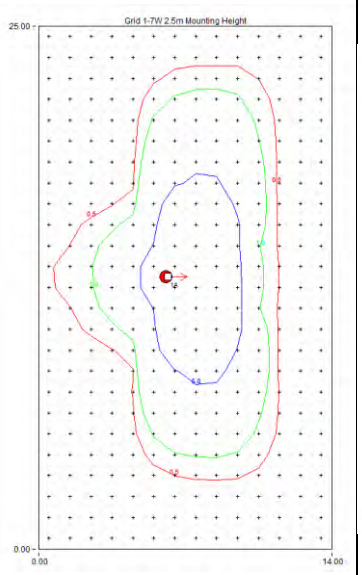
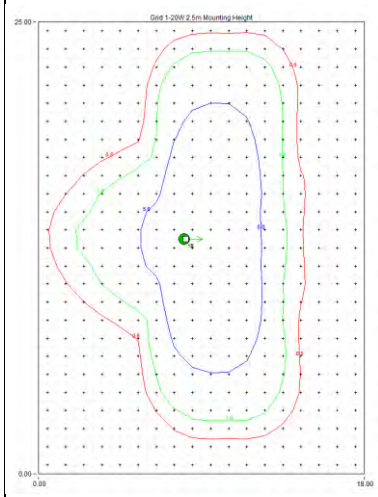
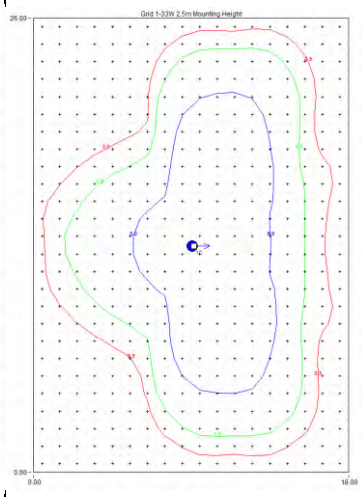
Type	Image	Quote	Description	Photometric Image	
2A		£27.73 £39.28 PIR Available with PIR or Photocell	DARKSKY B 6-Sided 3000K 8W 400 Lumen Output CRI of 85. IP44	8 Watt with 419 lumen output. Mounting height 2m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	8 Watt with 419 lumen output. Mounting height 2m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
					

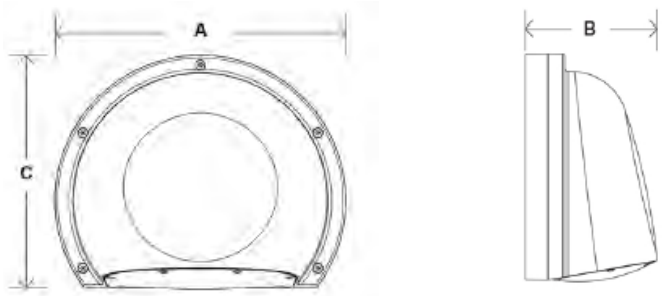
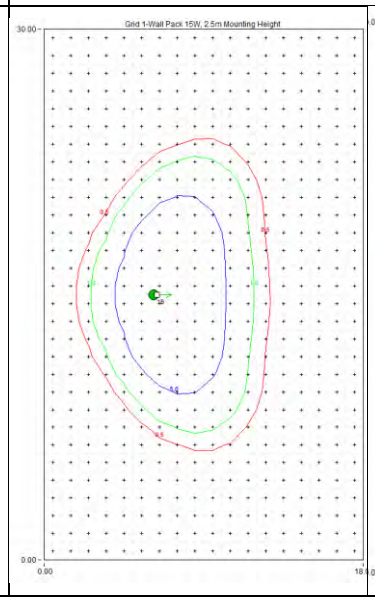
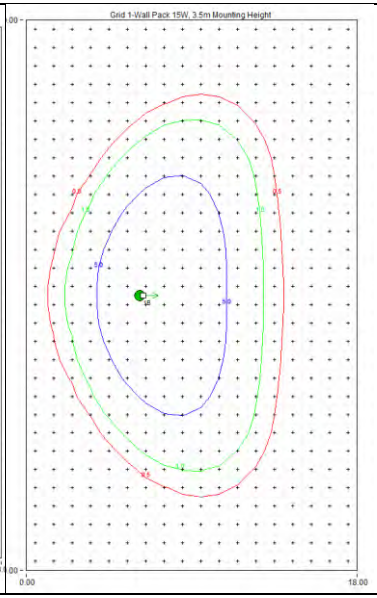
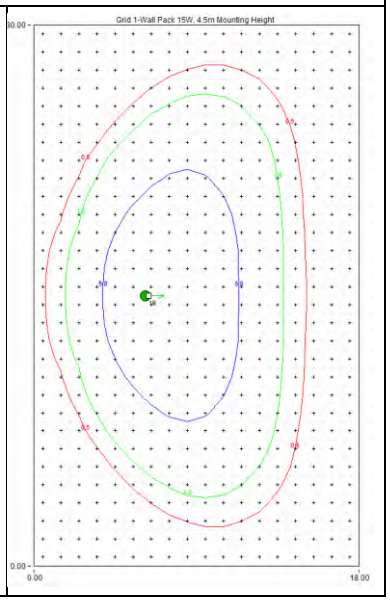
Type	Image	Quote	Description	Photometric Image	
3A		£105.68	DARKSKY E SQ 2000K or 3000K 4W (a), 7W (b), 160-510 Lumen Output CRI of >80. 0% ULOR	4 Watt 3000k with 160 lumen output. Mounting height 2.5m. Points shown are 0.5m from edges and then at 1m spacing. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	8 Watt 3000k with 510 lumen output. Mounting height 2.5m. Points shown are 0.5m from edges and then at 1m spacing. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
					

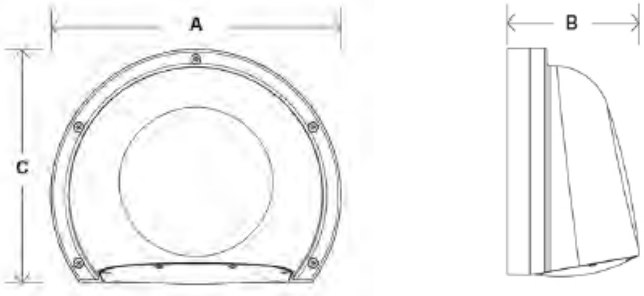
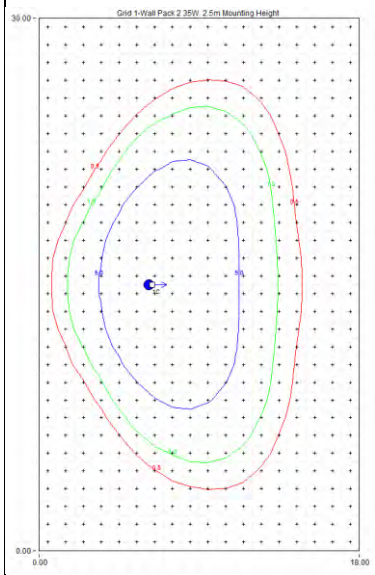
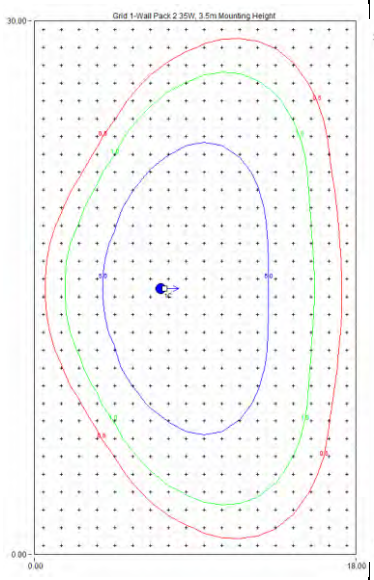
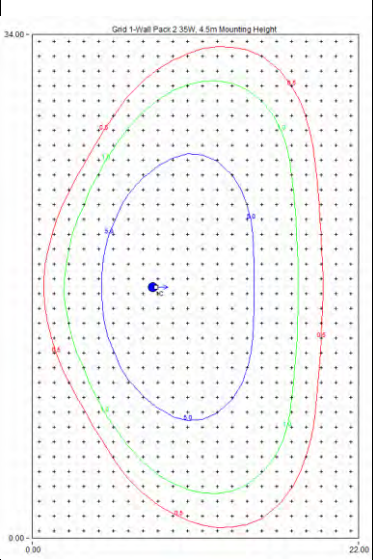
Type	Image	Quote	Description	Photometric Image		
4A		£167.05	DARKSKY F SQDown 3000K 21W 1,690 Lumen Output CRI of >80. 0% ULOR	21Watt 3000k with 1510lumen output. 12 deg Mounting height 2.5m. Points shown are 0.5m from edges and then at 1m spacing. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	21Watt 3000k with 1690lumen output. 18 deg Mounting height 2.5m. Points shown are 0.5m from edges and then at 1m spacing. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	21Watt 3000k with 1390lumen output. 32deg Mounting height 2.5m. Points shown are 0.5m from edges and then at 1m spacing. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions					
						

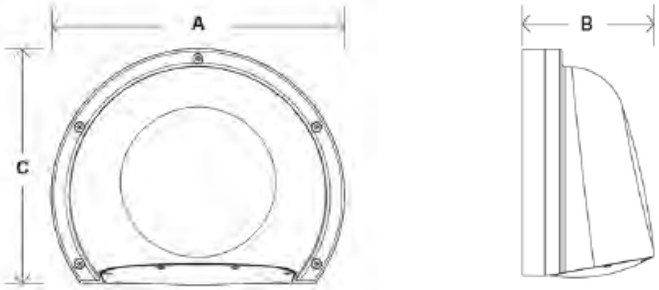
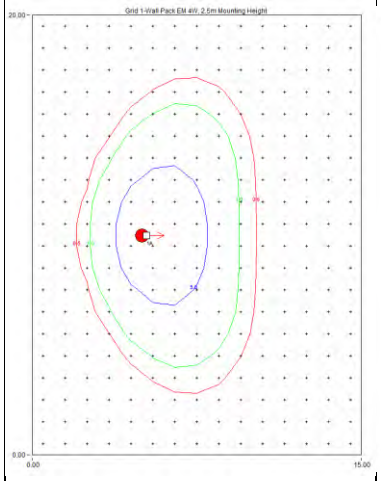
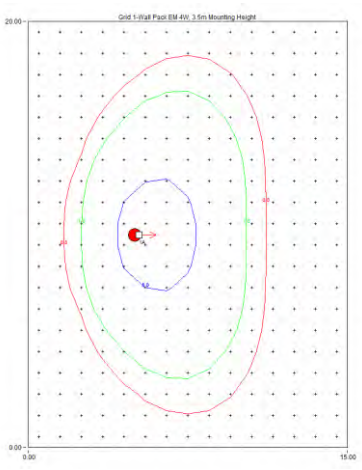
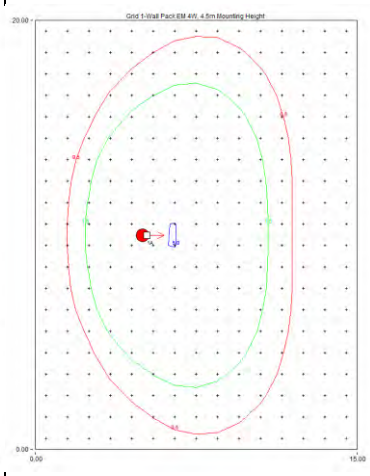
Type	Image	Quote	Description	Photometric Image		
5A		£255.68 £317.09 as emergency Available with PIR or Photocell	Peak Bulkhead. 3000K 525mA 13W (a), 28W (b), 42W (c), 1,100-4,450 Lumen Output CRI of >70. 0% ULOR	13 Watt with 1407 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	28 Watt with 3147 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	42 Watt with 4454 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
	 **Dimensions** Width (D) 220mm Length (B) 280mm Height (A) 146mm					

Type	Image	Quote	Description	Photometric Image		
6A		£248.86 £310.42 as emergency Available with mini-Photocell	Dark Sky III 3000K 200-1050mA 7W (a), 13W (b), 18.5W (c), 26W (d), 39W (e), 12 LED 1193-5269 Lumen Output CRI >70. IP65 0% ULOR	10 Watt with 990 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	20 Watt with 1990 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	30 Watt with 2990 lumen output. Mounting height 3m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
						

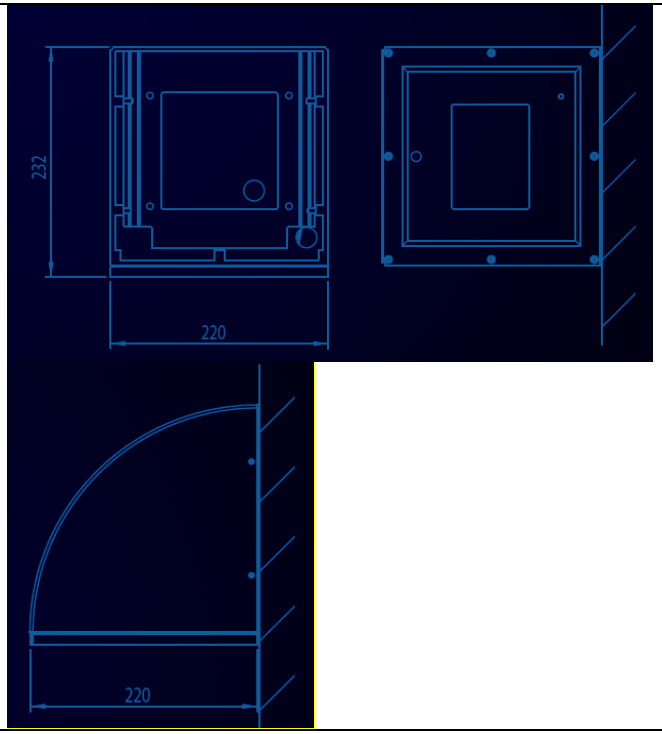
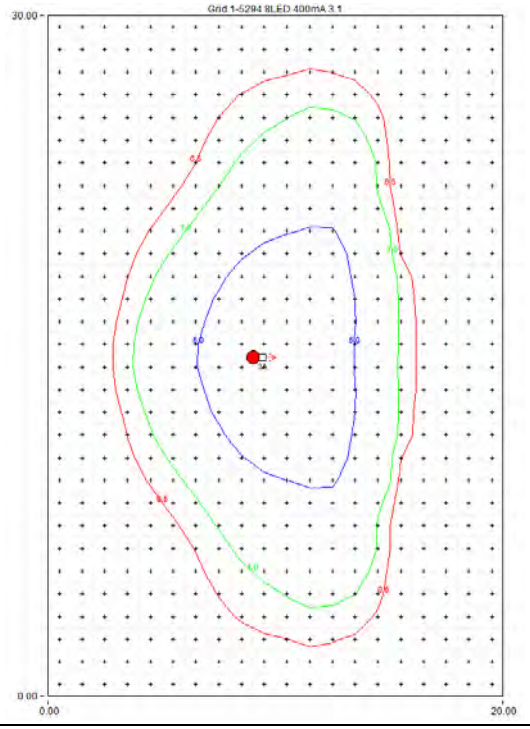
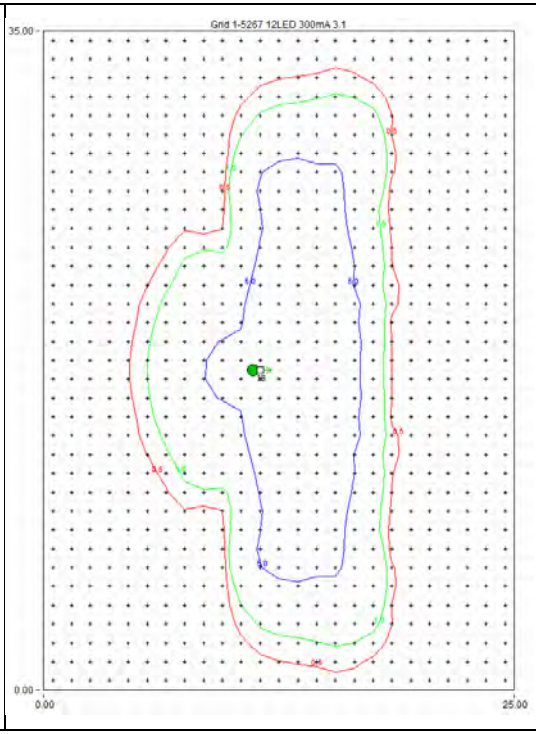
Type	Image	Quote	Description	Photometric Image		
7A		£290.91	i-LED Lightpack 3000K, 7W (a), 20W (b), 33W (c), 1000 to 4500 Lumen Output CRI >70 IP 67 0% ULOR	Approx. 7 Watt with T3 1000 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	Approx. 20 Watt with T3 2490 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	Approx. 33 Watt with T3 4500 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
						

Type	Image	Quote	Description	Photometric Image		
1U	 	INDU Wall Pack 1 £56.27	INDU Wall Pack 1 3000K 15W 24 LED 1,700 Lumen Output CRI of >80. IP 65 0% ULOR	15 Watt with 1,700 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	15 Watt with 1,700 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	15 Watt with 1,700 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
	 AxBxC (mm | inch) INDU WALL PACK 1 - 250x117x201 | 9.8x4.6x7.9 Weight (kg | lbs) INDU WALL PACK 1 - 1.4 | 3.1 Recommended installation height 3m to 6m					

Type	Image	Quote	Description	Photometric Image		
2U		INDU Wall Pack 2 £70.38	INDU Wall Pack 2 3000K 35W 48 LED 4,200 Lumen Output CRI of >80. 0% ULOR	35 Watt with 4,200 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	35 Watt with 4,200 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	35 Watt with 4,200 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
	 AxBxC (mm | inch) INDU WALL PACK 2 - 20x130x257 | 12.6x5.1x10.1 Weight (kg | lbs) INDU WALL PACK 2 - 2.1 | 4.6 Recommended installation height 3m to 6m					

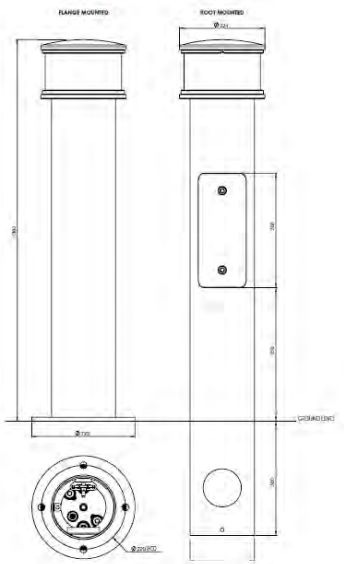
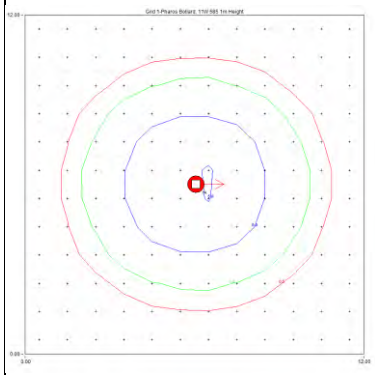
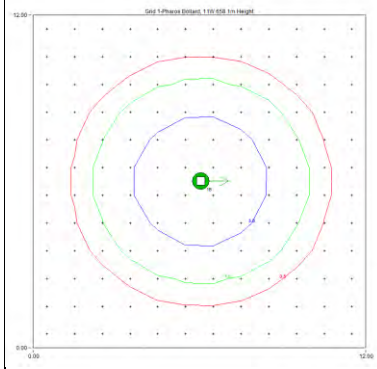
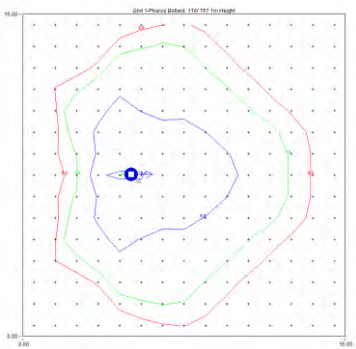
Type	Image	Quote	Description	Photometric Image		
3U		INDU Wall Pack 2 EM £135.24	INDU Wall Pack 2 EM 3000K 4W 400 Lumen Output CRI of >80. IP65 0% ULOR	4 Watt with 400 lumen output. Mounting height 2.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	4 Watt with 400 lumen output. Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	4 Watt with 400 lumen output. Mounting height 4.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
	 AxBxC (mm | inch) INDU WALL PACK 2 EM - 320x130x257 | 12.6x5.1x10.1 Weight (kg | lbs) INDU WALL PACK 2 EM - 2.3 | 5.1 Recommended installation height 3m to 6m					

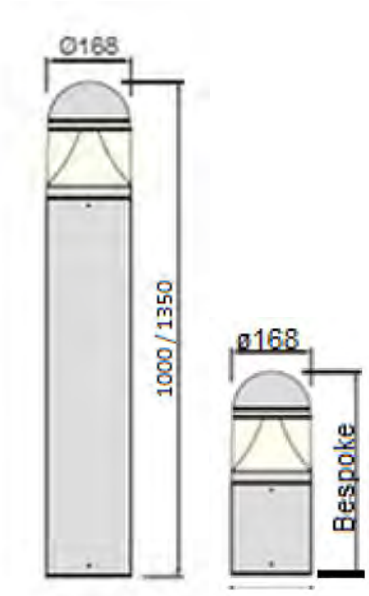
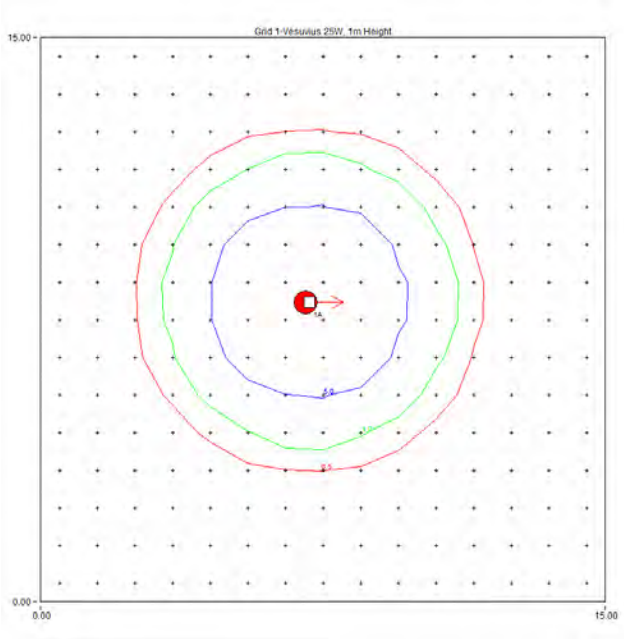
Wall Pack options have multiple optic variations available. Please contact supplier for further information.

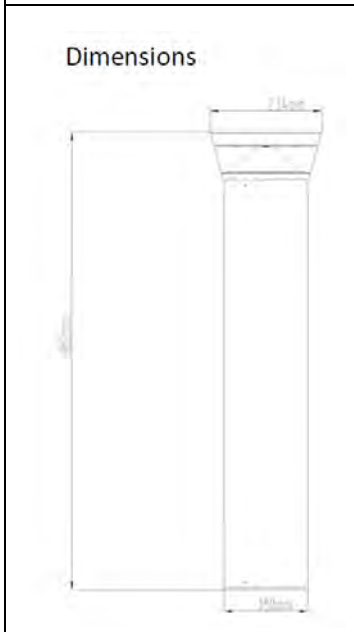
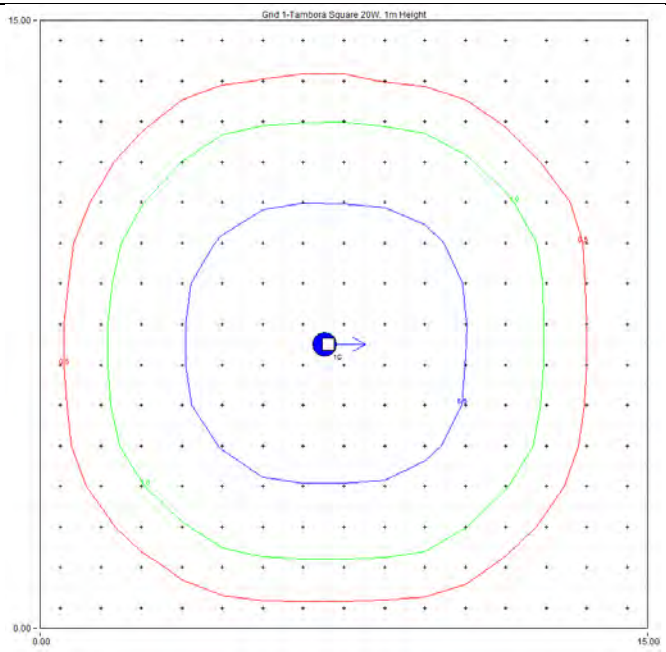
Type	Image	Quote	Description	Photometric Image	
4U		Urbis Wall Pack £197.65	Urbis Wall Pack 2700 or 3000K 8W-44W 8-16 LED 1,000-5,300 Lumen Output CRI >70 0% ULOR IP65 Housing IP66 LED Engine	8 LED, 12 Watt with 1300 max lumen output. 5294 Optic Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	16 LED, 16 Watt with 2100 max lumen output. 5267 Optic Mounting height 3.5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
					

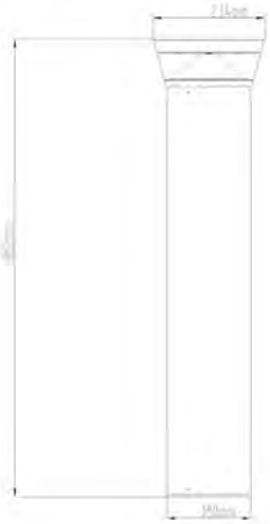
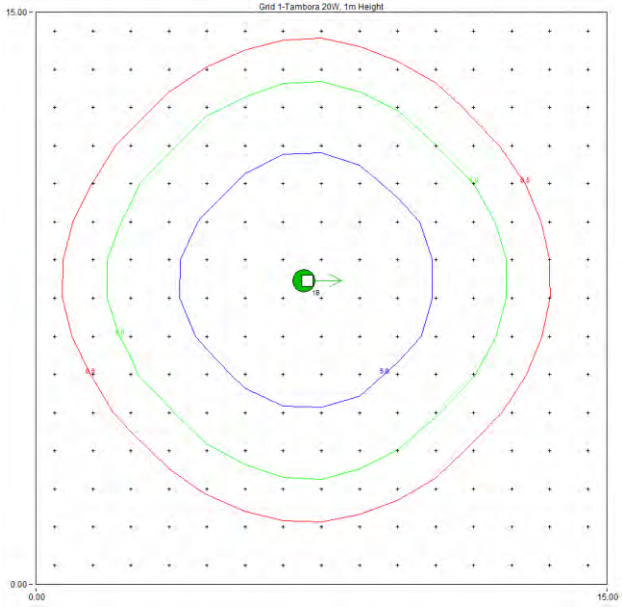
General Bollard Units

Examples of existing fittings you may find on site

Examples of available fittings that could be used as a Dark Skies compliant replacement						
Type	Image	Quote	Description	Photometric Image		
8U		Pharos Bollard £485.29	Pharos Bollard 3000K 11W, 8 LED 585-757 Lumen Output CRI 70. IP66	11 Watt with 585 lumen output. Symmetrical Frosted Mounting height 1m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	11 Watt with 658 lumen output. Symmetrical Mounting height 1m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	11 Watt with 757 lumen output. 5119 Optic. Asymmetrical Mounting height 1m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions	Points shown are 0.5m from edges and then at 1m spacing.				
						

Type	Image	Quote	Description	Photometric Image
8A		£221.59 £33.81 mounting kit Available with mini-Photocell	Vesuvius LED Bollard Maxi & Mini 3000K 12W, 25W, 1650 Lumen Output CRI >70 IP65 0% ULOR	25 Watt with 1650 lumen output. Mounting height 1m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.
				

Type	Image	Quote	Description	Photometric Image
9A		£296.51 £55.68 mounting kit	TAMBORA SQUARE Bollard 3000K 20W 2282 Lumen Output CRI >70 IP66 0% ULOR	20 Watt with 1650 lumen output. Mounting height 1m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.
				

Type	Image	Quote	Description	Photometric Image
10A		£296.51 £55.68 mounting kit	TAMBORA Round Bollard 3000K 20W 2409 Lumen Output CRI >70 IP66 0% ULOR	25 Watt with 1650 lumen output. Mounting height 1m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.
	Dimensions 			

General Floodlight Units

Examples of existing fittings you may find on site








Floodlight options have multiple optic variations available. Please contact supplier for further information.

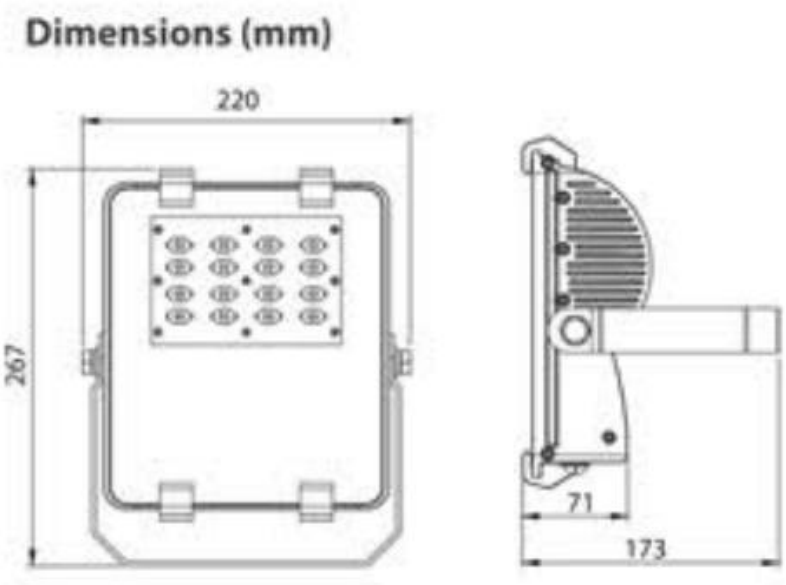
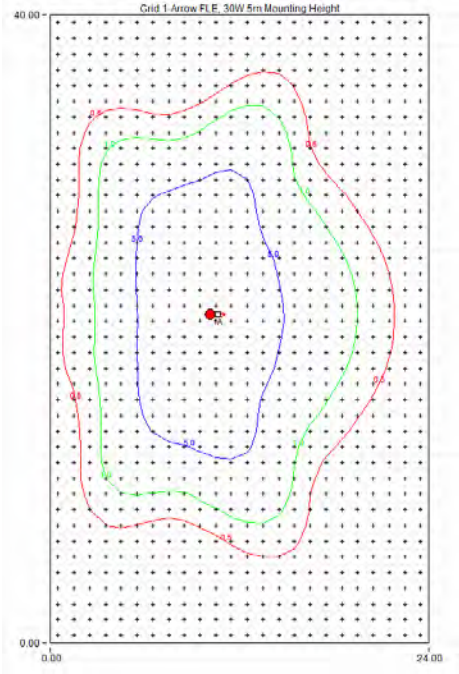
<table>
<tr><td colspan="5">Examples of available fittings that could be used as a Dark Skies compliant replacement</td></tr>
<tr><td>Type</td><td>Image</td><td>Quote</td><td>Description</td><td>Photometric Image</td></tr>
<tr><td rowspan="3">11A</td><td>  </td><td>£130.68

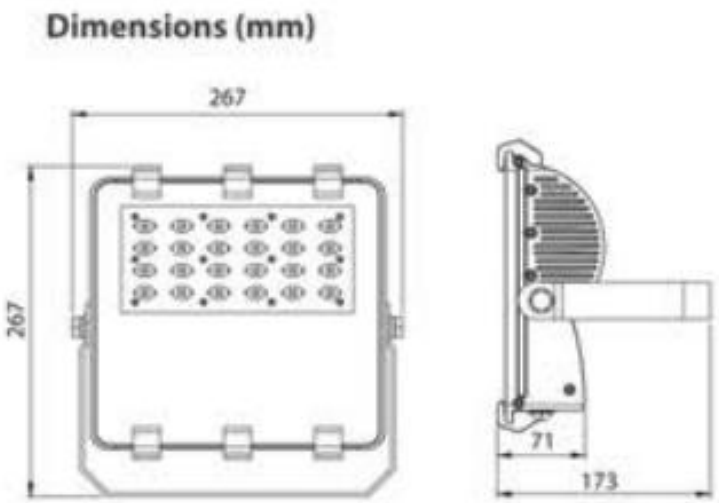
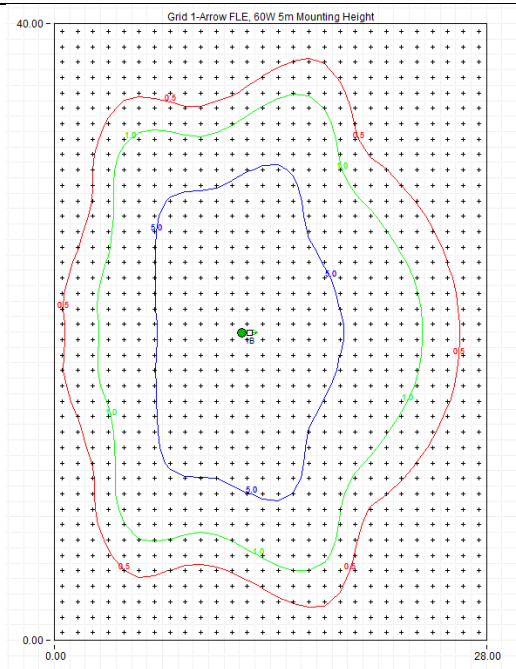
Available with mini-Photocell</td><td>ARROW Mini ALUX-FLE
3000K
30W & 40W
3,150-4200 Lumen Output,
CRI >70.
IP65

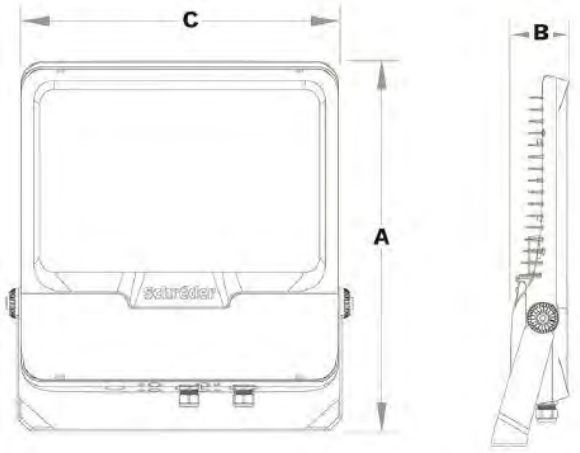
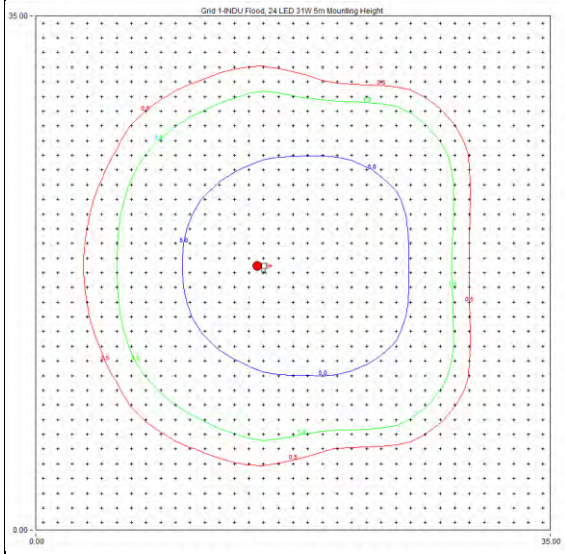
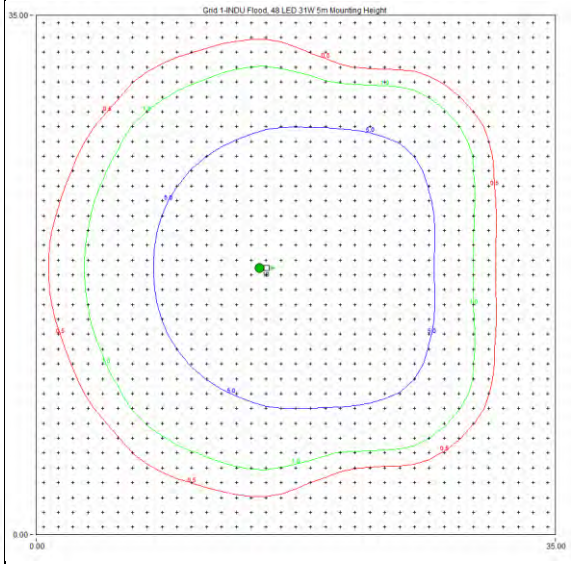
0% ULOR
(Subject to tilt)</td><td>30 Watt Arrow Flood with 3150 lumen output.

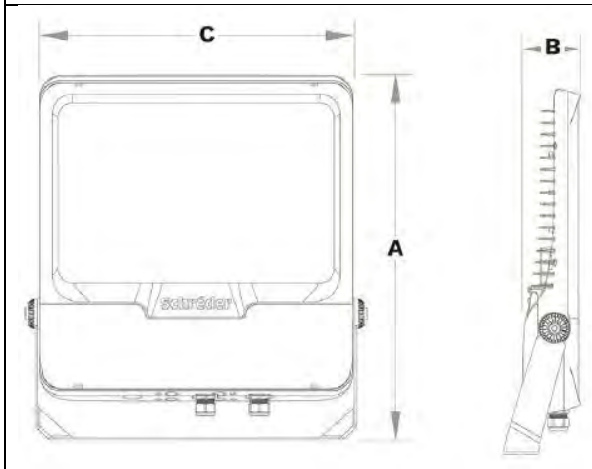
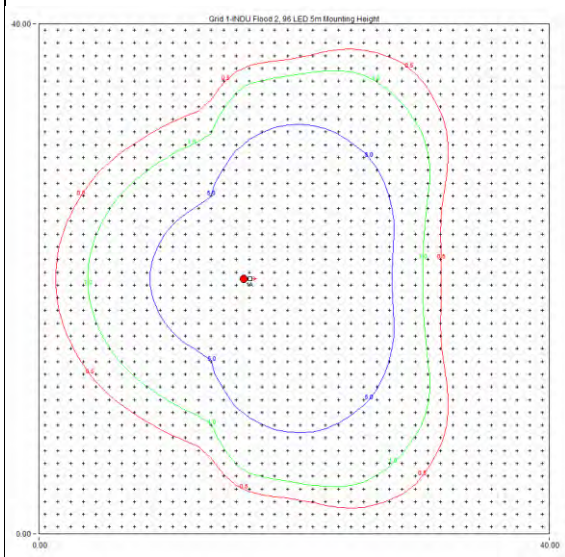
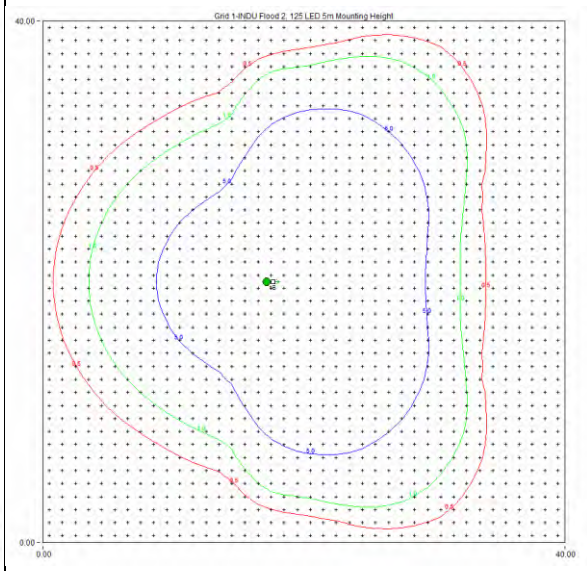
Mounting height 5m.

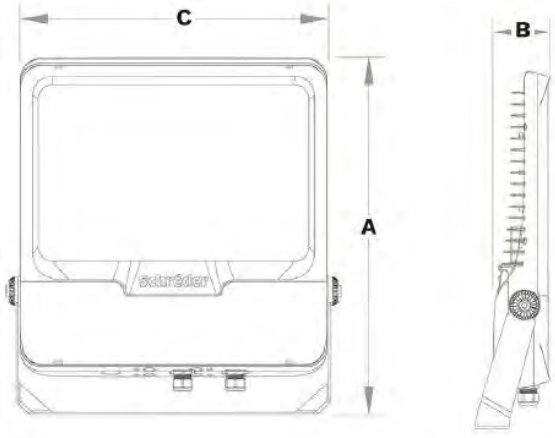
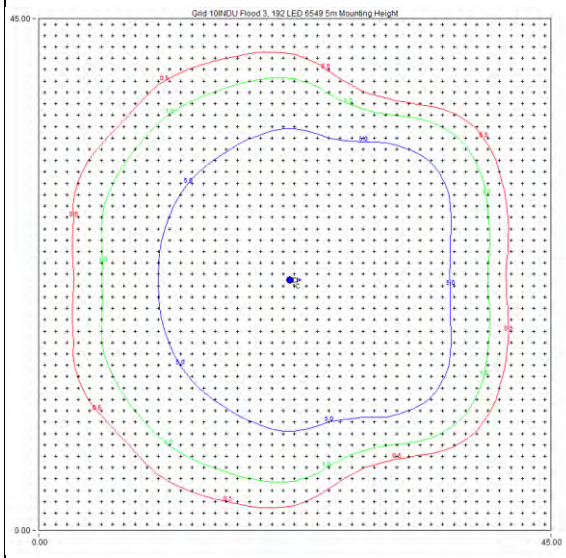
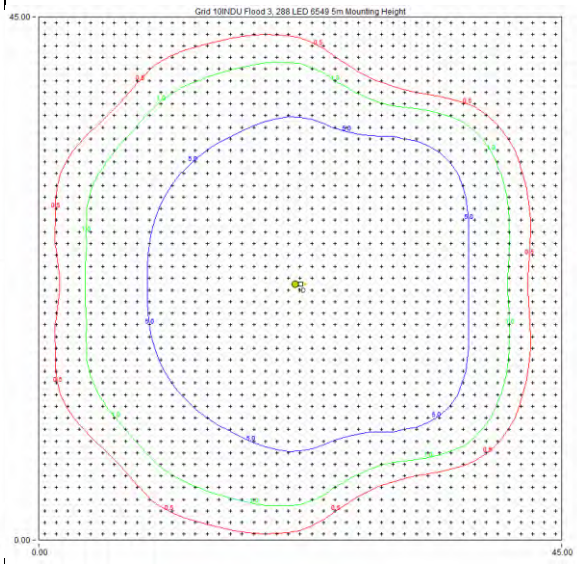
Contour lines
Blue=5 Lux,
Green=1.0 Lux,
Red=0.5 Lux.

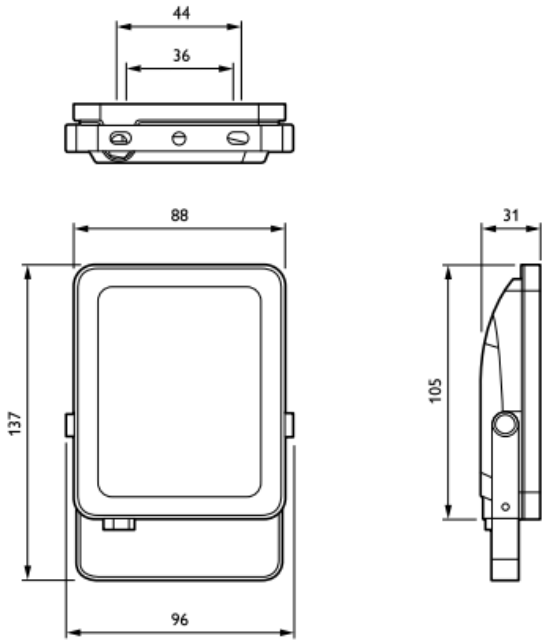
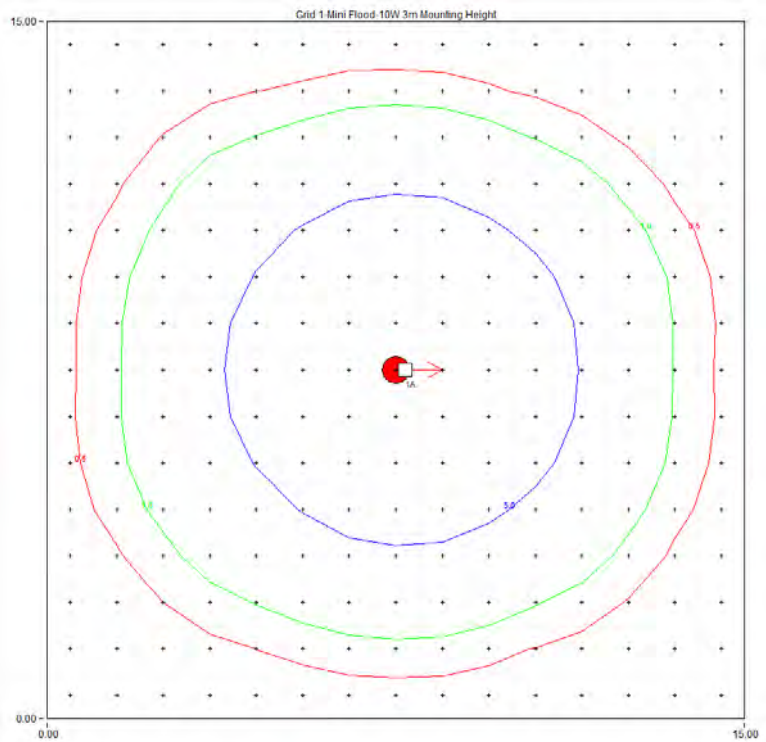
Typical full moon approx. 0.1Lux</td></tr>
<tr><td colspan="3">Dimensions</td><td>Points shown are 0.5m from edges and then at 1m spacing.</td></tr>
<tr><td colspan="3"> 
</td><td> 
</td></tr>
</table>

Type	Image	Quote	Description	Photometric Image
12A		£130.68 Available with mini-Photocell	ARROW Mini ALUX-FLE 3000K 50W & 60W, 5,250-6,300 Lumen Output, CRI >70. IP65 0% ULOR (Subject to tilt)	60 Watt Arrow Flood with 6300 lumen output. Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.
				

Type	Image	Quote	Description	Photometric Image	
5U		INDU Flood Gen2 1 £127.99 to £150.94	INDU Flood Gen2 1 Floodlight 3000K 31W or 63W, 24-48 LED 3,800-9600 Lumen Output CRI >70. IP66 0% ULOR (Subject to tilt)	24 LED, 31 Watt with 4,800 lumen output. 6549 Optic Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	48 LED, 31 Watt with 9,600 lumen output. 6549 Optic Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
	 INDU FLOOD GEN2 1 AxBxC (mm | inch) 390x77x321 | 15.4x3.0x12.6 Weight (kg | lbs) 5.6 | 12.3 Recommended installation height 3m to 16m				

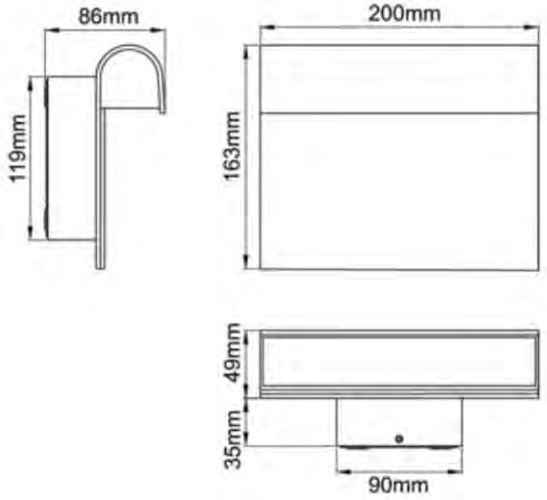
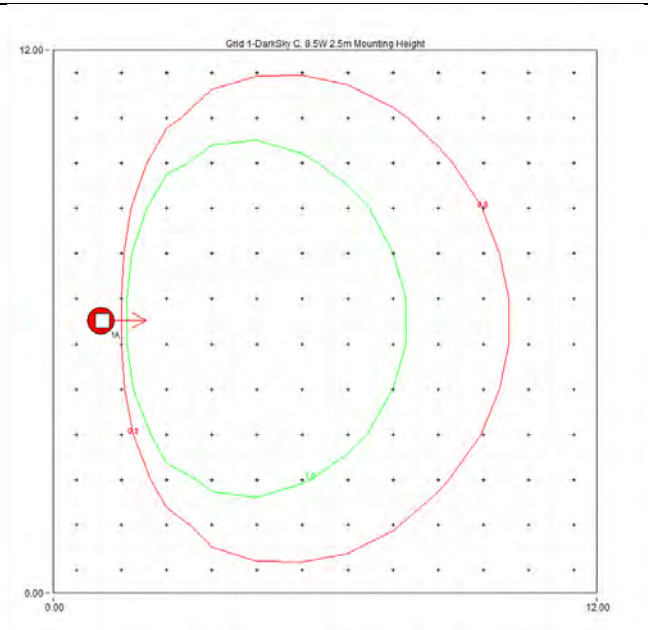
Type	Image	Quote	Description	Photometric Image	
6U		INDU Flood Gen2 2 £209.31 to 231.29	INDU Flood Gen2 2 Floodlight 3000K 125W or 190W, 96-144 LED 15,800-29,200 Lumen Output CRI >70. 0% ULOR (Subject to tilt)	96 LED, 125 Watt with 19,500 lumen output. 6547 Optic Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	144 LED, 125 Watt with 29,200 lumen output. 6547 Optic Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
	 INDU FLOOD GEN2 2 AxBxC (mm | inch) 492x77x421 | 19.4x3.0x16.6 Weight (kg | lbs) 2-8.8 | 19.4 Recommended installation height 3m to 16m				

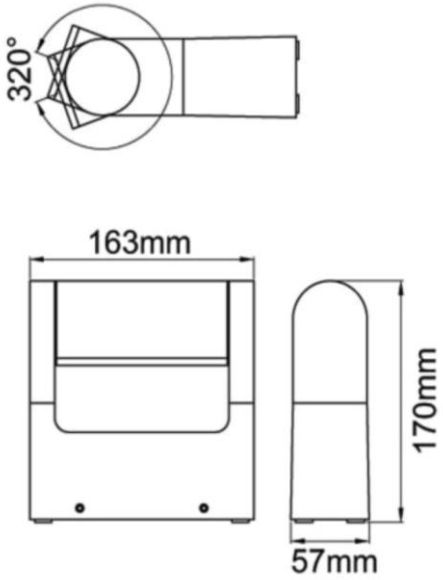
Type	Image	Quote	Description	Photometric Image	
7U		INDU Flood Gen2 3 £368.11 to £451.15	INDU Flood Gen2 3 Floodlight 3000K 250W-375W, 192-288 LED 32,900-58,900 Lumen Output CRI >70. 0% ULOR (Subject to tilt)	192 LED, 250 Watt with 39,300 lumen output. 6549 Optic Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	288 LED, 375 Watt with 58,900 lumen output. 6549 Optic Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
	 INDU FLOOD GEN2 3 AxBxC (mm | inch) 622x90x521 | 24.5x3.5x20.5 Weight (kg | lbs) 16.8 | 37.0 Recommended installation height 3m to 16m				

Type	Image	Quote	Description	Photometric Image
1P		Philips Ledinaire £12.90	Philips Ledinaire. Mini Floodlight. 3000K 10W 1000 Lumen Output CRI 80 IP 65 0% ULOR (Subject to tilt)	10 Watt with 1000 lumen output. Mounting height 5m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.
				

General Sign Lighting Units

Examples of existing fittings you may find on site

Examples of available fittings that could be used as a Dark Skies compliant replacement				
Type	Image	Quote	Description	Photometric Image
13A		£48.60	DARKSKY C 3000K 8.5W 319 Lumen Output CRI Ra 85 IP54 0% ULOR	8.5 Watt with 319 lumen output. Mounting height 1m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			
				

Type		Quote	Description	Photometric Image
14A		£57.19	DARKSKY D 3000K 8.5W 330 Lumen Output CRI 85 IP54 0% ULOR (Angled 90 degrees downwards)	Unable to Show in Reality
	Dimensions			
				

General Ornate Style Units

Examples of existing fittings you may find on site

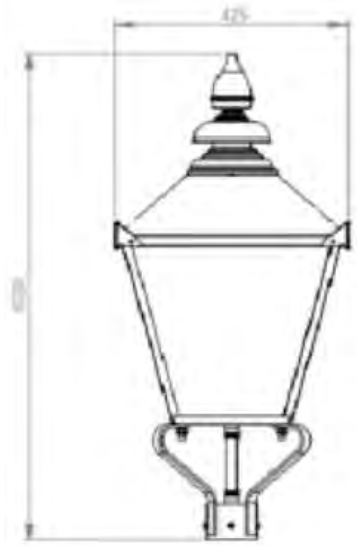
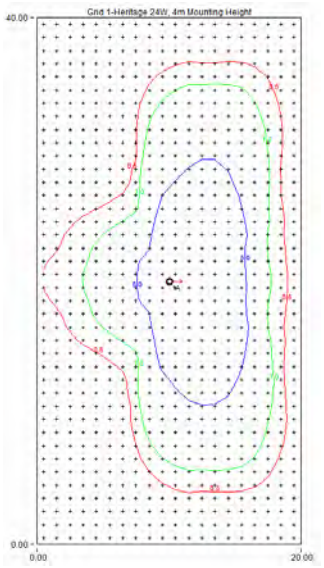
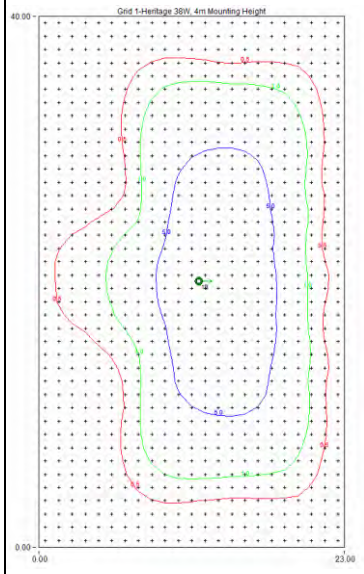
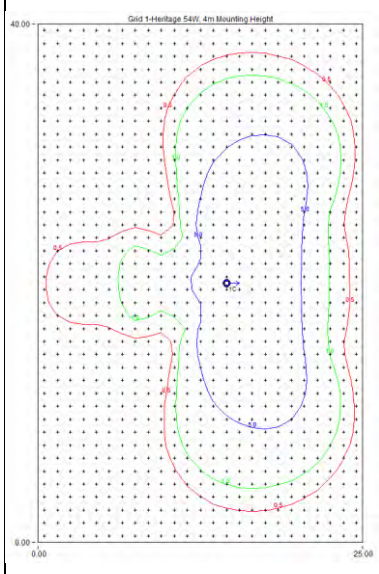









Heritage options have multiple optic variations available. Please contact supplier for further information.

Examples of available fittings that could be used as a Dark Skies compliant replacement						
Type	Image	Quote	Description	Photometric Image		
15A		£539. 77 Available with photocell or PIR	Victor Heritage Road Lantern 2700 or 3000K 7.4W to 216W, 12 to 48 LED 1,088-24,564 Lumen Output CRI >70 IP 66 0% ULOR	24 Watt with 1088 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	36 Watt with 5443 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux	54 Watt with 6993 lumen output. Mounting height 4m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.		
						

General Street Lighting Units

Examples of existing fittings you may find on site

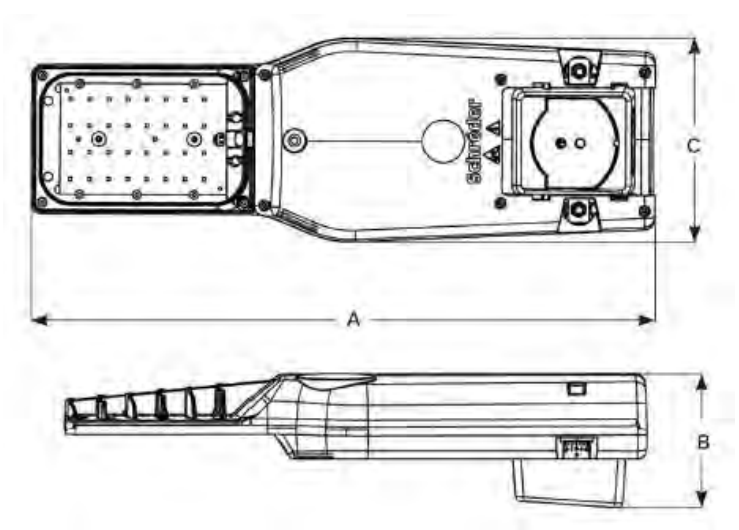
Road luminaire options have multiple optic variations available. Please contact supplier for further information.

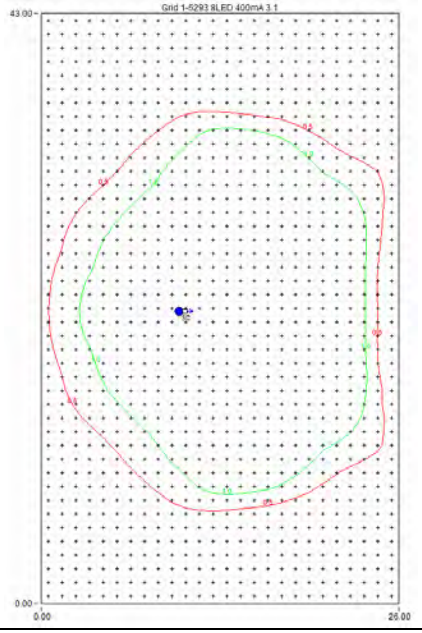
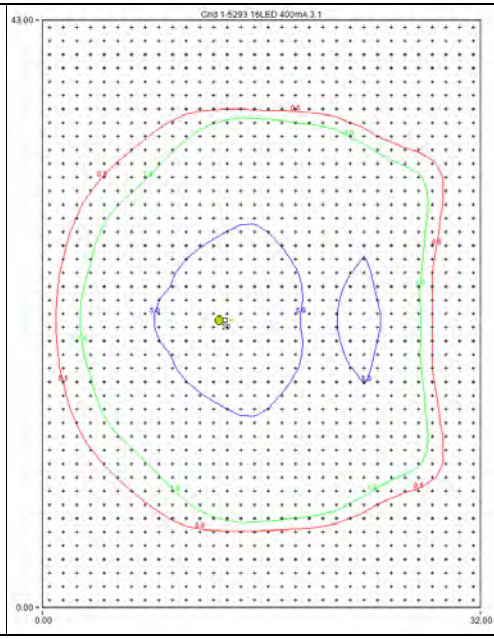
<table>
<tr><td colspan="6">Examples of available fittings that could be used as a Dark Skies compliant replacement</td></tr>
<tr><td>Type</td><td>Image</td><td>Quote</td><td>Description</td><td colspan="2">Photometric Image</td></tr>
<tr><td rowspan="3">9U</td><td>  </td><td>Axia 3.1
£140 to £150.59</td><td>Axia 3.1 LED Road
2700 or 3000K
300-870mA
8W-44W
8-16 LED
1,000-5,300 Lumen Output
CRI >70
IP 66
0% ULOR
(Subject to tilt)</td><td>8 LED, 11 Watt, 400mA with 1300 lumen output. 5293 Optic.

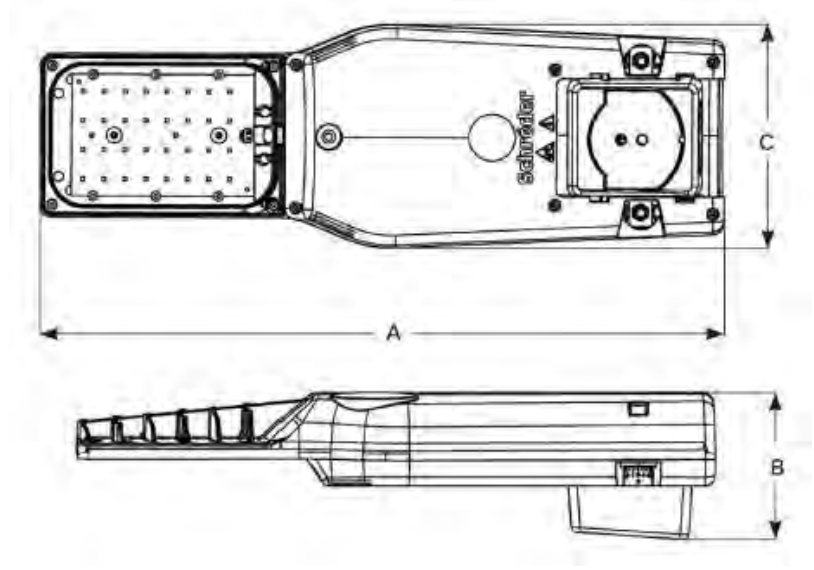
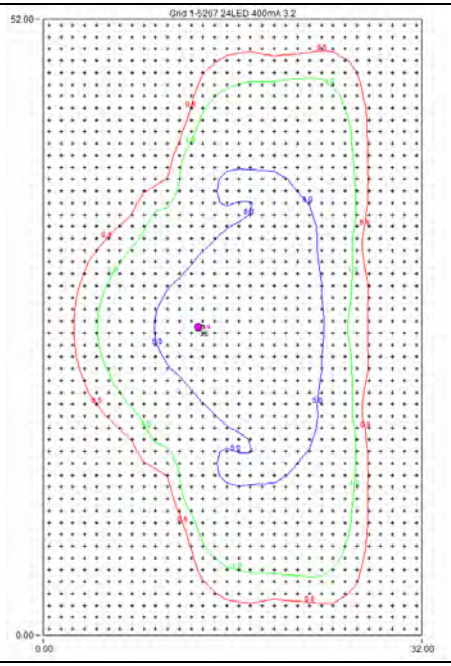
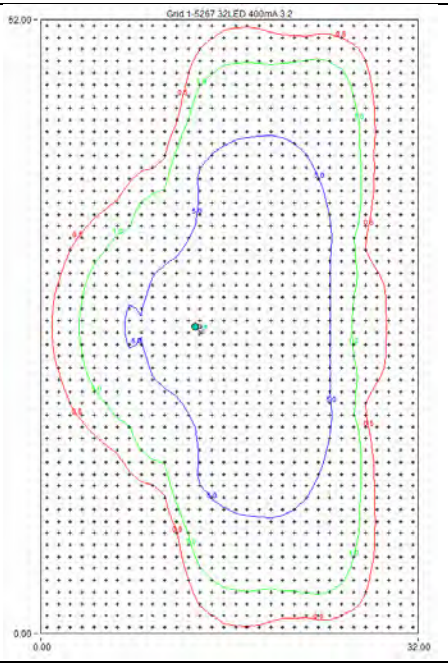
Mounting height 6m.

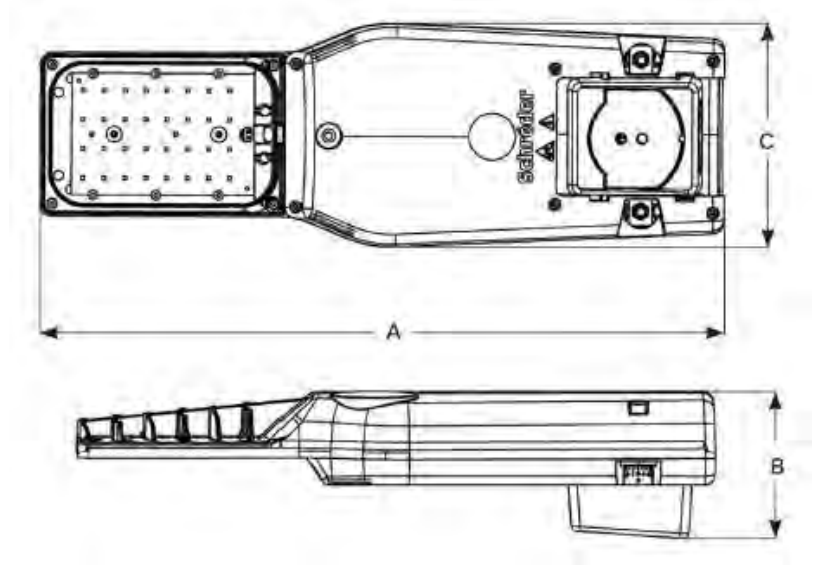
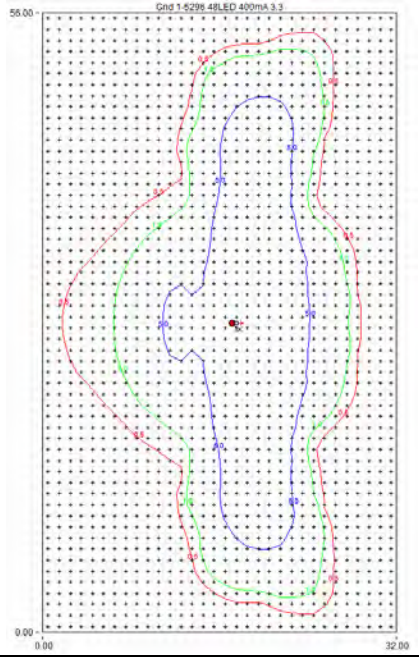
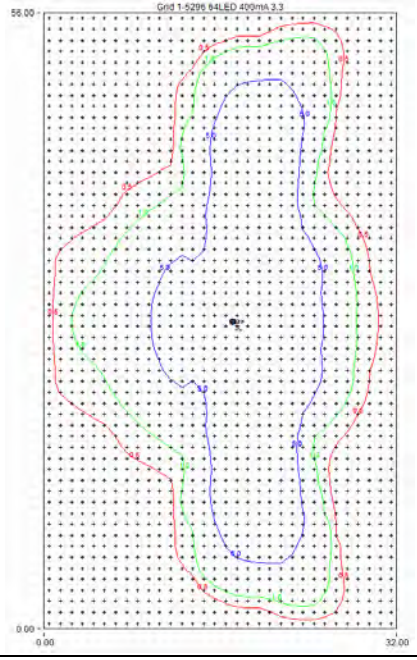
Contour lines
Blue=5 Lux,
Green=1.0 Lux, Red=0.5 Lux.
Typical full moon approx. 0.1 Lux</td><td>16 LED, 25.5 Watt, 500mA with 3300 lumen output. 5293 Optic.

Mounting height 6m.

Contour lines
Blue=5 Lux,
Green=1.0 Lux, Red=0.5 Lux.
Typical full moon approx. 0.1 Lux</td></tr>
<tr><td colspan="3">Dimensions</td><td colspan="2">Points shown are 0.5m from edges and then at 1m spacing.</td></tr>
<tr><td colspan="3"> 

AxBxC (mm | inch) AXIA 3.1 - 513x130x191 | 20.2x5.1x7.5</td><td colspan="2"> 
 </td></tr>
</table>

Type	Image	Quote	Description	Photometric Image	
10U		Axia 3.2 £177.65 to 189.41	Axia 3.2 LED Road 2700 or 3000K 200-800mA 15W-78W 24-32 LED 2,100-9,800 Lumen Output CRI >70 IP 66 0% ULOR (Subject to tilt)	24 LED, 29.7 Watt, 400mA with 4100 lumen output. 5267 Optic Mounting height 8m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	32 LED, 48.5 Watt, 500mA with 6700 lumen output. 5267 Optic Mounting height 8m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
	 AxBxC (mm | inch) AXIA 3.2 - 585x130x191 | 23.0x5.1x7.5				

Type	Image	Quote	Description	Photometric Image	
11U		Axia 3.3 £237.65 to 247.06	Axia 3.3 LED Road 2700 or 3000K 200-880mA 28W-172W 48-64 LED 4,200-20,600 Lumen Output CRI >70 IP 66 0% ULOR (Subject to tilt)	48 LED, 57 Watt, 400mA with 8300 lumen output. 5296 Optic. Mounting height 8m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux	64 LED, 94 Watt, 500mA with 13400 lumen output. 5296 Optic. Mounting height 8m. Contour lines Blue=5 Lux, Green=1.0 Lux, Red=0.5 Lux. Typical full moon approx. 0.1 Lux
	Dimensions			Points shown are 0.5m from edges and then at 1m spacing.	
	 AxBxC (mm | inch) AXIA 3.3 - 550x130x277 | 21.7x5.1x10.9				

Summary

The above Luminaires are the start of what is hoped to be a growing list of units that are manufactured with Dark Sky's in mind therefore environmentally protecting the night sky and projecting light in the downward direction to the areas that require illumination.

It is a desire to have a wider range of choices of Luminaires in the near future and will be a developing document as time progresses so is not intended to be an exhaustive nor a limiting list.

When installing lights be it for Commercial, Leisure or Domestic purposes it is an aim that it should only be provided to the areas required, to the level required and with limiting intrusion on neighboring facilities, public, wildlife, flora or fauna. This can be achieved through computer aided design for the larger schemes although, recognizing that domestic use does not fall into this bracket there are some smaller units listed in the above document to help advice and assist on an effective solution to the many varying requirements.

Glossary and Terms of Reference

Beam Angle

The total angle over which the luminous intensity of a luminaire drops to 50% of the peak beam value.

Colour Rendering

The ability of a light source to render the colours of objects as similar to those under a reference light source, or an acceptable source such as daylight.

Disability Glare

Glare produced directly or by reflection that impairs the visibility of objects without necessarily causing discomfort.

Discomfort glare

Glare which causes a visual discomfort.

Glare

The discomfort or impairment of vision experienced when parts of the visual field are excessively bright in relation to the general surroundings.

Illuminance

The luminous flux density at a surface i.e. the luminous flux incident per unit area. Unit lm-m^2, lux.

Luminance

The average road surface luminance (of a carriageway of a road)

Unit is candelas per square metre (cd/m2)

Lamp flux maintenance factor

The proportion of the initial luminous flux of a lamp that is produced after a set time.

Light trespass

Unwanted light from an installation falling on an area.

Light pollution

Term designating the spillage of a light into areas where it is not desired.

Louvre

A screen geometrically disposed to prevent lamps from being directly visible at a given angle.

Luminaire

Apparatus which distributes, filters or transforms the light emitted by a lamp. It includes all the parts necessary for supporting, fixing and protecting the lamp, but not the lamp itself.

Lux

The SI unit of Illuminance equal to one lumen per square metre.

Sky glow

Localized brightening of the night sky caused by upward light interacting with particles in the air. Upward light comprises light emitted by lighting above the horizontal as well as downward light reflected upwards from illuminated surfaces. This effect is more noticeable on misty nights or when there is a low cloud base.

Spill light

Stray light from a luminaire that incidentally illuminates nearby objects or surfaces in the public environment, this can be a cause of light trespass.