



WQ1 APPENDIX 1 - DRAX REPOWER BASELINE LIGHTING SURVEY REPORT

Drax Bioenergy with Carbon Capture and Storage

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations, 2009 - Regulation 5(2)(k)

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The Drax Power (Generating Stations) Order

Land at, and in the vicinity of, Drax Power Station, near Selby, North Yorkshire

Environmental Statement

Appendix 3.1 - Baseline Lighting Survey Report



The Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure)
Regulations 2009 – Regulation 5(2)(a)

Drax Power Limited

Drax Repower Project

Applicant: DRAX POWER LIMITED
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1 INTRODUCTION

1.1 Overview

- 1.1.1. Drax Power Limited (the applicant) is making an application for a Development Consent Order (DCO) to authorise the applicant to repower up to two existing coal-fired units with gas. In order to repower to gas, a new gas pipeline needs to be constructed from Drax Power Station to the National Gas Transmission System (NTS) (hereafter referred to as the 'Proposed Scheme').
- 1.1.2. WSP has been commissioned to undertake a baseline lighting survey report to identify and report the existing lighting environment within and in the vicinity of the Existing Drax Power Station Complex to accompany the application for a DCO.

1.2 Existing Drax Power Station Complex

- 1.2.1. Drax Power Station is a large power station, comprising originally of six coal-fired units. It was originally built, owned and operated by the Central Electricity Generating Board and had a capacity of just under 2,000 MW when Phase 1 was completed in 1975. Its current capacity is 4,000 MW after the construction of Phase 2 in 1986.
- 1.2.2. Three of the original six coal-fired units are now converted to biomass (Units 1-3) and this is assessed as the current baseline in the Environmental Statement (ES). By the latter half of 2018, four units (Units 1-4) will run on biomass with only two units (Units 5 and 6) running on coal. One or both of Units 5 and 6 will be repowered as part of the Proposed Scheme, this means the existing coal-fired units would be decommissioned and replaced with newly constructed gas-fired units utilising some of the existing infrastructure. The area within the Existing Drax Power Station Complex where development is proposed is referred to as the Power Station Site and is approximately 53.4 ha.

1.3 Pipeline Area

- 1.3.1. The Gas Pipeline route is approximately 3 km in length and crosses agricultural land to the east of the Existing Drax Power Station Complex. The land within the Pipeline Construction Area is 25.4 ha and the land within the Pipeline Operational Area is 2.4 ha.
- 1.3.2. An additional area is located on Rusholme Lane (Rusholme Lane Area) to accommodate a potential passing place for traffic during construction of the Gas Pipeline. This is considered to be part of the Pipeline Area.

1.4 Site Boundary

- 1.4.1. The Site is approximately 78.9 ha and lies approximately 4 m Above Ordnance Datum (AOD).
- 1.4.2. The Site Boundary (depicted with a red line in Chapter 1 (Introduction) Figure 1.1 of the ES) represents the maximum extent of all potential permanent and temporary works required as part of the Proposed Scheme.
- 1.4.3. The Power Station Site, the Carbon capture readiness reserve space and the Pipeline Area (including the Rusholme Lane Area) have been divided into a number of Development Parcels shown on Chapter 1 (Introduction) Figure 1.3 of the ES.

- 1.4.4. The current land uses at these development parcels are described in Table 3-1 of the ES Chapter 3 (Site and Project Description).

1.5 Project Description — the Proposed Scheme

- 1.5.1. The Proposed Scheme is to repower up to two existing coal-powered generating units (Units 5 and 6) at the Existing Drax Power Station Complex with new gas turbines that can operate in both combined cycle and open cycle modes. The term "repower" is used as existing infrastructure, such as the steam turbine and cooling towers, that are currently used for the coal fired units would be reutilised for the new gas fired generating units/stations.
- 1.5.2. The repowered units (which each constitute a new gas fired generating station) would have a new combined capacity of up to 3,600 MW in combined cycle mode (1,800 MW each), replacing existing units with a combined capacity to generate up to 1,320 MW (660 MW each).
- 1.5.3. Each gas generating station (or unit) would have up to two gas turbines, with each gas turbine powering a dedicated generator of up to 600 MW in capacity. The gas turbines in each generating station (or unit), therefore, would have a combined capacity of up to 1,200 MW. The gas turbines in each generating station (or unit), in combined cycle mode, would provide steam to the existing steam turbine (through Heat Recovery Steam Generators (HRSGs)) which would generate up to 600 MW per generating station (or unit). Each generating station (or unit) would have up to two HRSGs. This results in a capacity for each generating station of up to 1,800 MW and, should both Units 5 and 6 be repowered, a combined capacity of up to 3,600 MW. The new gas turbine generating stations (or units) have been designated the terms "Unit X" and "Unit Y".
- 1.5.4. Each of Unit X and Unit Y would have (subject to technology and commercial considerations) a battery energy storage facility with a capacity of up to 100 MW per Unit, resulting in a combined battery energy storage capacity of up to 200 MW. The two battery energy storage facilities would be stored in a single building.
- 1.5.5. The total combined capacity of the two gas fired generating stations, Unit X and Unit Y, and two battery storage facilities (i.e. the total combined capacity of the Proposed Scheme) is therefore 3,800 MW.
- 1.5.6. The DCO seeks consent for the following flexibility:
- Repowering of either Unit 5 or 6 and construction of Unit X as a gas fired generating station (this would leave either Unit 5 or 6 (depending on which had been repowered) as a coal-fired unit); or
- Repowering of both Units 5 and 6 and construction of Unit X and Unit Y as two gas fired generating stations.
- 1.5.7. In the event that a single unit is repowered and Unit X constructed, up to two gas turbines and up to two HRSGs and (subject to technology and commercial considerations) a battery energy storage facility of up to 100 MW storage capacity would be constructed. The size of the building housing the battery storage facility would not change, as the building could house sufficient battery capacity to allow the 100 MW output to be sustained for a longer duration. However, the fuel gas station and gas insulated switchgear required for the Gas Pipeline would be smaller.

- 1.5.8. In the event that two units are repowered and both Unit X and Unit Y are constructed, then construction works would be undertaken consecutively rather than concurrently. It is assumed for the purposes of this ES that there would be a gap of a year between construction periods, but this could be longer depending on commercial considerations. Unit Y would mirror Unit X, with up to two gas turbines and up to two HRSGs and (subject to technology and commercial considerations) a battery energy storage facility of up to 100 MW storage capacity which would be housed in the building constructed for the battery for Unit X.
- 1.5.9. In order to repower to gas, a new Gas Pipeline would be constructed from the Existing Drax Power Station Complex to the National Transmission System (NTS) operated by National Grid. Pipeline infrastructure would be the same whether Unit X was constructed or whether Unit X and Unit Y was constructed.
- 1.5.10. A gas receiving facility (GRF) comprising Pipeline Inspection Gauge (PIG) Trap Facility (PTF), Pressure Reduction and Metering Station (PRMS) and compressor station is proposed south of woodland to the east of New Road.
- 1.5.11. At the connection to the NTS there will be an above ground installation (AGI) south of Rusholme Lane. The AGI involves a PIG Trap Launching station (PTF-L) which will be operated by Drax, and a Minimum Offtake Connection (MOC), which will be operated by National Grid.
- 1.5.12. A full description of the Proposed Scheme and the Site is contained in Chapter 3 (Site and Project Description) of the ES.

1.6 Aims and Objectives

- 1.6.1. This baseline lighting survey report has been commissioned to ascertain the existing lighting environment within and in the vicinity of the Site (hereafter referred to as the 'Survey Area'). This report outlines the methodology adopted for the survey and sets out the baseline lighting environment within and in the vicinity of the Site.

1.7 Structure of this Report

- 1.7.1. The structure of this report is as follows:
 - Introduction;
 - Methodology;
 - Results and Discussion; and
 - Summary.

2 METHODOLOGY

2.1 Desktop Study

- 2.1.1. A desktop study was undertaken to identify suitable measurement locations for the baseline lighting survey. The measurement locations were selected to provide suitable coverage of the Survey Area to ensure the lighting environment could be determined.

2.2 Baseline Lighting Survey

- 2.2.1. A baseline lux survey was undertaken on 29 March 2018. Measurements were taken between 20:40 and 22:25. For the duration of the night-time survey, the conditions were dry. Cloud cover varied between 40% and 80% and the moon was visible. Given the high level of cloud cover, it is considered that moonlight did not have any significant effect on the lux readings taken.
- 2.2.2. The extent of the Survey Area, defined by the measurement locations identified in the desk study, was confirmed during the survey.
- 2.2.3. Readings of lux were recorded at 14 locations (A - N). The location of these lighting measurements is shown on Figure 3. At each of the measurement locations, vertical lux was recorded from northerly, southerly, easterly and westerly directions. A reading of horizontal lux was also made at each location to benchmark the lit surface. The readings of lux were taken using a Minolta T10 handheld meter (Serial Number: 61731028).
- 2.2.4. The lux readings taken during the survey on the 29 March 2018 are provided in Appendix A and have been used to inform the results and discussion set out in Section 3.
- 2.2.5. A number of photographs were taken during the surveys to help illustrate the lighting environment. These photographs were taken using a Sony Alpha 500. The photographs are provided in Section 3 to inform the discussion of the baseline lighting environment.
- 2.2.6. Observations from each measurement location were also taken relating to lighting installations visible, screening, whether sky glow was present, and levels of night-time activity. These observations have helped inform an understanding of the lighting environment, and the classification of indicative Environmental Zones.

2.3 Classification of Indicative Environmental Zones

- 2.3.1. This report has adopted the criteria for Environmental Zones contained within the Institute of Lighting Professionals (ILP) 'Guidance Notes for the Reduction of Obtrusive Light' (hereafter referred to as the 'Guidance Notes') (Ref. 1) to describe the baseline lighting conditions within the Survey Area. The Guidance Notes are included as Appendix B.
- 2.3.2. The Environmental Zones derive from an international scheme for classifying the lighting characteristics of an area to help ensure any obtrusive light is seen within the context of the brightness of its background. These Zones are defined in Table 2-1 below.
- 2.3.3. The threshold values for the Environmental Zones have also been extracted from the Guidance Notes and are outlined in Table 2-1.

Table 2-1 Environmental Zones for Exterior Lighting Control

Environmental Zone	Sky Glow ULR (Max) %	Light Intrusion (into windows) Ev (Lux)		Luminaire intensity in Candelas (cd)		Building Illuminance (cd/m ²) Pre-Curfew
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	
E0 - Protected Areas (e.g. International Dark Sky Association Dark Sky Parks, UNESCO Starlight Reserves)	0	0	0	0	0	0
E1 - Intrinsically dark landscapes (e.g. National Parks and Areas of Outstanding Natural Beauty)	0	2	0(1*)	2,500	0	0
E2 - Low district brightness (e.g. Village or relatively dark outer suburban locations)	2.5	5	1	7,500	500	5
E3 - Medium district brightness (e.g. small town centres or suburban locations)	5	10	2	10,000	1,000	10
E4 - High district brightness (e.g. town / city centres with high levels of night-time activity)	15	25	5	25,000	2,500	25

Table 2 is extracted from the Guidance Notes (Appendix B)

Notes to terms used in Table 2:

ULR = Upward Light Ratio of the installation is the maximum permitted percentage of luminaire flux that goes directly into the sky. Ev = Vertical Illuminance in lux measured flat on the glazing at the centre of the window. I = Light Intensity in Candelas (cd). L = Luminance in Candelas per Square Metre (cd/m²). Curfew = the time after which stricter requirement (for the control of obtrusive light) will apply; often a condition of use of lighting applied by the local planning authority. If not otherwise stated, 23:00 hours is suggested. * = Permitted only from Public road installations.

- 2.3.4. The lux readings recorded during the baseline lighting survey have allowed the lighting baseline conditions in the Survey Area and surrounding area to be benchmarked. The post-curfew values contained in the Guidance Notes have been used as the majority of the lighting installations in the Survey Area are operational throughout the hours of darkness.
- 2.3.5. In addition to lux readings, the observations taken from the measurement locations have been used to inform the categorisation of the measurement locations into indicative Environmental Zones. This is in accordance with the ILP 'Guidance on undertaking Environmental Lighting Impact Assessments' (2013) (Ref. 2).

2.4 Limitations

- 2.4.1. Whilst the lux measurements obtained during the baseline lighting survey were taken using a calibrated lux meter, the readings are considered to be approximately 95% accurate because of variations in weather conditions etc. However, in-combination with the detailed observations taken, these are considered to provide a robust baseline.

3 RESULTS AND DISCUSSION

3.1 Overview of Lighting Environment

- 3.1.1. The lighting environment within the Survey Area was dominated by lighting installations within the Existing Drax Power Station Complex, including floodlights fitted with High-Pressure Sodium (HPS) lamps and other fixtures fitted with HPS, Metal Halide (MH) and Light Emitting Diode (LED) lamps.
- 3.1.2. Other installations also contributed to the lighting environment in parts of the Survey Area including the street lighting along New Road/A645, façade lighting on residential and commercial properties, light spill from properties and intermittent lighting from the headlamps of passing cars.
- 3.1.3. To the east and south of the Survey Area, the landscape was generally darker, however, to the west and north were a mix of street/highways lighting installations, security/decorative façade lighting, traffic signals/signs and fugitive light spill from commercial and residential units which also contributed to the wider lighting environment.
- 3.1.4. Given the land uses present within the Survey Area and the varied lighting installations noted, the lighting environment was variable.
- 3.1.5. A discussion of the measurement locations and indicative Environmental Zones is provided below. The lux readings taken on-site are provided in Appendix A.

3.2 Discussion of Measurement Locations and Indicative Environmental Zones

Adjacent to Existing Drax Power Station Complex (Measurement Location A, C and D)

- 3.2.1. Measurement locations A, C and D were located on the A645/New Road adjacent to the Existing Drax Power Station Complex.
- 3.2.2. The lighting environment at location A was dominated by the operational lighting within the Existing Drax Power Station Complex. The lighting installations with the Existing Drax Power Station Complex included five floodlights mounted on columns at the base of cooling towers fitted with HPS lamps; three reflector optic luminaire with glass bowl fitted with HPS lamps mounted on 6 m steel columns on the eastern side of Drax South Entrance Access Road. Within the wider Complex, there was a mixture of lighting fixtures fitted with HPS, MH and LED lamps associated with partially visible and distant structure (including internal light spill), external plant, outdoor work areas and security lighting. These installations are shown in Photograph 1.
- 3.2.3. At Location A, the street lighting also influenced the lighting environment. The street lighting installations comprised refractor optic luminaires fitted with HPS mounted in clear glass bowls on 8 m steel columns spaced approximately 20 m apart on either side of the A645, roundabout and approach to the roundabout on New Road and Main Road. In addition, there were a number of sources of lighting associated with Drax Sports and Social Club which contributed to the overall lighting environment, including four MH floodlights mounted in pairs on 4 m steel columns within car park, seven HPS bulkheads mounted on the façade of the Club, four sports floodlights mounted on 12 m steel columns associated with playing pitches (albeit these were non-operational at the time of the survey) and three HPS street lights located on the access

road. In addition, there was fugitive internal light spill from Drax Sports and Social Club. There was also intermittent lighting spill from headlights of passing vehicles on surrounding roads and within the Club car park.

Photograph 1 - Taken at Location A facing North



Photograph 2 - Taken at Location D facing West



- 3.2.4. At Location C and D, the lighting environment was dominated by installations within the Existing Drax Power Station Complex, including floodlights fitted with HPS lamps, mounted in sets of 6 on approximately 20 m steel columns; a reflector optic luminaire fitted with a HPS lamp and two reflector optic luminaires fitted with MH lamps mounted in a glass bowl on a 5 m high steel column at northern gatehouse entrance; and a mixture of other lighting fixtures fitted with HPS, MH and LED lamps anticipated to be associated with partially visible and distant structure (including internal light spill), external plant, outdoor work areas and security lighting (see Photograph 2). At Location C, there was also intermittent light spill from the headlights of passing vehicles on New Road.
- 3.2.5. The levels of night-time activity noted in the area surrounding Locations A, C and D were considered to be low.
- 3.2.6. Lux readings recorded at Locations A, C and D ranged from 0.12 lux to 30.5 lux. The higher readings were recorded at A and D facing towards the north and east and at C facing west.
- 3.2.7. Given the sources of lighting, levels of night-time activity and the lux levels recorded, locations A, C and D were considered to be representative of an E3 Environmental Zone ('medium district brightness').

[West of the Existing Drax Power Station Complex \(Measurement Location B\)](#)

- 3.2.8. 3.13 Measurement location B was located on the A645, close to the junction with Church Dike Lane in Drax Village.

- 3.2.9. The lighting environment at Location B was influenced by partial views of lighting associated with the Existing Drax Power Station Complex, including fixtures fitted with a mixture of HPS, MH and LED (see Photograph 3). There were also partial views of lighting installations fitted with MH/LED/HPS lamps associated with English Village Salads site. In addition, there were partial views of single luminaire fitted with a LPS lamp associated with Drax Golf Club.
- 3.2.10. The levels of night-time activity noted in the area surrounding Location B were considered to be low.
- 3.2.11. Lux readings recorded at Location B ranged from 0.02 lux to 0.07 lux.
- 3.2.12. Given the sources of lighting, levels of night-time activity and the lux levels recorded, Location B were considered to be representative of an area on the border of Environmental Zones E2 ('low district brightness').

Photograph 3 - Taken at Location B facing North



Drax Villiage (Measurement Location K)

- 3.2.13. Measurement location K was located on Main Road, close to the junction with Church Dike Lane in Drax Village.
- 3.2.14. The lighting environment at location K was dominated by street lighting within Drax village, which comprised three refractor optic luminaires fitted with LPS lamps and mounted on 4 m steel columns on either side of Main Road. There are a number of decorative/security façade light fixtures associated with the surrounding residential properties. There was also intermittent light spill associated with the headlights of passing vehicle.

- 3.2.15. The levels of night-time activity noted in the area surrounding Location K were considered to be low.
- 3.2.16. Lux readings recorded at Location K ranged from 0.14 lux to 9.77 lux. The higher readings were recorded facing towards the south (9.77 lux) and west (2.22 lux).
- 3.2.17. Therefore, whilst the levels of night-time activity were limited, given the lighting sources present and the lux levels recorded, Location K was considered to be on the border of Environmental Zones E2/E3 ('low/medium district brightness').

[Landscape Surrounding Drax Village \(Measurement Locations E, F, G, H, I, J, L, N AND M\)](#)

- 3.2.18. Measurement locations E, F, G, H, I, J, L, N and M were located within the landscape surrounding Drax Village, with Locations E, F, G, H, I and J to the north of Drax, Locations L and M to the east and Location N to the south-west.
- 3.2.19. The lighting environment at Locations E, F, G, H, I, J, L and M was influenced by partial views of lighting installations within Existing Drax Power Station Complex (see Photograph 4), highways/street lighting on Main Road, New Road and the A645 and isolated lighting fixtures associated with individual properties. At Location N, the lighting environment was influenced by partial views of lighting installations within Existing Drax Power Station Complex, highways/street lighting on Main Road, New Road and the A645 and motion sensor security lighting associated with nearby kennels.

Photograph 4 - Taken at Location L facing West



- 3.2.20. The levels of night-time activity noted in the area surrounding the Locations were considered to be minimal.
- 3.2.21. Lux readings recorded at Locations E, F, G, H, I, J, L, N and M ranged from 0.00 lux to 0.96 lux. The lowest readings were recorded at Location M, facing south (0.00). The highest readings were recorded at Location J facing west (0.96 lux).
- 3.2.22. Given the sources of lighting, levels of night-time activity and the lux levels recorded, Location K were considered to be representative of an E2 Environmental Zone ('low district brightness').

4 SUMMARY

- 4.1.1. An assessment of the baseline lighting conditions was undertaken to outline the existing lighting environment within the Study Area. A baseline lighting survey was completed on the 29 March 2018 during which observations of the lighting environment, readings of lux and night-time photographs were taken.
- 4.1.2. The lighting environment across the Survey Area was largely dominated by the lighting installations associated with the Existing Drax Power Station Complex and street lighting installations consisting of refractor optic luminaires fitted with HPS lamps mounted in clear bowls on 8 m steel columns were located along Main Road, New Road and the A645 within the Survey Area. Other lighting installations that were observed within the Survey Area, included security/decorative façade lighting mounted on residential and commercial properties, fugitive light spill from commercial / and residential properties and intermittent light spill from the headlamps of passing vehicles.
- 4.1.3. The lighting conditions within the Survey Area closest to the Existing Drax Power Station Complex along New Road/A645 were considered to be indicative of an E3 Environmental Zone ('medium district brightness'). To the west of the Existing Drax Power Station Complex along the A645, the lighting conditions were considered to be more representative of an E2 Environmental Zone ('low district brightness'). The lighting conditions within Drax Village were considered to be indicative of an area on the border of Environmental Zones E2/E3 ('low/medium district brightness'). Within the landscape surrounding Drax village, the lighting environment was considered to be indicative of an E2 Environmental Zone ('low district brightness').

5 REFERENCES

- Ref. 1: Institute for Lighting Professionals (2011) Guidance Notes for the Reduction of Obtrusive Light.
- Ref. 2: Institute for Lighting Professionals (2013) Guidance on undertaking Environmental Lighting Impact Assessments

Appendix A

ILLUMINANCE MEASUREMENTS (LUX)

LOCATION	NORTH	EAST	SOUTH	WEST	HORIZONTAL
A	8.51	5.54	0.62	3.73	3.28
B	0.07	0.05	0.03	0.02	0.07
C	2.12	0.12	0.04	5.00	1.85
D	30.5	13.31	3.35	0.77	46.7
E	0.04	0.05	0.13	0.09	0.10
F	0.04	0.03	0.10	0.16	0.10
G	0.22	0.06	0.02	0.12	0.06
H	0.03	0.04	0.05	0.05	0.09
I	0.07	0.08	0.07	0.06	0.07
J	0.33	0.06	0.14	0.96	0.17
K	0.14	0.22	9.77	2.22	3.45
L	0.07	0.06	0.06	0.06	0.09
M	0.05	0.02	0.00	0.04	0.04
N	0.15	0.03	0.03	0.12	0.16

Appendix B

ILLUMINANCE MEASUREMENTS

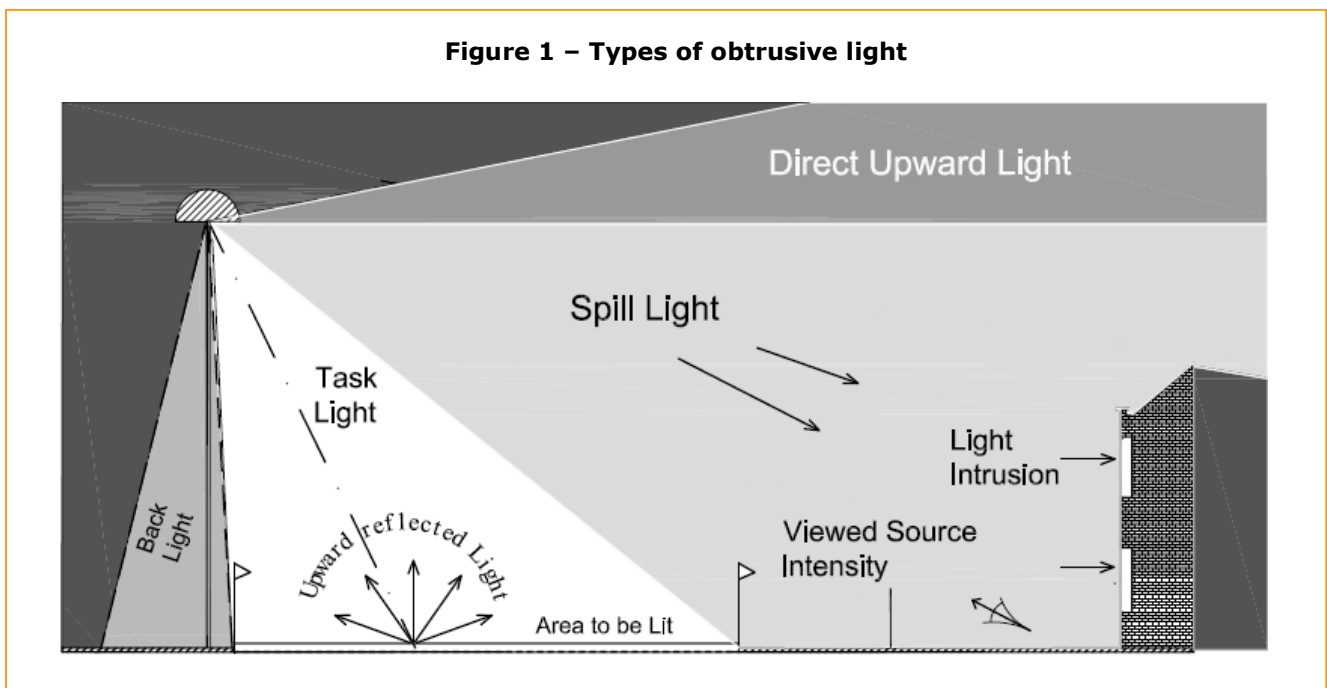
GUIDANCE NOTES FOR THE REDUCTION OF OBTRUSIVE LIGHT

“Think before you light - The right amount of light, where wanted, when wanted.”

Man's invention of artificial light has done much to safeguard and enhance our night-time environment but, if not properly controlled, **obtrusive light** (sometimes referred to as light pollution) can present serious physiological and ecological problems.

Obtrusive Light, whether it keeps you awake through a bedroom window or impedes your view of the night sky, is a form of pollution, which may also be a nuisance in law and which can be substantially reduced without detriment to the lighting task.

Sky glow, the brightening of the night sky, **Glare** the uncomfortable brightness of a light source when viewed against a darker background, and **Light Intrusion (“Trespass”)**, the spilling of light beyond the boundary of the property or area being lit, are all forms of obtrusive light which may cause nuisance to others and waste money and energy. Think before you light. Is it necessary? What effect will it have on others? Will it cause a nuisance? How can you minimise the problem?



Do not "over" light. This is a major cause of obtrusive light and is a waste of energy. There are published standards for most lighting tasks, adherence to which will help minimise upward reflected light. Organisations from which full details of these standards can be obtained are given on the last page of this leaflet.

Dim or switch off lights when the task is finished. Generally a lower level of lighting will suffice to enhance the night time scene than that required for safety and security.

“Good Design equals Good Lighting”

Any lighting scheme will consist of three basic elements: a light source, a luminaire and a method of installation.

Light sources (Lamps)

Remember that the light source output in LUMENS is not the same as the wattage and that it is the former that is important in combating the problems of obtrusive light.

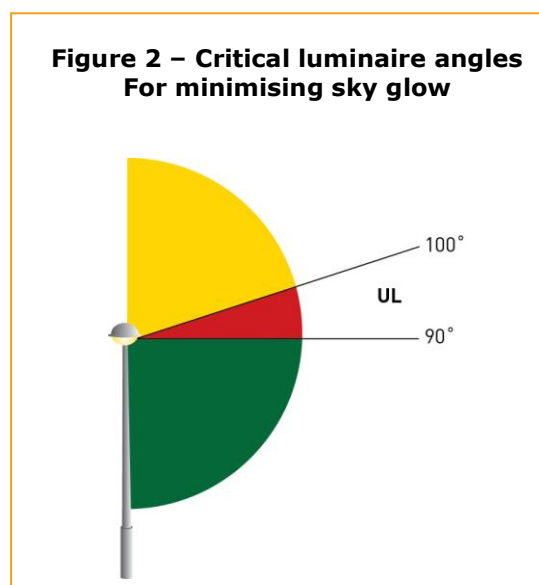
Most nighttime visual tasks are only dependant on light radiated within the visual spectrum. It is therefore NOT necessary for light sources to emit either ultra-violet or infra-red radiation unless specifically designed to do so. It is also understood that light from the shorter wavelengths of the spectrum has important effects on both flora and fauna that should be considered.

Research indicates that light from the blue end of the spectrum has important non-visual effects on the health of the human body, in particular in our sleep/wake patterns. It is therefore important to appreciate that while in obtrusive light terms the use of blue light should be minimised, there are many night-time tasks such as driving and sports where to be fully awake is an important aid to safety.

Luminaires

Care should always be taken when selecting luminaires to ensure that appropriate products are chosen and that their location will reduce spill light and glare to a minimum.

Use specifically designed lighting equipment that minimises the upward spread of light near to and above the horizontal. The most sensitive/critical zones for minimising sky glow are those between 90° and 100° as shown in Figure 2 and referred to as the lower, upward light output zone (UL).



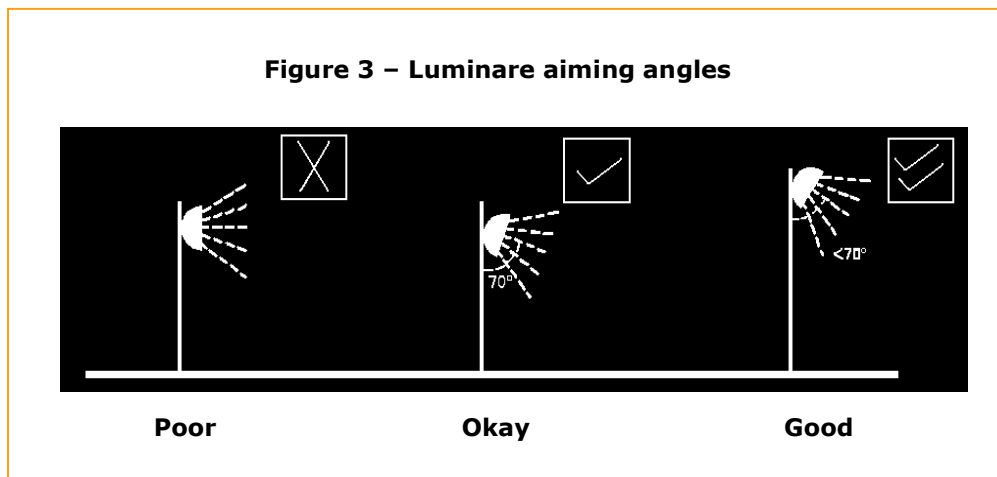
For most sports and area lighting installations the use of luminaires with double-asymmetric beams designed so that the front glazing is kept at or near parallel to the surface being lit should, if correctly aimed, ensures minimum obtrusive light.

Appendices 1 and 2 to these notes gives more details of how to choose and if necessary modify luminaires.

Installation

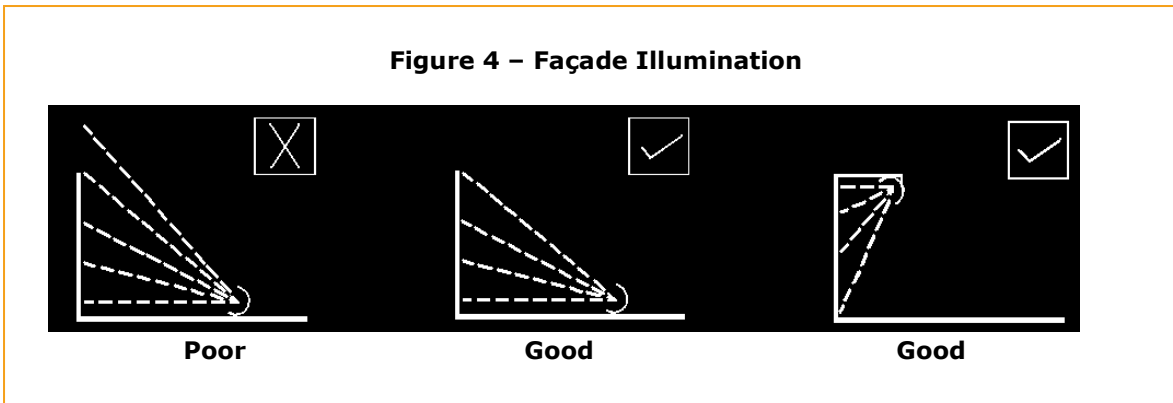
In most cases it will be beneficial to use as high a mounting height as possible, giving due regard to the daytime appearance of the installation. The requirements to control glare for the safety of road users are given in Table 3.

Keep glare to a minimum by ensuring that the main beam angle of all lights directed towards any potential observer is not more than 70°. Higher mounting heights allow lower main beam angles, which can assist in reducing glare. In areas with low ambient lighting levels, glare can be very obtrusive and extra care should be taken when positioning and aiming lighting equipment. With regard to domestic security lighting the ILP produces an information leaflet GN02:2009 that is freely available from its website.



When lighting vertical structures such as advertising signs, direct light downwards wherever possible. If there is no alternative to up-lighting, as with much decorative lighting of buildings, then the use of shields, baffles and louvres will help reduce spill light around and over the structure to a minimum.

For road and amenity lighting installations, (see also design standards listed on Page 5) light near to and above the horizontal should normally be minimised to reduce glare and sky glow (Note ULR's in Table 2). In rural areas the use of full horizontal cut off luminaires installed at 0° uplift will, in addition to reducing sky glow, also help to minimise visual intrusion within the open landscape. However in some urban locations, luminaires fitted with a more decorative bowl and good optical control of light should be acceptable and may be more appropriate.



Since 2006 “Artificial Light” has been added to the list of possible Statutory Nuisances in England, Wales and Scotland. The monitoring of such nuisances will be the responsibility of Environmental Health Officers (EHOs) for which separate guidance is being produced.

With regard to the planning aspect, many Local Planning Authorities (LPAs) have already produced, or are producing, policies that within the planning system will become part of their local development framework. For new developments there is an opportunity for LPAs to impose planning conditions related to external lighting, including curfew hours.

The Scottish Executive has published a design methodology document (March 2007) entitled [“Controlling Light Pollution and Reducing Energy Consumption”](#) to further assist in mitigating obtrusive light elements at the design stage.

ENVIRONMENTAL ZONES

It is recommended that Local Planning Authorities specify the following environmental zones for exterior lighting control within their Development Plans.

Table 1 – Environmental Zones			
Zone	Surrounding	Lighting Environment	Examples
E0	Protected	Dark	UNESCO Starlight Reserves, IDA Dark Sky Parks
E1	Natural	Intrinsically dark	National Parks, Areas of Outstanding Natural Beauty etc
E2	Rural	Low district brightness	Village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Small town centres or suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

Where an area to be lit lies on the boundary of two zones the obtrusive light limitation values used should be those applicable to the most rigorous zone.

NB: Zone E0 must always be surrounded by an E1 Zone.

DESIGN GUIDANCE

The following limitations may be supplemented or replaced by a LPA's own planning guidance for exterior lighting installations. As lighting design is not as simple as it may seem, you are advised to consult and/or work with a professional lighting designer before installing any exterior lighting.

Table 2 – Obtrusive Light Limitations for Exterior Lighting Installations – General Observers

Environmental Zone	Sky Glow ULR [Max %] ⁽¹⁾	Light Intrusion (into Windows) E _v [lux] ⁽²⁾		Luminaire Intensity I [candelas] ⁽³⁾		Building Luminance Pre-curfew ⁽⁴⁾
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Average, L [cd/m ²]
E0	0	0	0	0	0	0
E1	0	2	0 (1*)	2,500	0	0
E2	2.5	5	1	7,500	500	5
E3	5.0	10	2	10,000	1,000	10
E4	15	25	5	25,000	2,500	25

ULR = **Upward Light Ratio of the Installation** is the maximum permitted percentage of luminaire flux that goes directly into the sky.

E_v = **Vertical Illuminance in Lux** - measured flat on the glazing at the centre of the window.

I = **Light Intensity in Candelas (cd)**

L = **Luminance in Candelas per Square Metre (cd/m²)**

Curfew = **the time after which stricter requirements (for the control of obtrusive light) will apply**; often a condition of use of lighting applied by the local planning authority. If not otherwise stated - 23.00hrs is suggested.

***** = **Permitted only from** Public road lighting installations

(1) Upward Light Ratio – Some lighting schemes will require the deliberate and careful use of upward light, e.g. ground recessed luminaires, ground mounted floodlights, festive lighting, to which these limits cannot apply. However, care should always be taken to minimise any upward waste light by the proper application of suitably directional luminaires and light controlling attachments.

(2) Light Intrusion (into Windows) – These values are suggested maxima and need to take account of existing light intrusion at the point of measurement. In the case of road lighting on public highways where building facades are adjacent to the lit highway, these levels may not be obtainable. In such cases where a specific complaint has been received, the Highway Authority should endeavour to reduce the light intrusion into the window down to the post curfew value by fitting a shield, replacing the luminaire, or by varying the lighting level.

(3) Luminaire Intensity – This applies to each luminaire in the potentially obtrusive direction, outside of the area being lit. The figures given are for general guidance only and for some sports lighting applications with limited mounting heights, may be difficult to achieve.

(4) Building Luminance – This should be limited to avoid over lighting, and related to the general district brightness. In this reference building luminance is applicable to buildings directly illuminated as a night-time feature as against the illumination of a building caused by spill light from adjacent luminaires or luminaires fixed to the building but used to light an adjacent area.

Table 3 – Obtrusive Light Limitations for Exterior Lighting Installations – Road Users		
Road Classification ⁽¹⁾	Threshold Increment (TI)	Veiling Luminance (Lv)
No road lighting	15% based on adaptation luminance of 0.1cd/m ²	0.04
ME6/ ME5	15% based on adaptation luminance of 1cd/m ²	0.25
ME4/ ME3	15% based on adaptation luminance of 2cd/m	0.40
ME2 / ME1	15% based on adaptation luminance of 5cd/m ²	0.84

TI = Threshold Increment is a measure of the loss of visibility caused by the disability glare from the obtrusive light installation

Lv = Veiling Luminance is a measure of the adaptation luminance caused by the disability glare from the obtrusive light installation

(1) = Road Classifications as given in BS EN 13201 - 2: 2003 Road lighting Performance requirements. Limits apply where users of transport systems are subject to a reduction in the ability to see essential information. Values given are for relevant positions and for viewing directions in path of travel. For a more detailed description and methods for determining, calculating and measuring the above parameters see CIE Publication 150:2003.

RELEVANT PUBLICATIONS AND STANDARDS:

British Standards: ██████████	BS 5489-1: 2003 Code of practice for the design of road lighting – Part 1: Lighting of roads and public amenity areas BS EN 13201-2:2003 Road lighting – Part 2: Performance requirements BS EN 13201-3:2003 Road lighting – Part 3: Calculation of performance BS EN 13201-4:2003 Road lighting – Part 4: Methods of measuring lighting performance. BS EN 12193: 1999 Light and lighting – Sports lighting BS EN 12464-2: 2007 Lighting of work places – Outdoor work places
Countryside Commission/ DOE	Lighting in the Countryside: Towards good practice (1997) (<i>Out of Print but available on www.communities.gov.uk/index.asp?id=1144823</i>)
UK Government / Defra www.defra.gov.uk	Statutory Nuisance from Insects and Artificial Light – Guidance on Sections 101 to 103 of the Clean Neighbourhoods and Environment Act 2005 Road Lighting and the Environment (1993) (Out of Print)
CIBSE/SLL Publications: ██████████	CoL Code for Lighting (2002) LG1 The Industrial Environment (1989) LG4 Sports (1990+Addendum 2000) LG6 The Exterior Environment (1992) FF7 Environmental Considerations for Exterior Lighting (2003)
CIE Publications: ██████████	01 Guidelines for minimizing Urban Sky Glow near Astronomical Observatories (1980) 83 Guide for the lighting of sports events for colour television and film systems (1989) 92 Guide for floodlighting (1992) 115 Recommendations for the lighting of roads for motor and pedestrian traffic – Second Edition (2010) 126 Guidelines for minimizing Sky glow (1997) 129 Guide for lighting exterior work areas (1998) 136 Guide to the lighting of urban areas (2000) 150 Guide on the limitations of the effect of obtrusive light from outdoor lighting installations (2003) 154 The Maintenance of outdoor lighting systems (2003)
ILP Publications: ██████████	TR 5 Brightness of Illuminated Advertisements (2001) TR24 A Practical Guide to the Development of a Public Lighting Policy for Local Authorities (1999) GN02 Domestic Security Lighting, Friend or Foe
ILP/CIBSE Joint Publications	Lighting the Environment - A guide to good urban lighting (1995)
ILP/CSS Publications	Joint Code of Practice for the installation, maintenance and removal of seasonal decorations. (2005)
ILP/CfDS Joint Publication ██████████	Towards Understanding Sky glow. 2007
IESNA ██████████	TM-15-07 (R) Luminaire Classification System for Outdoor Luminaires

NB: These notes are intended as guidance only and the application of the values given in Tables 2 & 3 should be given due consideration along with all other factors in the lighting design. Lighting is a complex subject with both objective and subjective criteria to be considered. The notes are therefore no substitute for professionally assessed and designed lighting, where the various and maybe conflicting visual requirements need to be balanced.

APPENDIX 1 - PROPOSED OUTDOOR LUMINAIRE CLASSIFICATION SYSTEM

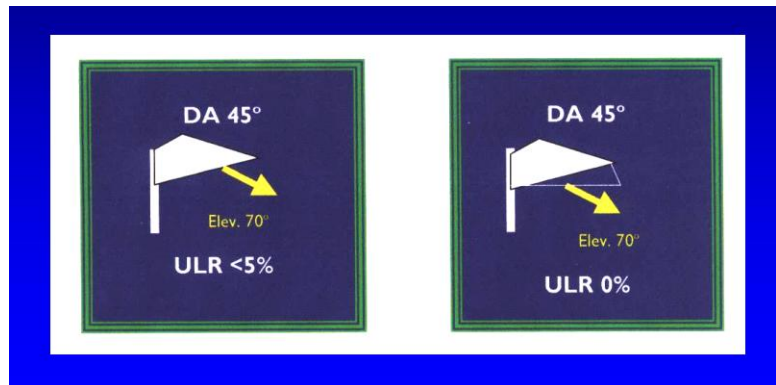
Variable Aim Luminaires – General Classifications:

➤ Type A	Symmetrical	
➤ Type B	Asymmetrical	
➤ Type C	Double-Asymmetrical	

Proposed labelling System:

Fixed Position luminaires

Variable Aim Luminaires
(Shown here for a 45° Double-Asymmetric luminaire aimed at 70° – with and without a cowl).



APPENDIX 2 - ILLUSTRATIONS OF LUMINAIRE ACCESSORIES FOR LIMITING OBTRUSIVE LIGHT (images provided by Philips and Thorn)

Cowl (or Hood)



External Louvre



SHIELD



SHIELD "Barn Doors"



Double Asymmetric Luminaire



Simple Hood



Circular Louvre



Cowl & Louvre



Internal Louvre (horizontal)



Internal Louvre (vertical)



