The London Resort Development Consent Order

BC080001

Environmental Statement
Volume 2: Appendices

Appendix 12.11 – Artificial Lighting Impact Assessment

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Revision: 00

December 2020

Planning Act 2008
The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009
Regulation 5(2)(a)
The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017
Regulation 12(1)

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Revision	Description	Issued by	Date	Checked
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Glossary

Term	Definition
Ave	Average value
Colour Rendering (Ra)	An indicator of how accurately colours can be distinguished under different light sources. The colour rendering index (measured in Ra) compares the ability of different light sources to render colours accurately. This measures the ability of a light source to render colours naturally, without distorting the hues seen under a full spectrum radiator (like daylight). The colour rendering index (CRI) ranges from 0 to 100. Colour rendering index CRI
Colour Temperature	The colour temperature provides an indication of the light colour and is expressed in Kelvin (K). Lamps are generally rated between 2700K (warm), 4000K (neutral) and 6500K (cool). Unit: kelvin, K.
Control Gear	A 'package' of electrical or electronic components including ballast, power factor correction capacitor and starter. High frequency electronic control gear may include other components to allow dimming, etc.
Curfew	A time defined by the local authority when outdoor lighting is reduced or switched off.
Glare	The uncomfortable brightness of a light source against a darker background which results in dazzling the observer or may cause nuisance. Condition of vision in which there is discomfort or a reduction in the ability to see significant objects, or both, due to an unsuitable distribution or range of luminance.
Glare Rating (GR)	Glare Rating values may be calculated for sports and area lighting applications to indicate the amount of glare present for an observer within the lighted area. GR values range from 10 to 90 (regardless of US or Metric units), where a value of 10 indicates unnoticeable glare and a value of 90 indicates unbearable glare. For most applications, the CIE (International Commission on Illumination) recommends that the maximum amount of glare allowed should be less than 45 to 55, depending on the application.
Horizontal Illuminance (E, Eh)	Illuminance incident on the horizontal surface. Unit: lux (lx) = lm/m^2 Symbol: E, Eh
Illuminance	The amount of light falling on a surface of unit area. The unit of illuminance is the lux, equal to one lumen per square metre. Unit: lux (lx) = lm/m^2
LED	Light Emitting Diode used as a light source. Solid-state semiconductor device that converts electrical energy directly into light of a specific colour or even white light.
Light Output Ratio (LOR)	Ratio of the total light emitted by a luminaire to the total light output of the lamp(s) it contains measured at standard operating conditions.
Light Spill	The unwanted spillage of light onto adjacent areas which may affect sensitive receptors, particularly residential properties and ecological sites.
Light Trespass	The spilling of light beyond the boundary of a property which may cause nuisance to others, particularly when spilling into windows of neighbouring properties.
Lumen	Unit of luminous flux, used to describe the amount of light produced by a lamp or falling on a surface.
Lumen Depreciation	The decline in the light output of a light source during its lifetime.
Luminaire	The correct term for a light fitting. An apparatus which controls the light from a lamp and includes all components for fixing and protecting the lamps or light source, as well as connecting them to an electrical supply.
Maintained Illuminance (luminance)	Value below which the average illuminance on the specified surface is not allowed to fall. The maintained illuminance is specified at the end of the maintenance cycle, taking into consideration the maintenance factor. It is one of the main specification elements for the lighting designer. In the various slighting standards the maintained illuminance is specified for various areas/activities. Unit: lux. Symbol: Em. (Eave)
Maintenance Factor	Correction factor used in lighting design to compensate for the rate of lumen depreciation, caused by lamp ageing (lumen depreciation and lamp failure) and dirt accumulation (luminaire and environment). It determines the maintenance cycle needed to ensure that illuminance does not fall below the maintained value.
Sky Glow	The upward spill of light into the sky which can cause a glowing effect and is often seen above cities when viewed from a dark area.
Source Intensity	This is the brightness of the source of the luminaires and applies to each source in the potentially obtrusive direction, outside of the area being lit.

Term	Definition
Ave	Average value
Uniformity Ratio	Ratio of the minimum over the average illuminance for a specified area (Emin/Eave). When defined as such, the uniformity ratio is also the ratio of the minimum over the maximum illuminance for a specified surface area (Emin/Emax).
Vertical Illuminance	Illuminance incident on the vertical surface. Unit: lux (lx) = lm/m^2 Symbol: Ev

1 Executive summary

The following Artificial Lighting Impact Assessment provides details on the artificial lighting strategy proposed for the London Resort together with the design criteria, recommendation and mitigations measure to avoid undue light pollution or adverse impact on the existing site conditions.

This document shall form the basis, of which the final designs and implementation of the artificial lighting are to be addressed. The lighting strategy sets out the recommendations, applicable regulations and best practice, to be adopted for the Proposed Development. Parameters are provided, to limit obtrusive light and light pollution onto adjacent and surrounding areas of the proposed development, together with considerations for protection of ecology and the environment.

The Proposed Development consists of two sites the Kent Project Site and the Essex Project Site (collectively referred to as the Project Site) as further described below and in section 3.1 in more detail.

1.1 Essex Project Site

The Essex Project site consisting of parking facilities within an existing area of similar usage; and additional extensive parking and industrial development for which minimal impact on the existing conditions are envisaged.

1.2 Kent Project Site

The Principle Development and Associated Development is located within the Kent Project Site and situated prominently within the Swanscombe Peninsula. The Swanscombe Peninsula is an area of existing brownfield land, which is unilluminated during the hours of darkness. Public access is provided from the east of the area adjacent the residential housing development via the riverside walkway. A network of existing pathways and vehicular access routes occur; although, these are unilluminated and signposted.

It is evident that the introduction of any form of artificial lighting into this area during hours of darkness would impact on the existing base line conditions. The introduction of artificial lighting would however be required to facilitate safe pedestrian access within this area and developments requiring exterior illumination for purposes of functionality.

It is envisaged the Proposed Development would impact on the existing conditions and, therefore, an increase from the existing Environmental lighting zone E2 to E4 (Ref: ILP GN01:20) is expected. Designated areas of brownfield within the Swanscombe Marshes are to be enhanced and maintained for the preservation of natural habitats and wildlife. A lighting strategy is proposed to ensure the lighting is managed within the Principle Development to avoid undue light spill onto these natural areas of preservation. Illumination of pathways within these areas are kept to a minimum and where applied it shall in a considered method at low level with minimal light spill beyond the area of the pathways. The lighting within these areas re generally restricted to the main access routes connecting the Resort to the ferry port.

It is expected that the presence of the Resort would be of a noticeable visible change to existing conditions. There are prevalently visible light source emanating from the surrounding industrial developments, other than the variations in coloured lighting, with the proposed lighting strategy it is unlikely that the direct brightness of light emanating from the Principle Development would be greater than those currently present from the existing industrial developments surrounding the site.

The Proposed Development includes for a transport infrastructure route linking the Principle Development toward the south and connecting to the A2 and railway network.

2 Introduction

The purpose of this report is to review the proposed lighting scheme and lighting environmental impact of the Proposed Development against the current best practice, regulations and guidelines for the reduction of Obtrusive Light.

3 The Proposed Development

3.1 The Proposed Development's location

The Project Site lies approximately 30 km south-east of central London on the south and north banks of the River Thames, in the counties of Kent and Essex. On the south side of the Thames, the Kent Project Site occupies much of the Swanscombe Peninsula, formed by a meander in the river, and includes a corridor for transport connections extending generally southwards to the A2(T) trunk road. On the northern side of the river the Essex Project Site includes areas of land east of the A1089 Ferry Road and the Tilbury Ferry Terminal, which currently provides passenger services across the river to Gravesend and incorporates the London International Cruise Terminal. Further details can be obtained within the master planning documents.

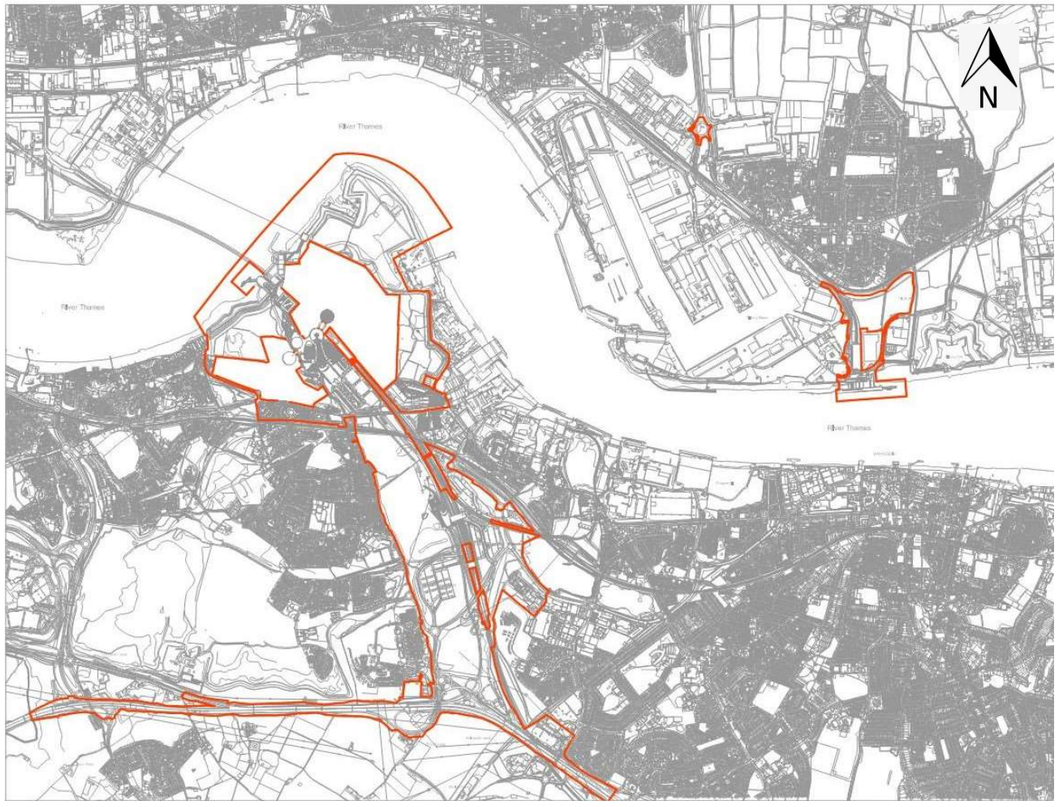


Figure 3—1 Site location and DCO order limits. Orange line indicates project boundary line

3.2 Project description

The Resort will be a nationally significant visitor attraction and leisure resort, built largely on brownfield land at Swanscombe Peninsula in Kent on the south bank of the River Thames and with supporting transport and visitor reception facilities on the northern side of the River Thames in Essex.

A distinction is made between the Principal Development, which comprises all works proposed within what would be the Entertainment Resort, and Associated Development, comprising other development that has a direct relationship with the Principal Development and is required to support its construction or operation.

A full description of the Proposed Development can be found in Chapter 3 Project Description of the Environmental Statement (document reference 6.2.13.1).

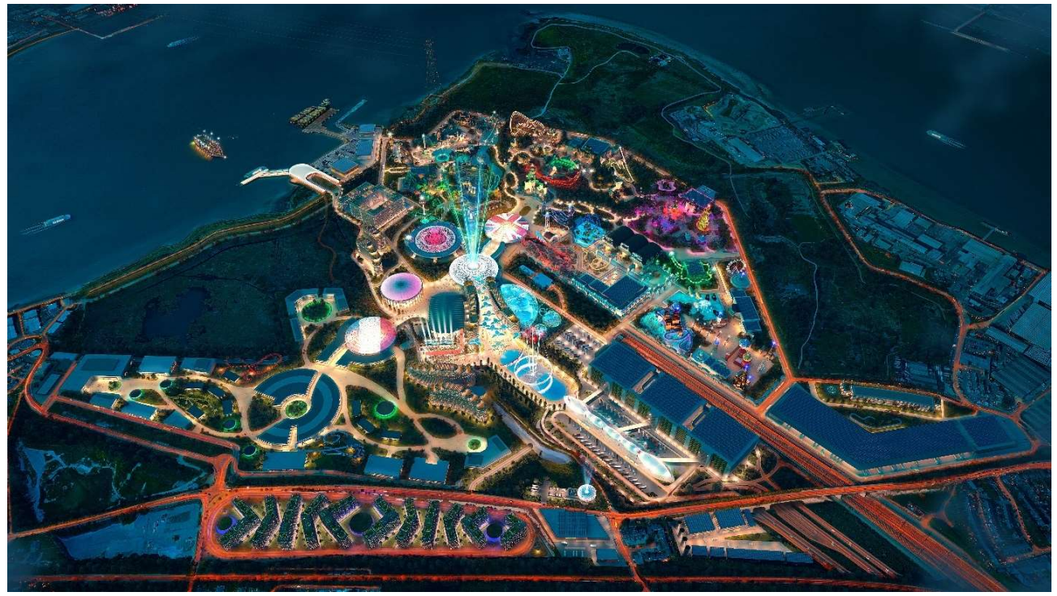


Figure 3—2 Artist impression of site plan when finished

Figure 3—3 Illustrative Masterplan. (Image curtesy EDP Consultants)

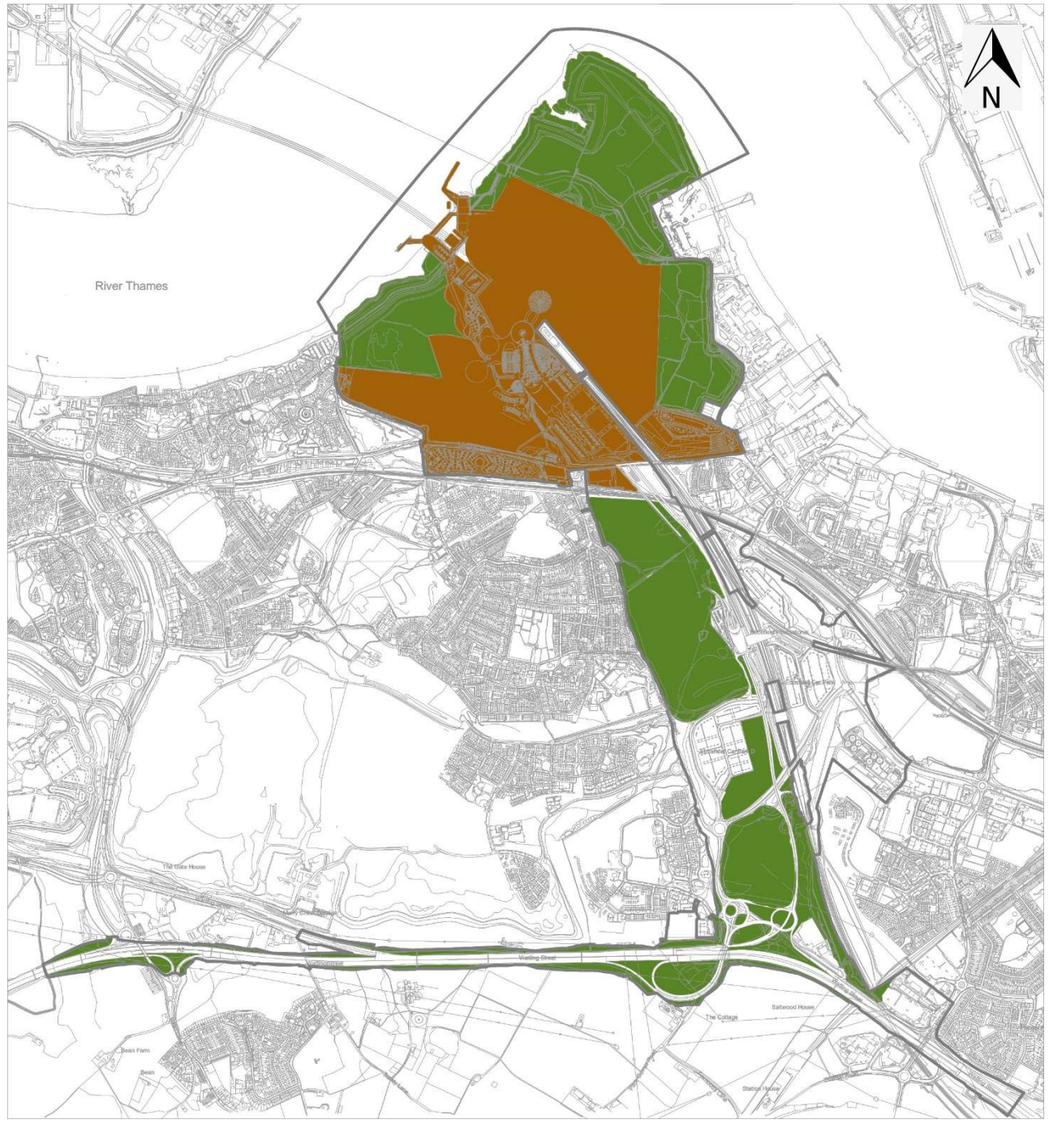


Figure 3—4 Site plan showing natural areas to be protected and enhanced and areas to be developed for construction

3.3 Existing baseline lighting conditions overview

The existing artificial lighting conditions are established via site surveys to determine the day and night-time characteristics for the area of the Proposed Development and immediate surrounding areas.

The following section provides information on the existing artificial lighting conditions present within the areas of the Proposed Development, upon which the base line existing lighting conditions are established.

The bases of the external lighting strategy within this document take into consideration the existing lighting conditions and context of the broader environmental and social impacts.

The information for the Kent Project Site, is broadly divided into three sections to include the Swanscombe Peninsula, the area forming the transport corridor connecting the Resort to towards the A2 and the areas of A2 East B262 junction and West to the B255 junction.

The Landscape Strategy (document ref edp5988_r015_231020) published by EDP Consultants should be referenced for further details of the historic and cultural associations of the landscape and character.

For further details of the masterplan, refer to 6.2.14.1 ES Appendix 14.1 Archaeological Desk-based Assessment, December 2020 as issued by APT Architects.

3.4 Baseline Conditions and Photographic survey

The following provides visual record from site surveys during daytime and hours of darkness together with reference light measurements recorded. Reference images where utilised are denoted with an asterisk (*).

The site visits carried out on the following days between the hours of 1500hrs and 1900hrs:

- 26th November 2020 – Sky conditions, partial cloud to clear sky. Moon 87%. Sunset 15.52rs
- 1st December 2020 – Sky conditions, cloudy. Moon 99%. Sunset 15.54hrs
- 17th December 2020 – Sky conditions heavy cloud cover. Moon 10%. Sunset 15.56hrs

Camera settings:

- Nikon D90 Digital SLR
- Lens: Nikon AF-S 18-105mm f/3.5-5.6, f/22-36.
- Aperture F5.6

Light meter:

- Konica Minolta illuminance meter;
- Konica Minolta Luminance Meter LS-100, Type T-10;
- Last calibrated: 9th December 2020.

Figure 3-5 references the viewpoint location as per indicative reference noted on the map and include for the direction of view i.e. Viewpoint 1.1 East, indicates the site photograph taken is at location 1.1 facing towards the east.

Figure 3—5 Photograph Viewpoint Reference Map 1

Figure 3—6 illustrates a pedestrian route leading from the residential area east of the river front providing the main means of public access to Swanscombe Marshes. Light Readings 39lux (adjacent columns) 3lux minimum. Columns – Sodium lamps.

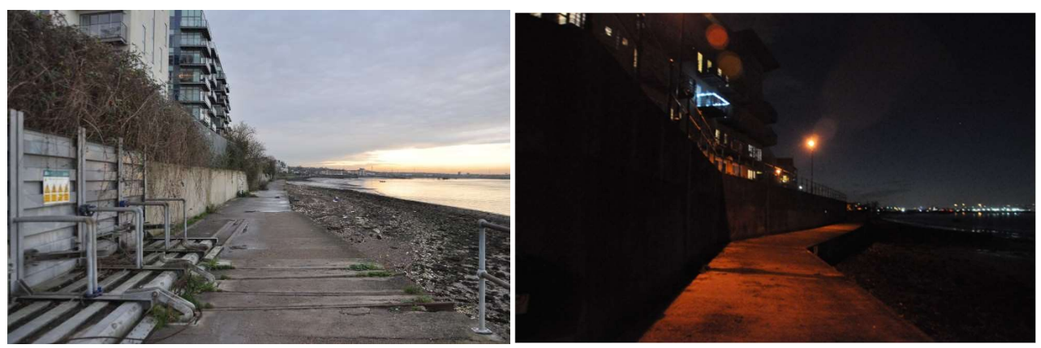


Figure 3—6 Viewpoint 1.1 West

Figure 3—7 illustrating the illumination of the pedestrian path leading to Swanscombe Marsh and visibility of light sources from industrial development on the adjacent side of the River Thames.

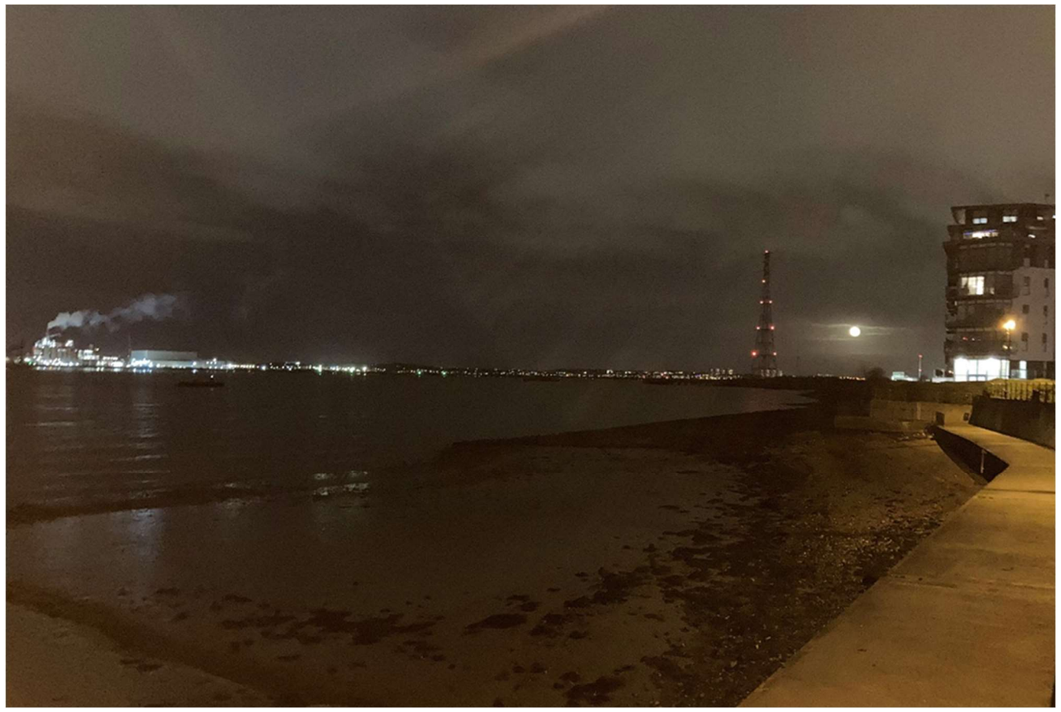


Figure 3—7 Viewpoint 1.1 East (night-time)

Figure 3—8 shows an exiting public pedestrian entrance to Swanscombe Marsh from Residential development east and night time view south. The pedestrian entrance to Swancombe Marsh provides the current main point of access to the public and is unilluminated during night time.

Figure 3—8 Viewpoint 1.2 South

Figure 3—9 depicts the area of Swanscombe Marsh is predominantly unilluminated at night-time, including pathways.

Figure 3—9 Viewpoint 1.2 East

The night-time image on Figure 3—10 illustrates the area of Swanscombe Marsh as unilluminated with the only visible light source from the surrounding developments. The very low levels of illumination (0.013lux to 0.017lux at floor level inland) recorded are predominately due to sky glow and any contribution from reflected moon light when present.

Figure 3—10 Viewpoint 1.2 East

Figure 3—11 Viewpoint 1.3 South East

The night-time visual on Figure 3—12 demonstrating the area as predominantly unilluminated at night-time. Light readings 0.14 to 0.12 lux by riverside and 0.013lux to 0.017lux, 10m from riverside and inland for majority of areas. There are predominant light sources visible around the perimeter of the Swanscombe Marsh emanating from the industrial developments both around the landside perimeter of the Swanscombe Marsh and areas on the adjacent side of the River Thames. Whilst the light sources have negligible light contributions to impact on illumination levels within the Swanscombe Marsh, the visibility of surrounding light source are predominant, some with minimal control of light distribution and poor directional aiming trajectories of floodlights.

Figure 3—12 Viewpoint 1.3. West

Figure 3—13 shows the visibility of existing light sources and sky glow from adjacent north bank of River Thames.

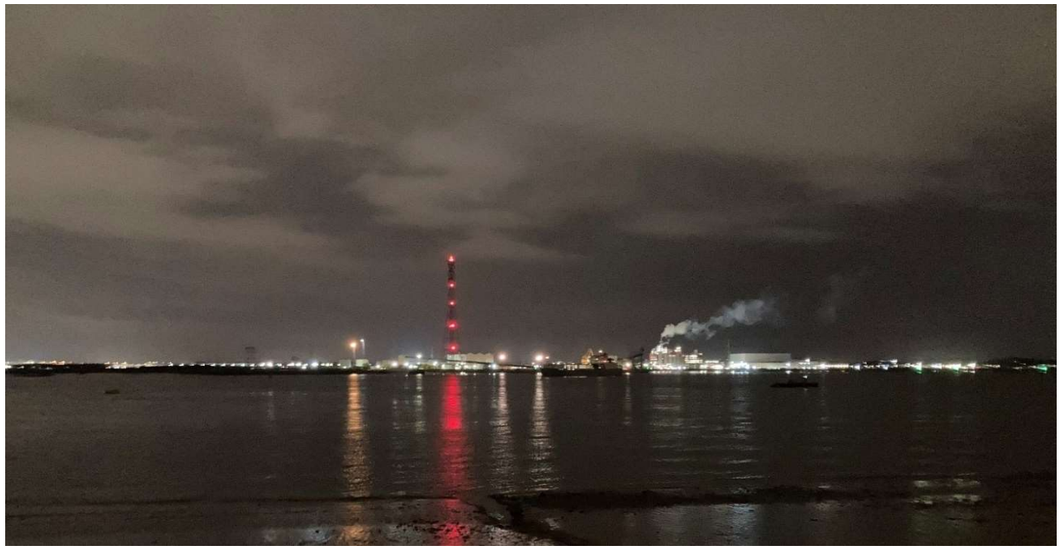


Figure 3—13 Viewpoint 1.3 North

Figure 3—14 shows the visibility of existing light sources from development boundary from the East perimeter.

Figure 3—14 Viewpoint 1.3 East

Figure 3—15 Photograph Viewpoint Reference Map 2

Figure 3—16 shows existing pier, non-operational and appears to be disused for a prolonged length of time.

Figure 3—16 Viewpoint 1.4 East and North

Figure 3—17 show existing moorings with no visible light sources active within the area during night-time. Viability of light sources from north bank of River Thames.

Figure 3—17 Viewpoint 1.5 East

Figure 3—18 Viewpoint 1.6 - South

Figure 3—19 indicates existing vehicular access to moorings.

Figure 3—19 Viewpoint 1.6 North and South

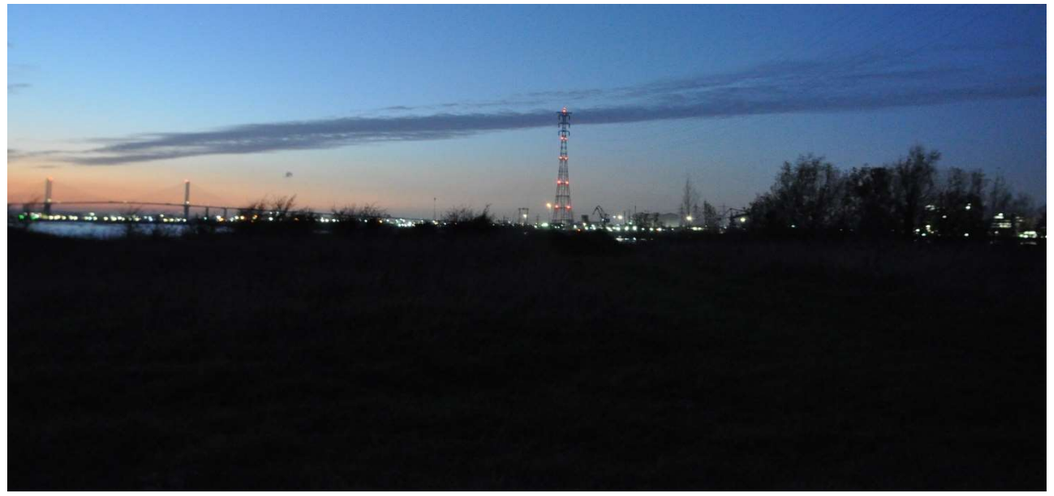


Figure 3—20 Viewpoint 1.6 East

Figure 3—21 Viewpoint 1.7 North East

Figure 3—22 Photograph Viewpoint Reference Map 3

Figure 3—23 illustrates that the residential area east of the Proposed Development consists of town houses and residential apartments. The street lighting being the predominant from of external illumination being present. The lamp sources being LED with a colour temperature of 4000K. The streets are illuminated in accordance with the requirement of the BS 5489 and BS EN 13201 and appear to be within the road lighting classification of P4. Illumination levels of 39lux measured directly under street lighting columns and a minimum of 3.7lux.

Figure 3—23 Viewpoint 1.8 North and East

Figure 3—24 shows Manor Road and Lower Road. The illumination of industrial developments east of the Proposed Development include for general exterior lighting of the premises consisting of a mixture of LED, Metal Halide and Sodium lamps. There is notable glare from some light source which are poorly directed with minimal shielding. Street lighting is provided for Lower Road utilising LED lighting columns to P5 road lighting classification and the length of Manor Road is unilluminated.

Figure 3—24 Viewpoint 1.9 North East

Figure 3—25 shows the areas of Swanscombe Marsh are unilluminated with visible of light sources emanating from industrial developments from the surrounding areas around the perimeter of the marshes.

Figure 3—25 Viewpoint 1.9 West

Figure 3—26 Photograph Viewpoint Reference Map 4

Figure 3—27 shows the areas of brownfield land parallel to the railway lines and adjacent Ebbsfleet International Terminal is generally not accessible to the public and unilluminated during hours of darkness. A pedestrian pathway provides access from Swanscombe town to Northfleet Station and Ebbsfleet International Terminal. Light readings being those obtained from sky glow and moonlight when present. Illumination levels of 0.013lux to 0.017lux at floor level for the area of brownfield land.

Figure 3—27 Viewpoint 1.10 North

Similar light readings were recorded in area shown on Figure 3—28 for Illumination levels of 0.013lux to 0.017lux at floor level.

Figure 3—28 Viewpoint 1.10 South

A pedsetrian path as shown on Figure 3—29 providing connection from Swnscombe town and Northfleet Station, is illuminated via LED lighting columns. The areas either side of the pathway are unilluminated with negligible contributions of light from the pathway illumination.

Figure 3—29 Viewpoint 1.11 East and North

Figure 3—30 shows International Way leading to Ebbsfleet International Terminal. Street illumination provided from lighting columns with Metal Halide lamp source illuminated in accordance with BS 5489 and BS EN 13201.

Figure 3—30 Viewpoint 1.12 West

Figure 3—31 shows Ebbsfleet International Terminal. Street illumination provided from lighting columns with mixture for LED and Metal Halide lamp sources, illuminated in accordance with BS 5489 and BS EN 13201.

Figure 3—31 Viewpoint 1.13 North West

Figure 3—32 shows Ebbsfleet International Terminal car park. Illumination provided from lighting masts with LED lamp sources illuminated in accordance with BS 5489 and BS EN 13201. Ebbsfleet International Terminal car park D in the distance is illumainted in a simialr method.

Figure 3—32 Viewpoint 1.13 South West

Figure 3—33 Photograph Viewpoint Reference Map 5 — Section of A2 to south west of the Proposed Development.

Figure 3—34 shows Watling Street, the street is unilluminated during night time. Dense tree line and shrubs provide shielding of lighting from cars into the areas of brownfield land. It is not expected that the Proposed development would have any adverse effects from lighting due to any increase in traffic densities to those currently present.

Figure 3—34 Viewpoint 1.14 East

Figure 3—35 depicts a pedestrian access pathway of located off Watling Street which routes under the A2 to the south of the A2. High tree line and solid fence line the perimeter of the A2 and limit the intrusion of light into the central natural habits. It is not expected that the Proposed development would have any adverse effects from lighting due to any increase in traffic densities to those currently present.

Figure 3—35 Viewpoint 1.15 East

The vehicular route A2 shown on Figure 3—36 is lined with dense tree coverage and shrubs either side of the dual carriageway. A solid fence all lines the road towards the northern side. It is not expected that the Proposed Development would have any adverse effects from lighting due to any increase in traffic densities to those currently present.

Figure 3—36 Viewpoint 1.16 East

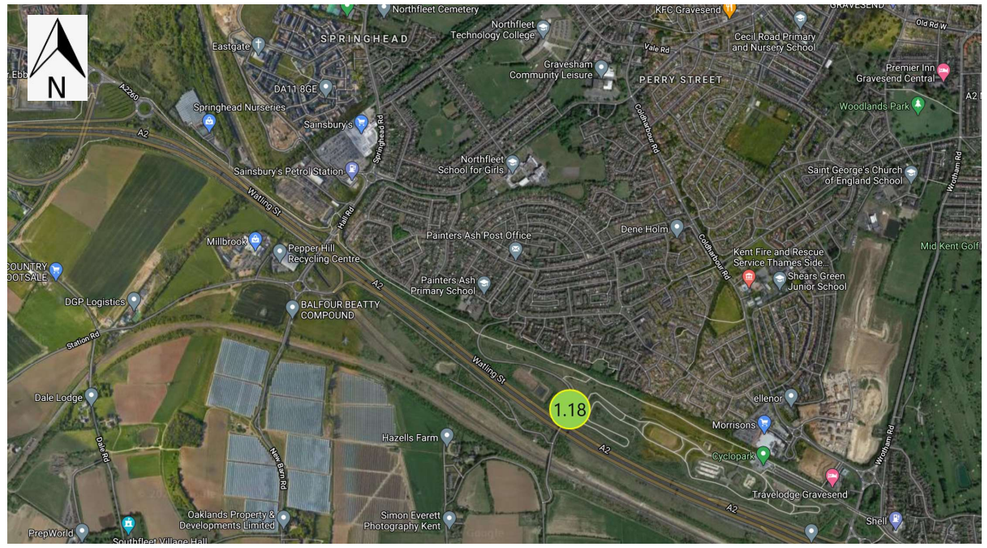


Figure 3—37 Photograph Viewpoint Reference Map 6 - Area of A2 south east of the Proposed Development

Figure 3—38 shows the area of land between the north of the A2 with Roman Road running central within the area which is unilluminated at night. Roman Road for this section areas is generally only accessible to pedestrian and cyclist and unilluminated at night-time. The roadway illumination to this area is shielded by dense tree lining cover and shrubs providing shielding from car headlights with the visibility of the roadway street columns being present, however not contributing any significant illumination with the areas of natural habits other than onto the verges of the A2. Light reading recorded between 0.42lux at the areas adjacent the A2 and between 0.13lux and 0.0lux centrally within the area of natural habitat. The areas further south entertaining an outdoor skate park and BMX track include a raised bank adjacent the section A2 which limits any light into this area. It is not expected that the Proposed development would have any adverse effects from lighting due to any increase in traffic densities to those currently present.

Figure 3—38 Viewpoint 1.16 East and West

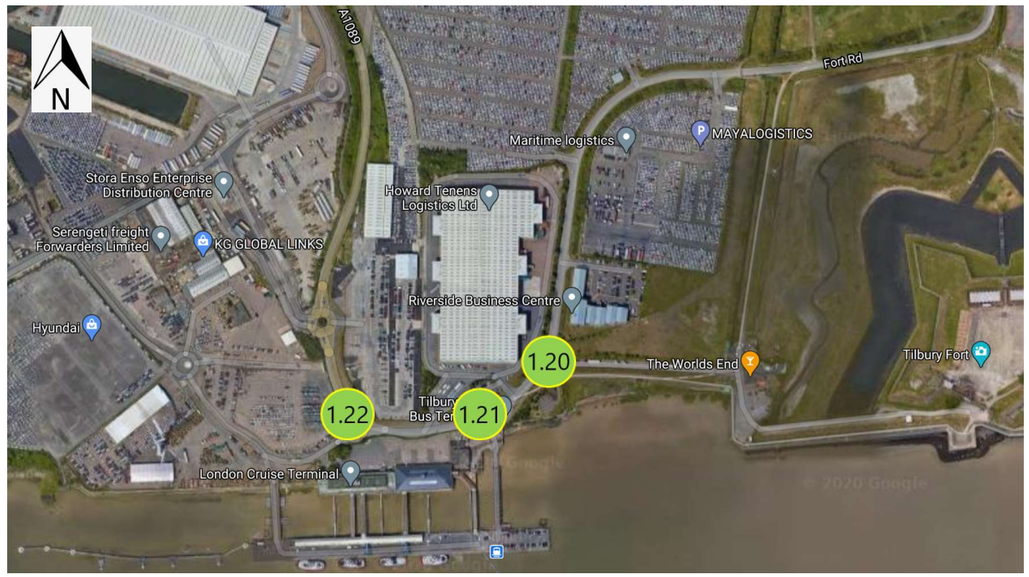


Figure 3—39 Photograph Viewpoint Reference Map 7 -Tilbury Terminal

The roadways shown on Figure 3—40 are illuminated in accordance with BS 5489 and BS EN 13201. Illumination levels recorded 66lux directly below lighting columns and 22lux minimum. The industrial buildings contain wall mounted and columns mounted luminaires providing illumaintion of the eternal pereimeter areas of the building and storage facilites. Many of the light source are not shileded and visiable glare beyond the development boundaries.

Figure 3—40 Viewpoint 1.20 West and East

Figure 3—41 depicts a pedestrian path leading east parallel to the River Thames and illuminated with street lighting columns with sodium lamps. Light reading recorded 70lux below lighting columns and 3lux minimum. Visible light sources are present from the adjacent south bank side of the River Thames.

Figure 3—41 Viewpoint 1.21 East

The street lighting as shown on Figure 3—42 utilises a mixture of LED and sodium lamp sources. Illumination of the external storage facilities is visible.

Figure 3—42 Viewpoint 1.21 West and East

Figure 3—43 shows illumination of storage area that contains visible glare from floodlights. The entrance to the port also emits glare form unshielded luminaires.

Figure 3—43 Viewpoint 1.21 North and South

Illumination of port illustrated on Figure 3—44 includes column mounted luminaires which emit light onto the River Thames and contains a high element of glare from unshielded light sources. Illumination from development on the south bank side of the River Thames is visible.

Figure 3—44 Viewpoint 1.21 South

Illumination of car park shown on Figure 3—45 consists of lighting masts with sodium lamp source with element of glare. The street lighting is addressed utilising LED lighting columns.

Figure 3—45 Viewpoint 1.22 West

3.5 Sensitive receptors

In order to establish the parameters by which spill light from artificial lighting is to be assessed, all relevant sensitive receptors must be identified.

As the Principal Development and Associated Developments are assumed to be in Environmental Zone E2 to E4 (refer to paragraph 4.6), with ecological receptors identified in the surrounding areas (e.g. bats, birds, invertebrates and other light sensitive wildlife) this assessment will focus on the potential impact to marshes and neighbouring properties and infrastructure.

Sensitive receptors in this case are:

1. **Marshes:** All marshes located by the London Resort and Resort gates which are home to different wildlife species that include migratory birds, invertebrates, reptiles, voles and others.
2. **River Thames:** Impact of light on the water surface and surrounding areas. Lighting impact to be assessed to avoid potential conflict between vessels from navigational signalling using the River Thames. Lighting impact to be assessed as bats are often roosting near shores or wet environments – refer to Ecological Report for habitat information.
3. **Neighbouring residential:** Residential buildings near the Proposed Development. The wider neighbourhood will be considered within the lighting computational analysis further developed in this document.

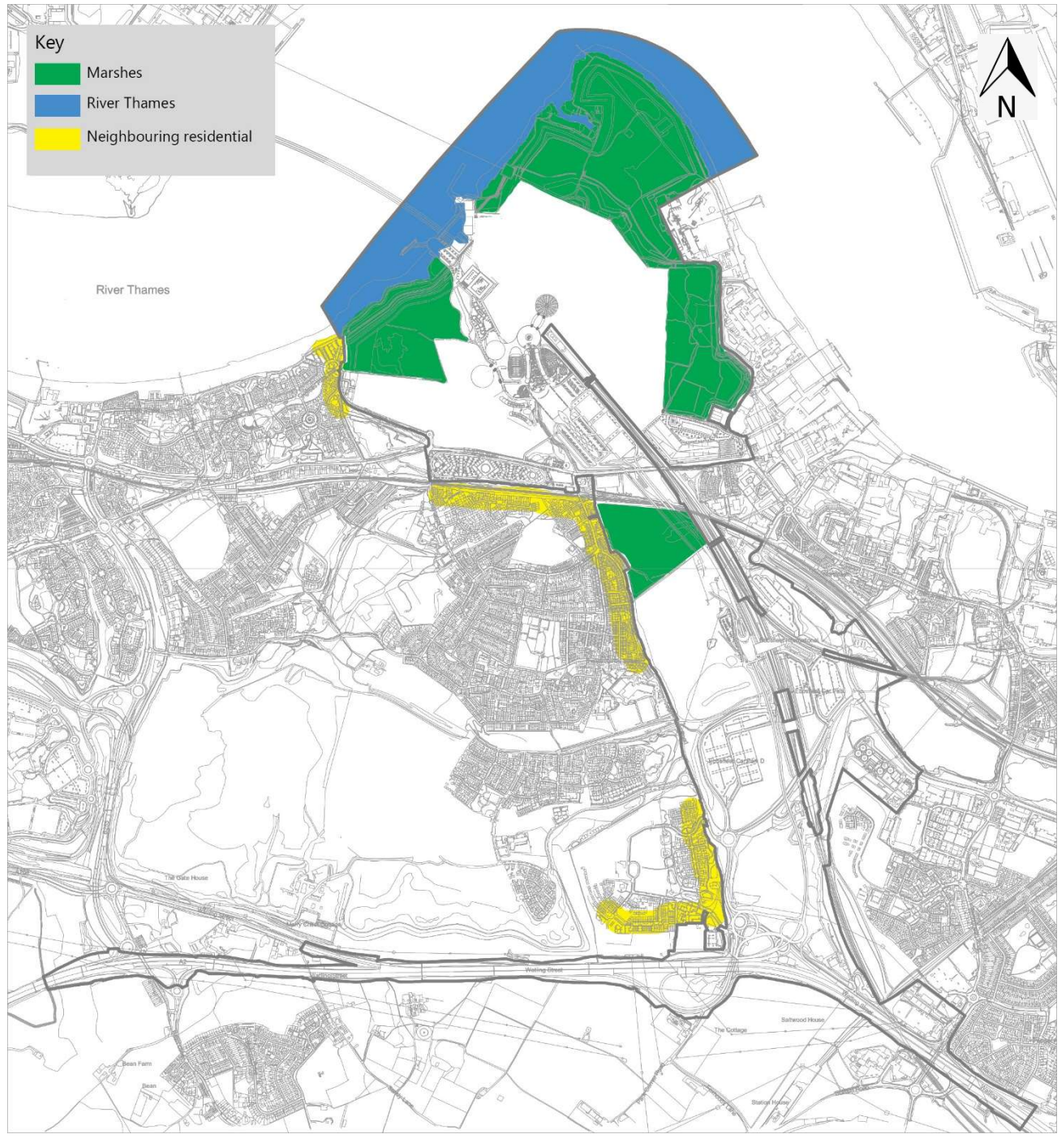


Figure 3—46 Map showing the areas designated as sensitive receptors

4 Lighting standards, legislation and guidance

4.1 Legislative framework

The Clean Neighbourhoods and Environment Act 2005 gives local authorities and the Environment Agency additional powers to deal with a wide range of issues by classifying light pollution as a statutory nuisance.

The statutory nuisance regime does not include light emitted from light sources which are used for transport purposes and other premises where high levels of light are required for safety and security reasons.

It is expected that the following sources are those with greatest potential to generate issues relating to artificial lighting:

- Domestic security lights
- Commercial security lights
- External sports facilities e.g. outdoor floodlit facilities
- Domestic decorative lighting
- Exterior lighting of buildings and decorative lighting of landscapes; and
- Laser shows / sky beams / light art.

4.2 Planning policy

The National Planning Policy Framework (NPPF) by the Ministry of Housing, Communities and Local Government which seeks to minimise the negative effects of artificial lighting.

Paragraph 180 of the NPPF states, *"Planning policies and decisions should also ensure that new development is appropriate for its location considering the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: (excerpt C) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation".*

NPPF is supported by Planning Practice Guidance (PPG), which provides further guidance and makes the following references to light pollution:

- Paragraph 001 (Reference ID 31-001-20191101) states, *"Artificial light provides valuable benefits to society, including through extending opportunities for sport and recreation, and can be essential to a new development. Artificial light is not always necessary, it has the potential to become what is termed 'light pollution' or 'obtrusive light' and not all modern lighting is suitable in all locations. It can be a source of annoyance to people, harmful to wildlife, undermine enjoyment of the countryside or detract from enjoyment of the night sky. However, for maximum benefit, it is important to get the right light, in the right place and for it to be used at the right time".*

- Paragraph 001 (Reference ID: 31-002-20191101) states, *"Is a proposal likely to have a significant impact on a protected site or species? This could be a particular concern where forms of artificial light with a potentially high impact on wildlife and ecosystems (e.g. white or ultraviolet light) are being proposed close to protected sites, sensitive wildlife receptors or areas, including where the light is likely to shine on water where bats feed".*

- Paragraph 002 (Reference ID: 31-001-20191101) states, *"Light intrusion occurs when the light 'spills' beyond the boundary of the area being lit. These adverse effects can usually be avoided with careful lamp and luminaire selection and positioning".*

- Paragraph 003 (Reference ID: 31-001-20191101) states, *"The use of lighting only when the light is required can have a number of benefits, including minimising light pollution, reducing energy consumption, reducing harm to wildlife and improving people's ability to enjoy the night sky. Impacts on sensitive ecological receptors throughout the year, or at particular times (e.g. during bird migrations) may be mitigated by the design of the lighting or by turning it off or down at sensitive times".*

- Paragraph 005 (Reference ID: 31-001-20191101) of the PPG considers the character of the area and surrounding environment with reference to how these may affect what is an appropriate level of lighting for that type of development proposed. It cautions to avoid glare and an appropriate selection of lighting so that it fulfils its purpose without over-lighting.

4.3 Port of London Authority

The Port of London Authority establishes guidance for lighting of the riverbank. The following notes apply to the Proposed Development:

- Artificial lighting application local to the riverbank, the ferry port or any lighting which may impact on the waterway and naval navigation shall agree with the recommendations of the Port of London Authority (PLA) together with the recommendations of the ILP.

- Illumination directly onto the River Thames shall be avoided and light spill limited to no more than 2lux, unless deemed required to the purposes of safety and function such as the ferry port and agree with PLA.

- As a rule, the use of red, green, and white light onto or near the waterway shall be avoided. It is however expected that the use of white light would be required for the illumination of the ferry port to ensure suitable level of illumination for safe operation.

- The use of fireworks (especially red fireworks) and laser displays directed towards the river shall not be permitted and any usage of such nature that may impact on the waterway and naval navigation are to be agreed in advance with the relevant local authorities and the PLA.

4.4 International Dark-Sky Association

The International Dark-Sky Association is an organisation that provides guidelines for the creation of dark-sky reserves around the world. Its aim is to preserve and protect the night-time environment and our heritage of dark skies through environmentally responsible outdoor lighting. Although it is not the aim of the Principal Development to obtain recognition from International Dark-Sky Association (IDA), it is important to follow the principles established by this organisation in order to generate a night-sky friendly environment.

The general lighting principles of the IDA should be followed to ensure good lighting that reduces light pollution and its impact on dark skies. Some of the principles established are as follows:

- New lighting should not adversely degrade the sky quality beyond the immediate area to be lit.
- Angle light downward. No unnecessary light above or near the horizontal.

- Luminaires should be aimed towards where the light is needed, carefully considering the spill on the natural environment and neighbouring properties.
- Luminaires should be switched off when not needed. The use of smart control systems is highly recommended.
- Do not over illuminate
- Avoid bright white and cooler temperature LED's (anything above 3000K)
- Install luminaires at lowest possible height to achieve lighting levels

Figure 4—1 Example of luminaire types approved by the IDA - (Source IDA)

4.4.1 Impact of light pollution

The IDA guidance notes also contain information about the impact of light pollution in other areas. The impact of light pollution is not only confined to the visibility of stars at night and obtrusive light. It also affects the following animals which are present on site according to EDP's Landscape Strategy (document ref xx).

4.4.1.1 Bats

As nocturnal specialists, most bat species are susceptible to artificial light. Due to the decline in numbers, all bat species are protected by the Wildlife & Countryside Act (1981) and the Conservations Regulations (1994). This makes it illegal to kill, capture or disturb bats, obstruct access to roosts or damage/destroy roosts. Lighting in the vicinity of bat roosts causing disturbance could constitute an offence. For planning applications developers should:

- Refer to Ecological report for identification of sensitive locations for bat habitats and roosting
- Not directly illuminate bat roosts
- Avoid illuminating foraging areas and route

4.4.1.2 Birds

Evidence shows that artificial light can reduce sleep in birds, which disrupts the long-term circadian rhythm that dictates the onset of breeding. Birds are likely to be disrupted by changes to insect behaviour due to artificial lights. In general:

- Do not directly illuminate important areas for nesting birds – probably wildlife sites

4.4.1.3 Invertebrates

Moths attracted to lights are a familiar sight. Artificial light, particularly blue UV rich, significantly impacts invertebrates, disturbing feeding, breeding and movement which may reduce and fragment populations. It is estimated that a third of insects that are attracted to lights will die as a result of their encounter. Evidence also shows that pollination rates in illuminated plans can be reduced by 62% - (Knop et al 2017. Nature 548). In general:

- Avoid illuminating water or reflective surfaces
- Do not illuminate ecologically sensitive areas
- Use colour temperature, CCTs of less than 3000K
- Use narrow band minimal UV source

Figure 4—2 Precedent images of different rural areas using warm and low-level luminaires in the public realm for the preservation of the dark sky and protection of the surrounding environment

4.5 The ILP (Institute of Lighting Professionals) notes for the reduction of obtrusive light GN01

The Institute of Lighting Professionals (ILP) has produced the '*Guidance Notes for the Reduction of Obtrusive Light* (Guidance Note GN01:20), along with the '*SLL Code for Lighting 2012*' provide guidance for local authorities with a recommendation that they are incorporated at the local plan level. The guidance defines various forms of light pollution and describes a series of environmental zones and how to provide external lighting in each of these zones to mitigate unwanted light. The ILP guidance notes provide suitable criteria against which the effects of artificial lighting can be assessed and have been used in this assessment

The main potential issues with artificial lighting within a site of this environmental context are:

- poorly controlled sources;
- where light is not directed into the required area and is lit with excessive amounts of light; and
- where an area is lit too brightly for its purpose, and excess light is reflected upwards.

Figure 4—3 shows the key characteristics of how the artificial lighting design for a development should be developed – 'Useful Light' (as required for functional use), 'Spill Light', and 'Light Trespass' (Light that is not wanted or required. This light may be a nuisance to others, a waste of energy, and an unnecessary source of greenhouse gases).

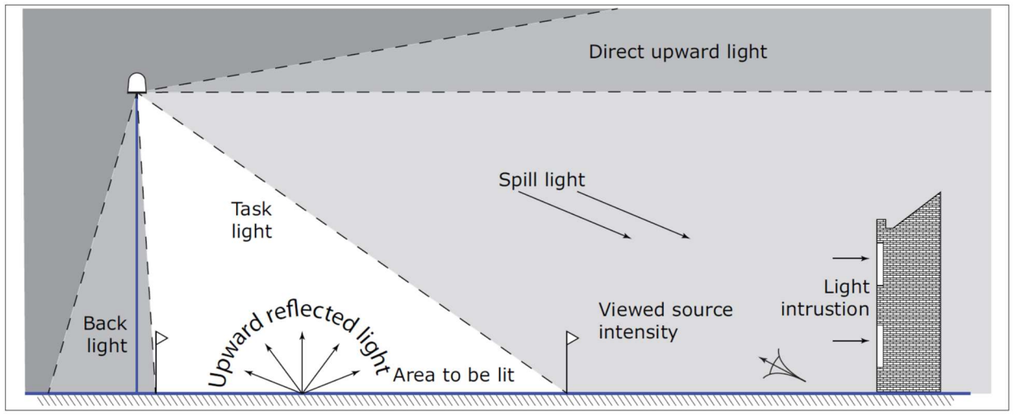


Figure 4—3 Types of obtrusive light – (Source: ILP GN01/20)

4.6 Lighting Environmental Zones

The classification of Lighting Environmental Zones, in the UK, are established within the documents GN01/20, 'Guidance notes for the reduction of obtrusive light' published by the Institute of Lighting Professionals (ILP).

As with any new development, there is a risk that the proposed lighting strategy may have a negative impact on the surrounding environment and residents, in terms of light spillage, brightness or glare. The identification of four environmental zones have been established as a basis for outdoor lighting regulations.

The environmental zone rating can be used to help ensure that the lighting goals of an environment are appropriately defined and met, considering the context and relevant surroundings.

Table 2: Environmental zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town/city centres with high levels of night-time activity

Notes:

1. 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.
2. Rural zones under protected designations should use a higher standard of policy.
3. Zone E0 must always be surrounded by an E1 Zone.
4. Zoning should be agreed with the local planning authority and due to local requirements a more stringent zone classification may be applied to protect special/specific areas.
5. SQM (Sky Quality Measurements) referenced by the International Dark-Sky Association (IDA), the criteria for E0 being revised in mid 2019 but not retrospective.
6. Astronomical observable dark skies will offer clearer views of the Milky Way and of other objects such as the Andromeda galaxy and the Orion Nebula.
7. Although values of SQM 20 to 20.5 may not offer clear views of astronomical dark sky objects such as the Milky Way, these skies will have their own relative intrinsic value in the UK.

Figure 4—4 Extract table on guidance for the reduction of obtrusive lighting – (Source: ILP GN01/20)

The Principal Development has been subdivided into different Lighting Environmental Zones that will set the conditions for the lighting in the public realm and provide guidance for internal lighting and signage/event lighting with the main purpose of protecting the natural environment surrounding the London Resort and the neighbouring communities.

Figure 4—5 denotes the valuation of environmental zones for the Proposed Development based upon the ILP GN01:20. The final confirmation of Environmental Zones are to be determined by the Local Planning Authorities and the Port of London Authority. The above provides an indication of zone classifications based on the review of existing areas and the Proposed Development with reference to the ILP GN01:20.

Generally, the concentration of areas of high brightness is confined to the Principal Development with Zone E4 classification, with the Associated Development generally categorised as Zone E3.

Most of the Principal Development and Associated Development areas are generally surrounded by Zone E2 rural areas. A buffer zone (Zone E3) is applied at the perimeter boundaries between high and low areas of brightness i.e. between Zone E4 areas directly adjacent to Zone E2 areas. This avoids stark contrasts between areas of high and low brightness allowing for a more seamless transition between these spaces.

The lighting classification for the Proposed Ferry Terminal is noted as Environmental Lighting Zone E2 to minimise light spill onto the River Thames, however additional considerations are also to be taken into account and compliance with the requirement of the Port of London Authority and the ferry operators are also required to be adhered to.

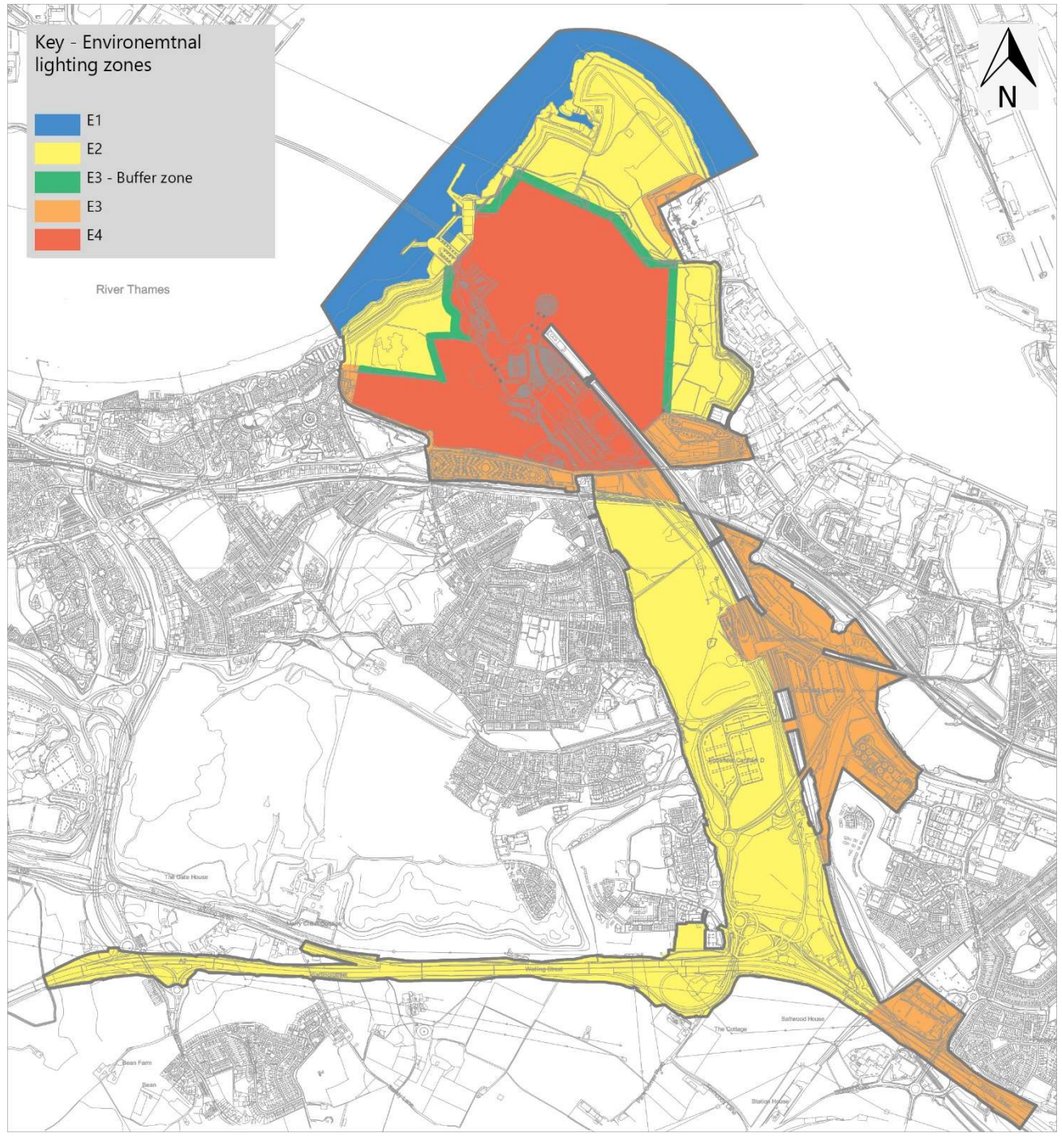


Figure 4—5 Environmental lighting zones within Order Limits

Table 4—1 Lighting design criteria for environmental lighting zones – (Source: ILP GN01/20)

Environmental Zone	Sky Glow ULR (Max %)	Maximum values of vertical illuminance on properties		Luminaire Intensity I (cd)		Building Luminance (pre-curfew)
		Pre-curfew	Post-curfew	Pre-curfew	Post-curfew	Average L (cd/m2)
E0	0	0	0	0	0	0
E1	0	2	0	2500	0	0
E2	2.5	5	1	7500	500	5
E3	5	10	2	10,000	1000	10
E4	15	25	5	25,000	2500	25

The ILP has produced guidance on the maximum permissible light spill into windows of adjacent properties, before and after the curfew time, based on which environmental zone the development is located in. Table 4—1 above illustrates the various lighting design criteria associated with meeting the recommendations set out in achieving lighting compliance.

4.6.1 Objective of lighting environmental lighting zones

4.6.1.1 Environmental Zone E1

No artificial lighting. Maintain the river in its current condition. This applies only to the area of the river which is within the CDO Order Limits. This classification aims to avoid the spill of unnecessary lighting onto the water possibly affecting the current natural environment.

4.6.1.2 Environmental Zone E2

This environmental zone is applied to mitigate the glow coming from the Principal Development and neighbouring communities to protect the natural areas that are to be conserved and enhanced. The aim is also to mitigate lighting in such a way that no lighting sources (lamps) are visible from animal habitats, as well as to reduce glow and minimise glare to create a comfortable and safe environment for visitors and the local fauna.

4.6.1.3 Environmental Zone E3 Buffer

To provide a dense, dark, corridor between the marshes and natural areas and the first line of development of the London Resort. Lighting in this buffer zone should be only limited to gateways and areas where it is strictly required for security and safety purposes.

4.6.1.4 Environmental Zone E3

This environmental zone is designated to areas of the development that have lower levels of intensity and activity. Residential zones for staff and training centres. The objective is to provide the necessary levels of light to create a safe and comfortable environment without over illuminating and reducing the spill of light onto buildings and areas of the E2 Environmental Lighting Zone.

4.6.1.5 Environmental Zone E4

Applies to the centre of the London Resort, which will be an area of high levels of night-time activity. The objective is similar to Zone E3. Limit and control the spill of light onto the night sky and adjacent environmental lighting zones.

5 Lighting strategy and impact assessment

5.1 Lighting strategy objectives

Landscape Design Objectives	Lighting Strategy Objectives
A Destination Landscape • *Create a world-class, exciting resort landscape with a bold and innovative concept based around riverine and estuarine principles;* • *Bring the principle of the marsh landscape into the resort with rain gardens, swales and natural planting to manage surface water drainage, create a strong structure to the landscape and respond to the local site conditions;* • *Planting to be based on native species and local habitats, designed to have seasonal impact and create beautiful vistas whilst creating positive micro-climates;* • *Hard and soft landscape design detailing to be climate and micro-climate resilient*	Lighting should help the London Resort to become a destination landscape by enhancing all soft and hard scape areas at night by a careful consideration of a design narrative that follows and complements the landscape objective.

Landscape Design Objectives	Lighting Strategy Objectives
A Biodiverse Landscape • *Existing and retained habitats to be managed to check the natural ecological succession which is currently taking place and maintain open ground and grassland habitats as well as woodland and scrub.* • *Where existing habitats will be lost, translocation of some areas to new locations on site to preserve and enhance biodiversity;* • *Enhancements within existing habitats to improve biodiversity including variation in water levels in Black Duck Marsh and increasing wet habitat in Botany Marsh; and* • *Ecological and water quality monitoring to be included as part of a management plan for the site to ensure the rich diversity of plant and animal life is maintained;*	Lighting should respect, enhance and protect the existing and retained natural environments by the careful use of lighting only where it is required. Lighting should also be controlled both digitally and physically to avoid excess of illumination, glare, high contrast

Landscape Design Objectives	Lighting Strategy Objectives
A Resilient Landscape • *Integrate marsh landscape into the resort with rain gardens, swales and naturalistic planting to manage surface water drainage and create a strong landscape structure;* • *Planting to be based on native species and local habitats, designed to have seasonal impact as well as providing shade, natural cooling and wind protection.* • *Habitat creation to be multi-functional, improving biodiversity, creating natural security, managing water resource and providing natural beauty;* • *Raised and new food banks to manage increased risk of flooding as a result of climate change; and* • *Landscape to be climate and micro-climate resilient with reduced reliance on irrigation and chemical controls and use of sustainable materials wherever feasible.*	Lighting should be flexible, durable and easy to maintain in order to contribute to the resilient landscape initiative. Luminaires in protected environment should possess the correct light colour temperature, mounting height and light distribution to not disturb the local fauna.

Landscape Design Objectives	Lighting Strategy Objectives
A Historic Landscape • *Use the Pilgrim's Way historic route as principal pedestrian access from London Road to the Resort, Marshes and Thames Jetty with a grand sense of arrival; and* • *Celebrate local heritage through engagement with key landscape features such as the chalk cliffs and super pylon, public art installations and an interactive visitor centre display.*	Appropriate lighting in historical areas of the Principal Development can enhance the heritage identity. The right fixture, colour temperature and intensity are key elements to reinforce the sense of history and identity within historical areas.

Landscape Design Objectives	Lighting Strategy Objectives
An Accessible Landscape • *Footpath and cycle routes to improve connectivity from Ingress Park, London Road and Botany Marsh Road* • *Development of a way-finding strategy to provide clear directional guidance and orientation information for all users.* • *Creation of active landscape spaces within the resort where visitors can interact with water, plants, geology, history and natural sounds;* • *Creation of tranquil amenity spaces for picnics, resting points and appreciation of nature both within the resort and the surrounding marsh landscape; and* • *Access to the marshes and River Thames frontage to be improved and enhanced through use of boardwalks, bird hides and clear signage information to limit disturbances to wildlife.*	The lighting proposal should support the needs of all people visiting the London Resort after dark. Lighting should be provided to vital link routes between infrastructure zones and local communities. A safe and secure environment should also be created to allow these communities to prosper and benefit from the construction of the London Resort.

5.2 Lighting design criteria

5.2.1 Environmental impact

Good lighting can bring both social and economic benefits, but the use of artificial lighting comes with environmental consequences. This not only includes power consumption, but also the risk of light spill, light pollution and over illumination all of which can have a detrimental impact on the well-being of neighbouring residents, the mooring community, visitors and employees of the Principal Development, but also on the marsh's local ecologies. Therefore, the quantity of light and the equipment is kept to a minimum in those areas that need the least amount of light. The specification of the luminaires should consider optical control, efficacy and whole lifetime cost to keep energy consumption to a minimum and the light distribution only to where it is needed.

5.2.2 Safety

The lighting should be designed to keep a safe environment. The positive definition of potential hazards such as level changes and borders, and the adequate illumination of areas where pedestrians are likely to encounter moving vehicles should take priority in the lighting design for the external areas of the London Resort.

5.2.3 Security

The lighting development for the London Resort should be designed to provide an overall sense of security supporting both active and general passive surveillance. Lighting should provide adequate recognition and modelling of people where required.

5.2.4 Accessibility

The design of the lighting must support the needs of all people visiting the London Resort after dark. Design measures must include the avoidance of high contrasts, direct and reflected sources of glare, and confusing upward lighting. Accessibility through the Principal Development can also be aided through the creation of a legible environment and the use of light to promote movement and aid intuitive wayfinding.

5.2.5 Legibility

Key physical elements such as architectural landmark buildings, beacons and other parts of the urban realm should be careful and positively illuminated to aid wayfinding and create a mental map in visitors and staff. The lighting of key feature elements such as paths, meeting places, boundaries, gateways and landmarks will also help to enhance people's sense of safety and security.

5.2.6 Character

Lighting can help to define the overall character of the London Resort at night, as well as making distinction between the different zones within the Principal Development. Light can be used to reinforce and enhance the character of individual spaces being by light colour temperature, intensity and mounting height.

5.2.7 Heritage

An appropriate atmosphere must be created in those areas of the London Resort that are characterised by their history. The careful and considered highlight of historical elements (these being the pylon, the ferry jetty or any other element that can potentially be highlighted) can not only help with interpretation and enjoyment of the site at night but also help contribute towards the overall legibility and character.

5.2.8 Identity

The experience of the London Resort at night will play an important role in forming the image and memory of the Principal Development in all its visitors and staff. A proper identity can be created by the careful and considered lighting approach that helps to enhance the character and legibility of the whole area.

5.2.9 Events

Events will be one of the key elements happening at the London Resort. They provide an additional layer of interest, magic and wonder that add to the mental image that the visitor forms of the place. Careful location of event infrastructure including signage will add to the experience of the London Resort and help to protect the natural areas within the Principal Development that are to be conserved and enhanced.

5.2.10 Social impact

Effective, safe and atmospheric lighting can help create a positive environment for people and the natural surroundings. Appropriate lighting can help create greater interaction between the local communities and the London Resort by promoting a respectful use of lighting that is not obtrusive into any neighbouring community. Careful consideration of the lit character of each part of the Principal Development will also benefit the whole, by example providing areas of greater activity by night within the Resort area and areas of low activity within the natural zones. Additionally, the positive lighting of some connection routes within the Principal Development will benefit the local area helping to create links into the city and other local communities.

5.2.11 Technology

Light sources, luminaires, control technologies, efficiencies are all rapidly changing due to the latest technological advancements. The development of digital lighting controls promises new flexibility and ease of management together with greater energy saving measures. It will be important for each area within the Principal Development to utilise the latest technology available at the time of design and procurement to ensure the best benefit for the whole project. In this way the associated positive effects on management of the lighting and the social and environmental aspects can be properly managed.

5.3 Lighting Principles

5.3.1 Colour Temperature and colour rendering index

Colour temperature defines the colour appearance of the light. It is a quality to which people are subconsciously sensitive. The warmth of a fire or candle fame speaks at a very deep level of safety, history, and communion. Cooler light, as experienced on a clear night with a bright moon and sparkling stars, for example, has a more open, magical and dramatic quality. Warm light comes forward in the visual scene whereas cool light often recedes and creates depth.

Warm light is proposed to be used across all the Principal Development with special importance in the Thames Shoreline and the marshes for the following reasons:

- Warm light is mentally associated with safety, history, communion, relaxation and intimacy, which are pivotal elements in the natural visitor experience around the London Resort.
- Any type of light could suppress the secretion of melatonin in human beings and different animals, however the exposure to blue light at night does so more powerfully as retina is more sensitive to blue light wavelength. Red light has very small impact on the melanopsin receptors, and they do no stimulate wakefulness. Warm light has higher quantities of red light, therefore is the appropriate light to generate a relaxed environment across Triple Bay
- Red, amber and yellow light, and light up to 2200K have a shorter wavelength than 3000K, 4000K light. This is beneficial for the animals as they are less attracted to this type of light therefore generating less disturbance on the natural environment at night.
- According to different scientific studies and the International Dark Sky Association (IDA) blue light brightens the night sky more than any other colour of light, so it is important to minimize the amount emitted. Triple Bay and Amaala have the potential to become a dark sky reserve and a world class site to preserve the night sky turning this into an important part of the visitor's experience.

Therefore, the following ranges of colour temperature have been associated to the different Lighting Environmental Zones within the Principal Development:

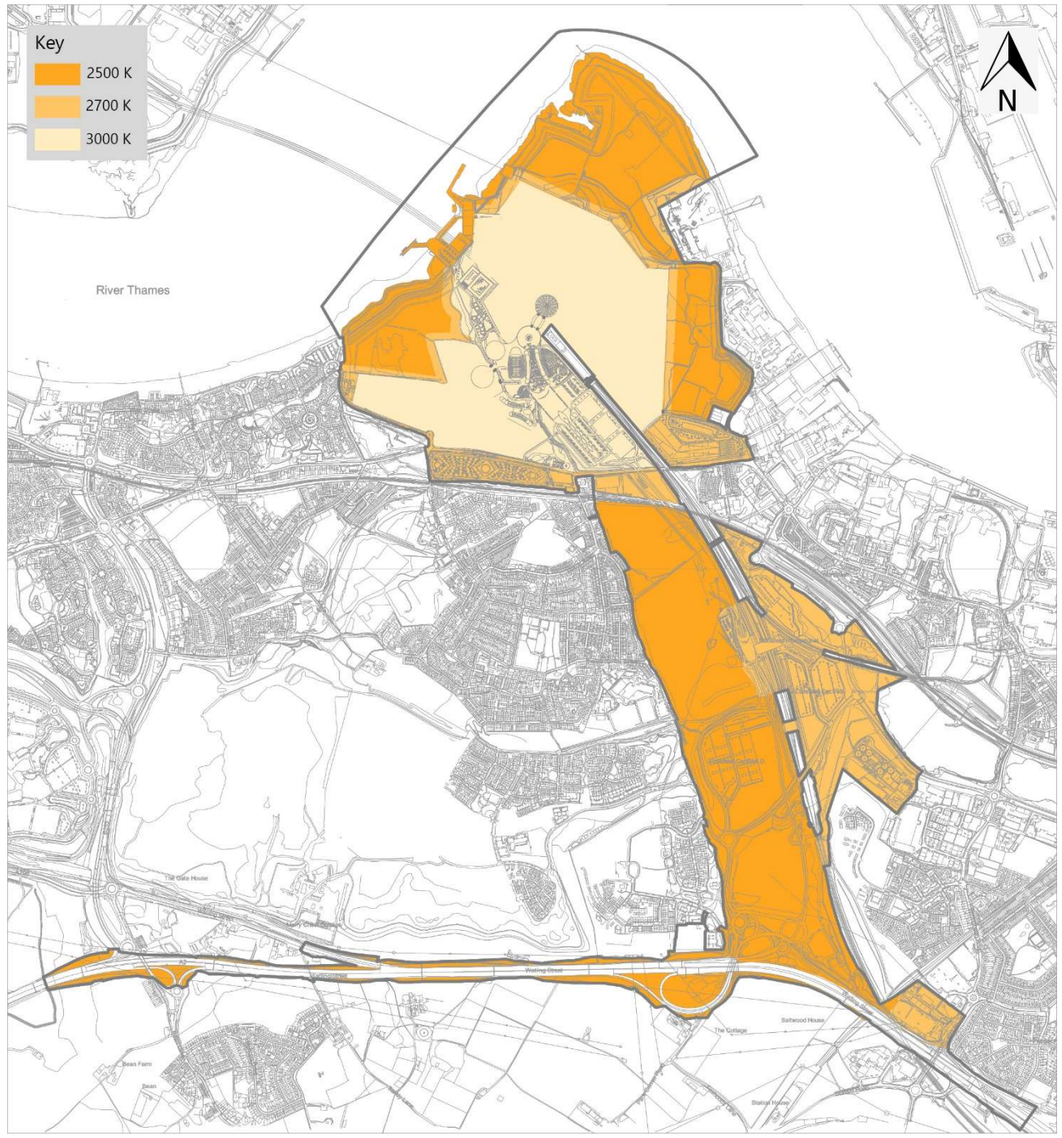


Figure 5—1 Range of light colour temperature across the Principal Development and Associated Developments

- Lighting environmental zone E1: no light
- Lighting environmental zone E2: 2500K
- Lighting environmental zone E3: 2700K
- Lighting environmental zone E4: 3000K

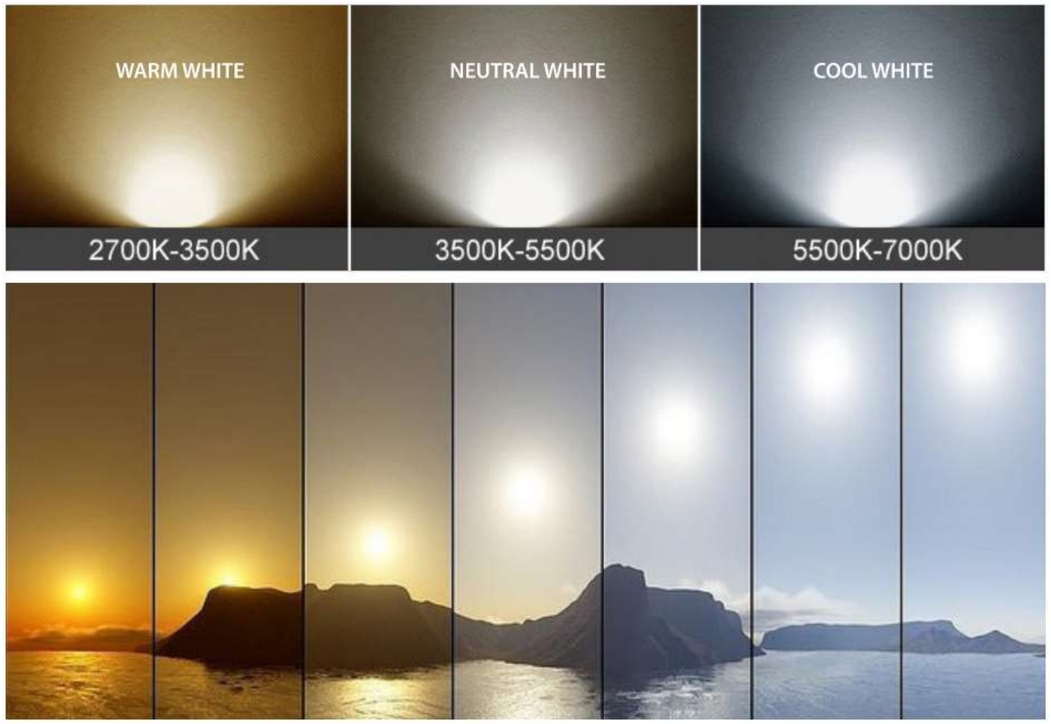


Figure 5—2 Light colour temperature example chart

The Colour Rendering Index provides an objective indication of the ability of a light source to render the colours of various objects faithfully, in comparison with a natural light source. The general colour rendering index Ra has been introduced to specify the colour rendering properties of a light source. The maximum value of Ra is 100. This figure decreases with decreasing colour rendering quality.

It is important for visual performance and the feeling of comfort and well-being that colours of objects and of human skin are rendered naturally, correctly and in a way that makes people look attractive and healthy.

In principle, exterior lighting applications do not have the same requirements as interior environments in terms of colour rendition. Over the last 20 years, 60-70 CRI value was commonly encountered in exterior lighting schemes. As technology progresses, the light quality of LEDs improves rapidly. Long-standing high-quality lighting manufacturers now provide a minimum of CRI 80 for outdoor products.

Figure 5—3 Differences between CRI levels

5.3.2 Intensity

The intensity of light across the Project Site must be appropriately considered from the brightest thoroughfares to the dimmest landscaped areas, both for the area in question, and in relation to adjacent areas.

Users' safety, security and comfort is of primary importance and a considered approach to the amount of light employed across the Principal Development and Associated Developments will help improve all these measures. Varied levels of light intensity will act to increase the legibility of the Resort, improving peoples' orientation as they move through the site.

It is suggested that the levels of illumination should be at their highest when spaces are shared by vehicles and pedestrians, and when the speed of their movements are highest. When the movement of people is slower, though, or when there is less interaction with motorised traffic, the lighting levels can be much lower, while still providing an appropriate level of safety, and comfort.

5.3.3 Mounting height and shielding

The mounting height of the lighting equipment will contribute to the perceived scale of spaces. Mounting luminaires too high on columns or buildings risks creating an environment that feels unwelcoming and scale-less for pedestrians and an increased proportion of spilled and uncontrolled light on the natural environment. A carefully considered range of mounting heights appropriate to the form and function of the space under consideration will assist in achieving the right sense of scale and add to the legibility of the area after dark.

Figure 5—4 Comparison between high and low mounting scales. Image on the left shows large scale lighting column without any glare control and the image on the right shows a smaller column with controlled lighting distribution providing light to the path only

Shielding is required in certain lighting fixtures to help minimise the amount of light that can spill onto the night sky and the surrounding natural environment

Both, the Principal Development and Associated Development should include shielded luminaires in all public realm. There are two proposed levels of shielding depending on the level of sensitivity of the area.

5.3.3.1 Integrated shielding

A full cut-off shielded light fixture has an integrated solid barrier at the top, located over the light source (lamp) such that it is covered. The solid housing should not have any translucent parts or diffused materials which will allow for lighting escaping towards the dark sky. These luminaires allow light to be accurately cast downwards into the desired area without major levels of light spill. Spread lenses, snoots, internal/external louvres, honeycomb louvres and other glare mitigation and light control measures can be used in these luminaires to further limit the spread of light beyond a targeted area.

5.3.3.2 Integrated and external shielding

Areas within the Lighting Environmental Zones E1 and E2 need further mitigation measures to be adopted in order to fully shield the light from direct line of sight from the marshes and Thames shoreline. 100% light source shielding can be achieved using physical landscape and architectural barriers (such as: dense shrubs and dense low-level vegetation, dunes, bunds, berms, etc.) and, furniture-integrated (or otherwise recessed) luminaires, solid balustrade, solid or very dense screens, and dunes and others, in combination with full cut-off fixtures.

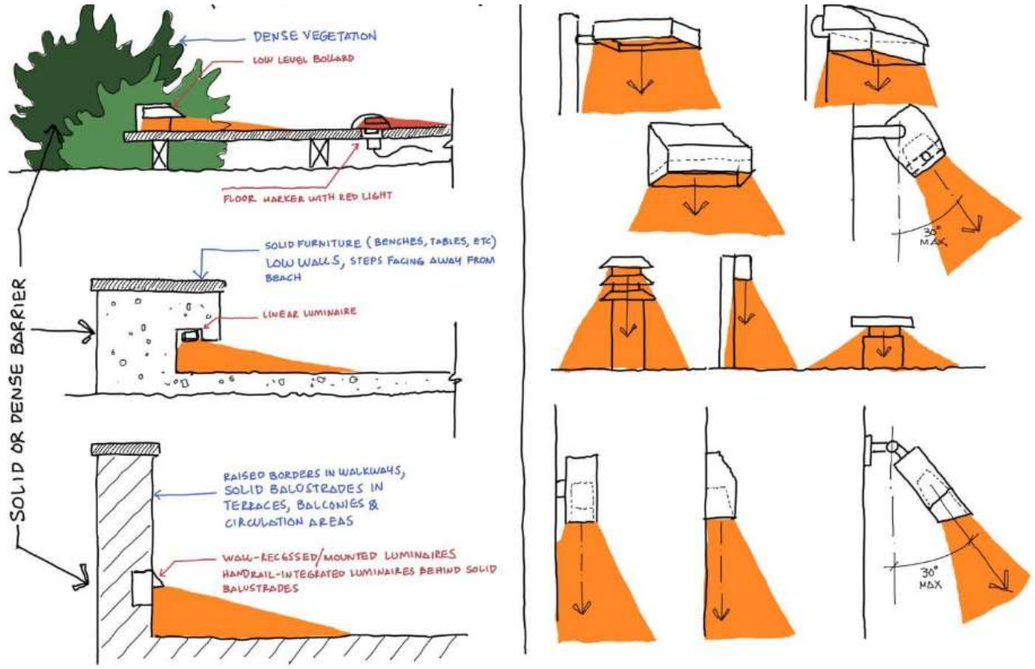


Figure 5—5 Sketches on the left on the above figure show examples of luminaires with integrated shielding and external shielding. The sketches on the right show luminaires with only integrated shielding.

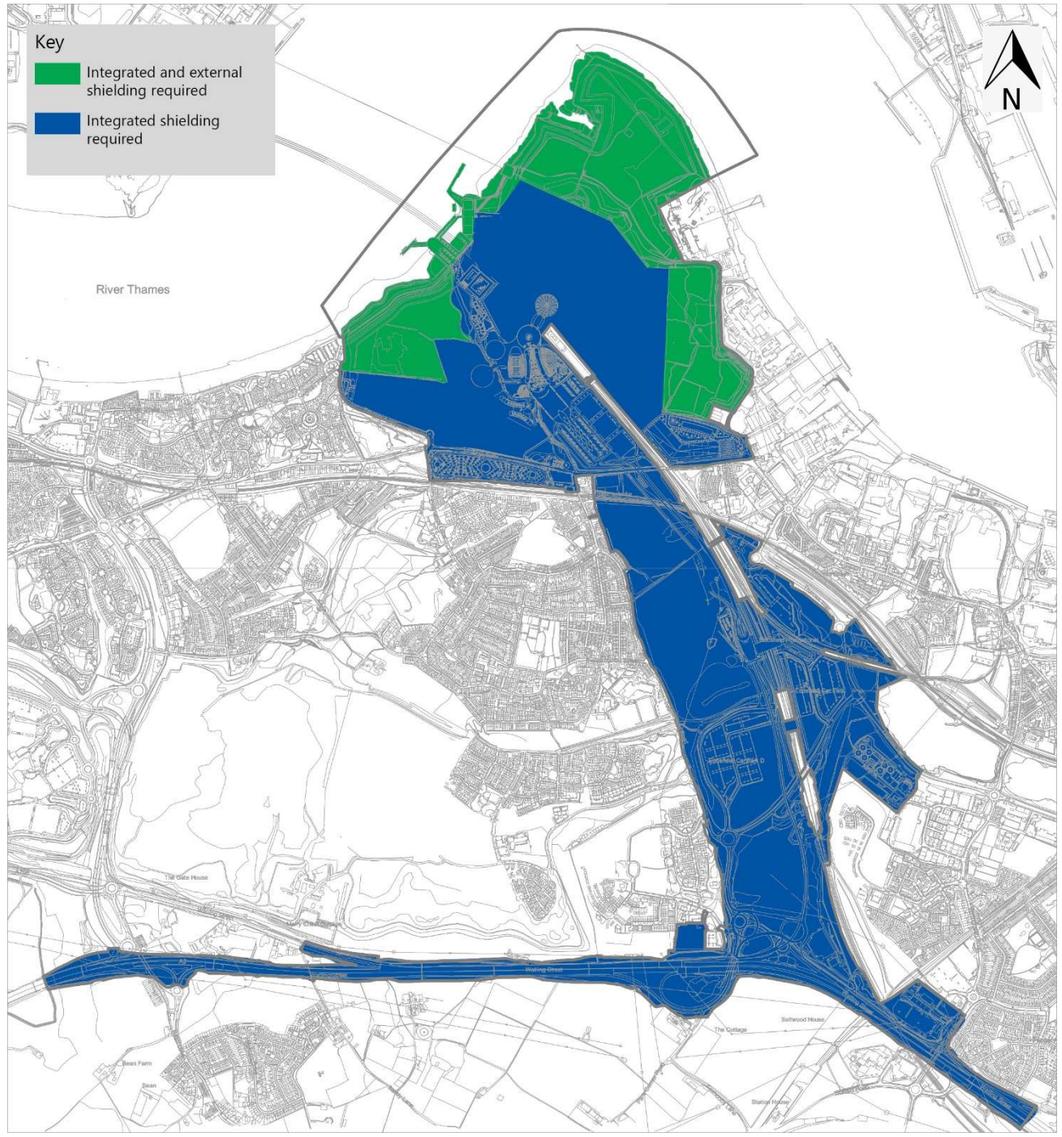


Figure 5—6 Different levels of shielding that apply for the Principal and Associated developments

5.4 Circulation strategy

The lighting design for the roads and circulation areas around and inside the Principal Development should seek to minimise the amount and intensity of light applied to fulfil the various functional and aesthetic objectives demanded by each application. This will not only help to save energy and reduce light pollution, but more importantly it will contribute with the creation of a unique, appropriate and legible character for each route.

The classifications on Figure 5—7 are assigned to the potential new roads being proposed for the Principal and Associated Developments.

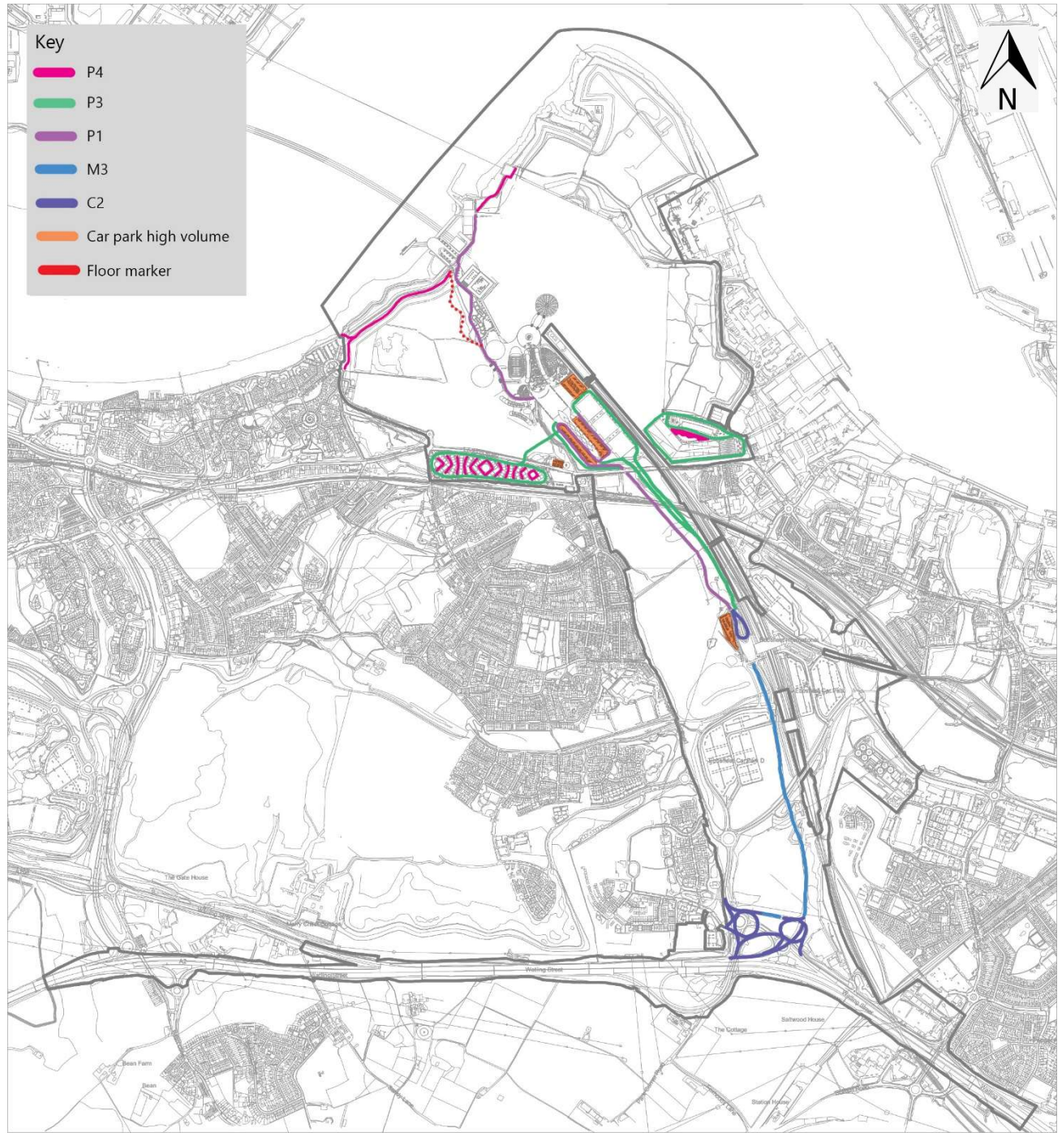


Figure 5—7 Lighting classes applied to new (potential) circulation and parking areas

5.4.1 P4 routes

This lighting classification is assigned to the shared paths that make the England Coast Path north west to the Black Duck Marsh. It is also applied to the pedestrian zones between the staff residential blocks and around the training centre areas.

This lighting intensity classification accompanied by a very warm colour temperature (see colour temperature section) and a low mounting height with appropriate shielding can make these paths inviting and safe whilst protecting the adjacent natural environment.

Figure 5—8 Precedent images for low level luminaires. Bollards and handrail integrated luminaires

5.4.2 P3 routes

This classification is applied to routes for motorised vehicles with pedestrian paths around the staff residential zone and training centre. It is also applied to the link road for coaches and cars between the Ebbsfleet International Station and the car park areas inside the Principal Development.

Figure 5—9 Precedent images for roads in the P3 category

5.4.3 P1 routes

The roads linking the Ferry Port to the Resort car park and to the Ebbsfleet Station are required to have a higher illuminance level due to the potential presence of a land train, local buses, cars, cycles and pedestrians on the side.

A higher intensity will also aid with legibility and the character of this road, as the main link between the different infrastructure areas of the project.

Figure 5—10 Precedent images of luminaires in P1 routes

5.4.4 M3 routes

This classification is applied to the motorway section that stretches from the A2 exit roundabouts to the Ebbsfleet International Station.

5.4.5 C2 areas

The C2 (Conflict zone) classification applies to the new roundabouts in the A2 motorway and the area around the Ebbsfleet International Station. This classification requires a higher level of illumination in areas that can be prone to accidents.

Figure 5—11 Precedent image for lighting of roads in the M3 and C2 category. Dense vegetation on both sides of the road blocks the light and shields the natural environment in the interior areas of the natural reserves

5.4.6 Car parks

The lighting classification that applies to this zone has the requirements for a car park area with a high vehicular volume.

Figure 5—12 Precedent image of luminaires/columns used for car parks

5.4.7 Floor marker

Although no intensity is specified for this area, the lighting levels for the boardwalk connecting the Resort to the Ferry Port should be enough to demarcate the route. This is with the aim of maintaining the possibility of this path being accessible at night.

Figure 5—13 Precedent image of floor markers

Table 5—1 Comparative chart between different lighting classifications. Information is extracted from BS EN 13201-2:2015

Lighting classification	Average horizontal illuminance	Uniformity	Notes
P4	5.00 lux	0.10	The lighting to these areas can be provided by 1.20m bollards or handrails or 4.0m columns depending on the guidance for the environmental lighting zone.
P3	7.50 lux	0.25	The lighting for these routes can be provided from 6 to 8 m column. Final height dependent on the type of vehicular restrictions for these roads.
P1	15.00 lux	0.25	The height of the columns on the link road from the Resort to the Ferry port shall be limited to 6.0m due to its proximity to the Black Duck Marsh. Other areas under this lighting classification can be illuminated from 8.0m columns.
M3	1.00 cd/m2	0.40	It is recommended that the lighting to these conflict areas is to be provided from 8.00m columns in order to minimise the spill of light. Final height to be dependent on lighting design for the road, client and planning approval
C2	20 lux	0.40	It is recommended that the lighting to these conflict areas is to be provided from 8.00m columns in order to minimise the spill of light. Final height to be dependent on lighting design for the road, client and planning approval
Car park	20 lux	0.25	It is recommended that the lighting to these conflict areas is to be provided from 8.00m columns in order to minimise the spill of light.
Floor marker	n/a	n/a	Floor integrated markers to delimitate walking platform and help with the identification of potential hazards.

6 Light Character Areas

The London Resort has been divided into different light character areas, each with a characteristic spatial function and visual landscape style. At night, the character of each zone will largely be defined by the lighting.

By applying the principles of the Environmental Lighting zones in conjunction with a design ideal that follows the architectural and landscape language, light can be used as a tool to enhance the visual landscape by reinforcing these character areas. At the same time, using a consistent lighting approach will ensure that visual connections are made between areas, unifying the overall London Resort character after dark.

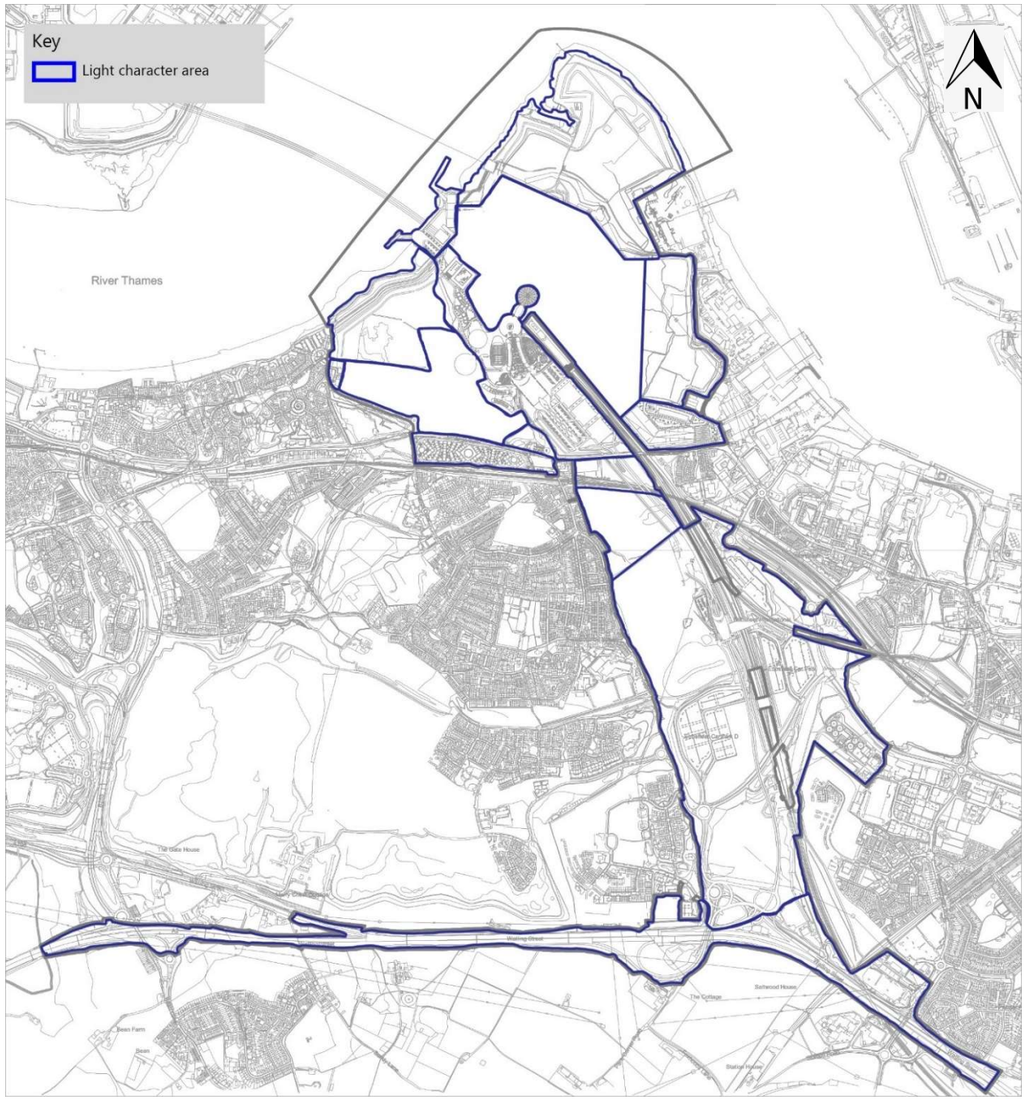


Figure 6—1 Light character areas

Figure 6—2 Envisaged glow plan

6.1.1 Black Duck Marsh

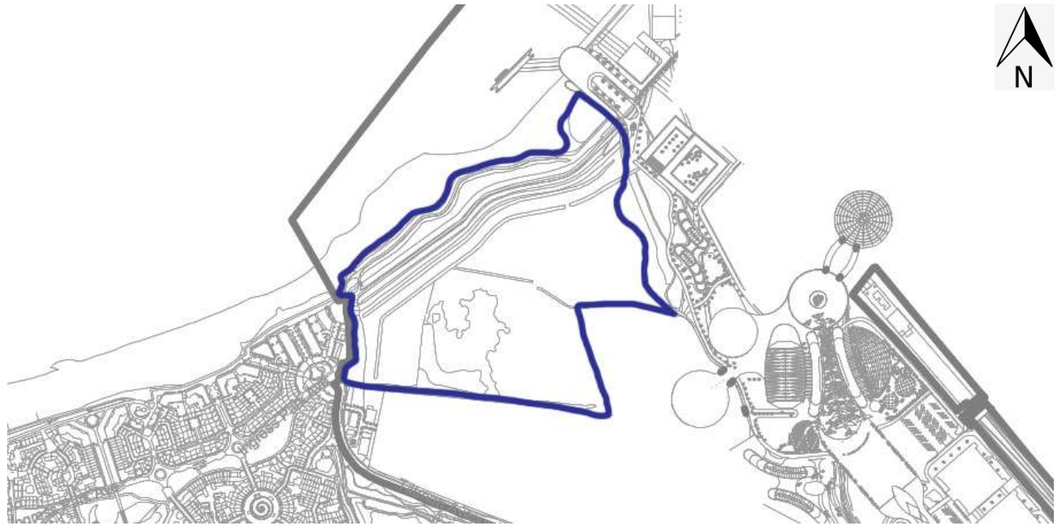


Figure 6—3 Black Duck Marsh area

The Black Duck Marsh is located on the north-eastern side of the DCO Order Limits. The area will be enhanced by the incorporation of new areas of open water, small islets for bird roost and scrapes to vary the marsh profile and diversify the habitats of animals. This area is also characterised for being the West Gateway to the resort and provide a connection between the Ferry Port, the North Resort Gateway and the residential area on the west. A shared path for bicycles and people will use the retained lower track and a new raised boardwalk will run north to south on the western area of these marshes.

The lighting experience in this area will be largely defined by luminaires mounted a low levels to avoid direct view of the light sources, very warm colour temperature to minimise the impact on natural species and appropriate shielding to decrease the amount of light spilled onto the ground and the night sky.

Figure 6—4 Close-up envisaged glow plan for Black Duck Marsh

Table 6—1 Lighting strategy for Black Duck Marsh

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
West arrival gateway	E3	P4	2500K	4.00m	Gateway shall be illuminated from column-mounted sources to indicate destination arrival. Furniture can have concealed integrated lighting. Luminaires shall be properly shielded and face away from marshes and river shore.
New bridge providing access to existing Thames Path	E2	P4	2500K	1.20m	Bridge walking surface to be illuminated from highly concealed luminaires at low level.
Walking route along top of raised flood defence bund	E2	N/A	N/A	N/A	Area not illuminated at night-time to avoid light spill onto the reedbeds.
Lower track – shared path (England Coast Path)	E2	P4	2500K	1.20m	Track to be illuminated from low-lever light sources to provide a safe and secure connection route between the residential area on the west and the Ferry Port and beyond.
Marshes	E2	N/A	N/A	N/A	Natural areas to be always kept dark.
Wet woodland buffer zone	E3 Buffer zone	N/A	2700K	Varies	Lighting limited only to areas where required for security and safety purposes. This area should act as a dark corridor to protect the marshes from the Principal Development light spill.
West raised boardwalk	E3 Buffer zone	N/A	Red or amber	Floor level	Floor-integrated markers to allow circulation at night-time in this link route. The floor markers will provide enough light to demarcate the circulation route and aid with the identification of potential hazards.

Figure 6—5 and Figure 6—6 show a general and detailed section through the North-western edge of Black Duck Marsh. The raised flood embankment with path will act as a natural shielding element to block the sightline of light coming from the path towards the reedbeds.

The path will require illumination from both sides because of its width. Dense low-level vegetation is proposed to the east to help minimise light towards the marsh.

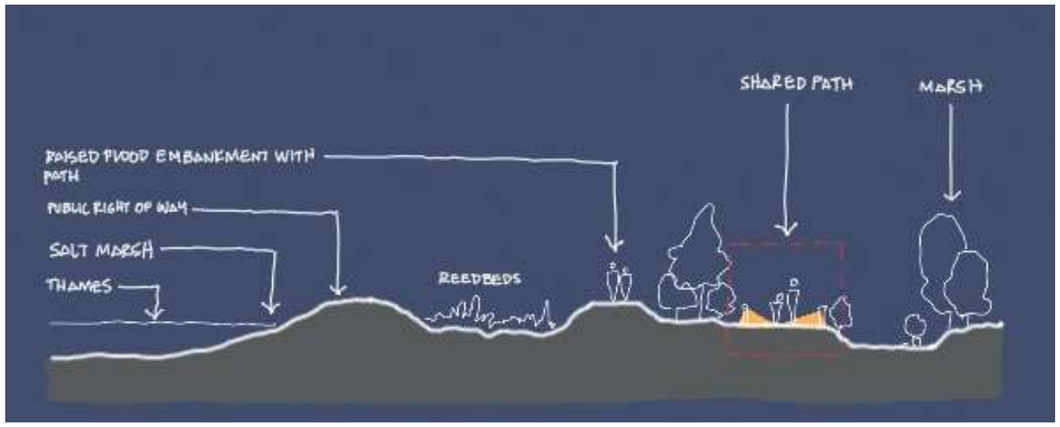


Figure 6—5 Schematic section of the north-west edge of the area, including the Thames shore and footpaths

Figure 6—6 shows a more detailed section of the shared path. Integrated-floor marker are recommended to segregate the path between cyclist and pedestrians to minimise the risk of collision.

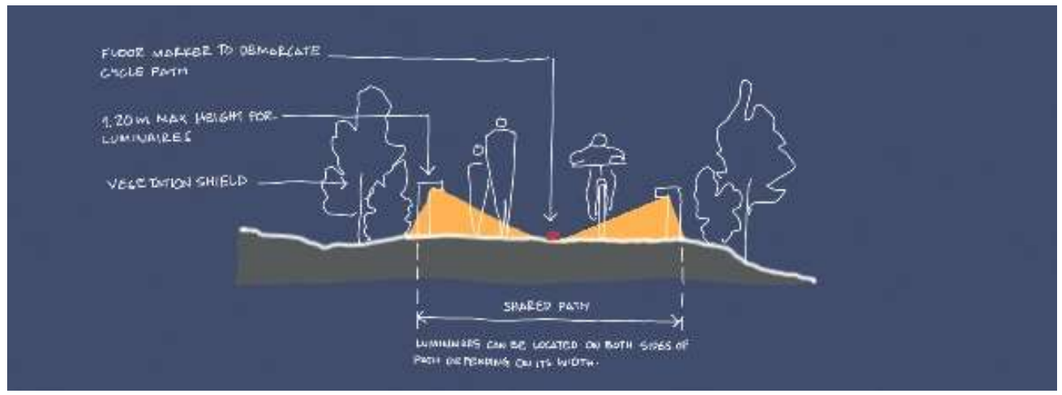


Figure 6—6 Schematic section of potential lighting system for shared path

The images on Figure 6—7 show precedents of low-level lighting illuminating pathways in parks and areas with soft landscape. Low-level, properly shielded warm lighting will make these paths more inviting and secure and enhance the link between the Ferry Port and both the mooring community in Broadness Marsh and the residential area to the west of Black Duck Marsh.

Figure 6—7 Precedent images of low-level path lighting

6.1.2 Ferry Terminal and Wharf Area

The Ferry Port and Wharf Area is located to the north of the Black Duck Marsh and to the west of the North Gateway to the London Resort. This area will be a major arrival point for visitors to the Resort and will become a connection and travelling point for the neighbouring communities.

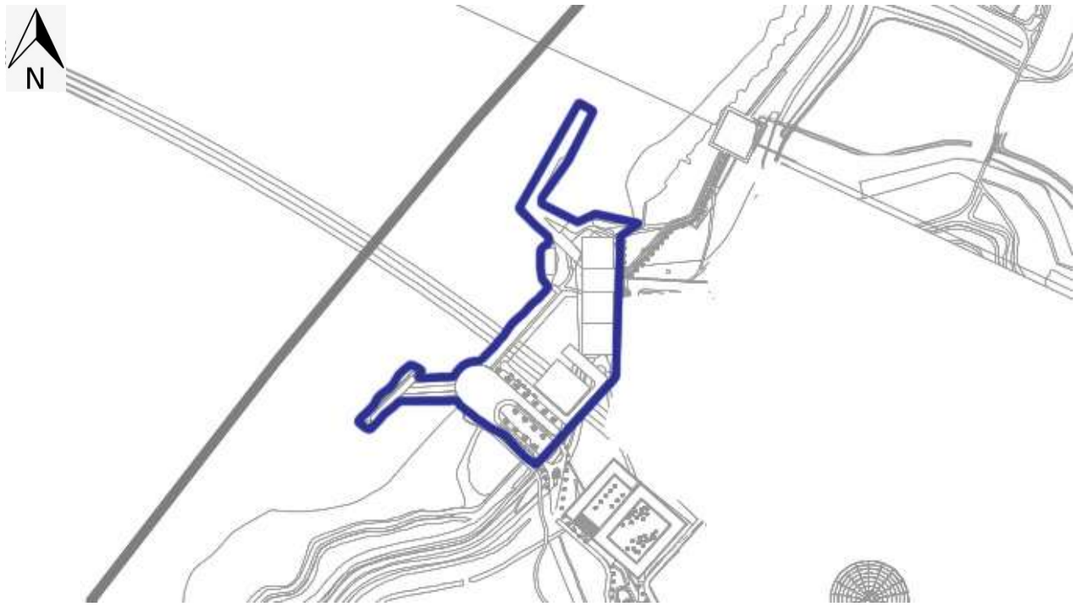


Figure 6—8 Ferry terminal and wharf area

Figure 6—9 Close-up envisaged glow plan for the Ferry Terminal and wharf area

Table 6—2 Lighting strategy for Ferry Terminal

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
Ferry Pontoon	E2	10 lux	2500K	1.20m	Pontoon walking surface to be illuminated from highly concealed luminaires at low level. Lighting limited only to hours of operation.
Floating platform	E2	50lux	2500K	1.20m / top of structure if covered	Area should be illuminated from highly concealed luminaires in order to avoid light spill onto the water. Lighting limited only to hours of operation
Ferry terminal architectural lighting	E2	N/A	N/A	N/A	Avoid architectural lighting of facades facing the water or the marshes. Lighting to external areas should be provided from canopy or wall mounted luminaires with defined optical distribution to keep the light where is required.
Ferry landscape court	E2	P4	2500K	Ground floor ceiling	Avoid using in-ground uplight close to walking areas. Use of low-level bollards preferred to create a comfortable and safe environment.
Ferry working areas (fuel berths and other)	E2	50 lux	2700K	1.20m / top of structure if covered	Area should be illuminated from highly concealed luminaires in order to avoid light spill onto the water. Lighting limited only to hours of operation
Shared path (England Coast Path)	E2	P4	2500K	1.20m	Track to be illuminated from low-lever light sources to provide a safe and secure connection route between the residential area on the west and the Ferry Port and beyond.
Feature raised boardwalk	E3 Buffer zone	Floor marker. Refer to circulation strategy	Red, amber.	Floor marker	Lighting limited only to areas where required for security and safety purposes. This area should act as a dark corridor to protect the marshes from the Principal Development light spill.

Figure 6—10 shows an indicative section through the flood defences and in the background the Ferry terminal. It is recommended that the gangway and the ferry pontoon are at least lit from integrated handrail lighting with a very warm light colour temperature.

It is highly likely that the pontoon and gangway will be covered. If this is the case, then recessed and highly shielded ceiling-mounted luminaires with accurate optical distribution can be used to achieve the necessary light levels. It is important that the luminaires recessed in the ceiling have an accurate optical distribution to keep the light on the horizontal surfaces and minimise light spill onto the water.

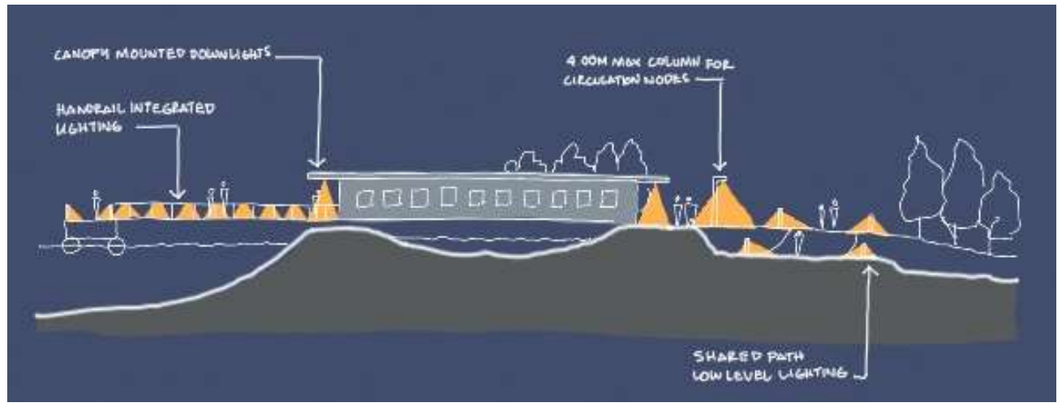


Figure 6—10 Indicative section through flood defences and Ferry Terminal

Handrail integrated luminaires should be characterised for having an asymmetrical optical distribution that directs the light towards the centre of the gangway and pontoon.

Figure 6—11 Precedent images of handrail-integrated lighting

6.1.3 Broadness Marsh

Lighting in this area shall be designed in line with the objective of maintaining and enhancing the structural complexity of the existing open mosaic habitat. This will benefit a range of species and species groups including birds and reptiles, but with invertebrates living in the brownfield. In general, lighting should be limited to certain circulation areas (connection from the Ferry Port to the base of the Kent Pylon in order the keep the area as dark as possible during the hours of darkness.

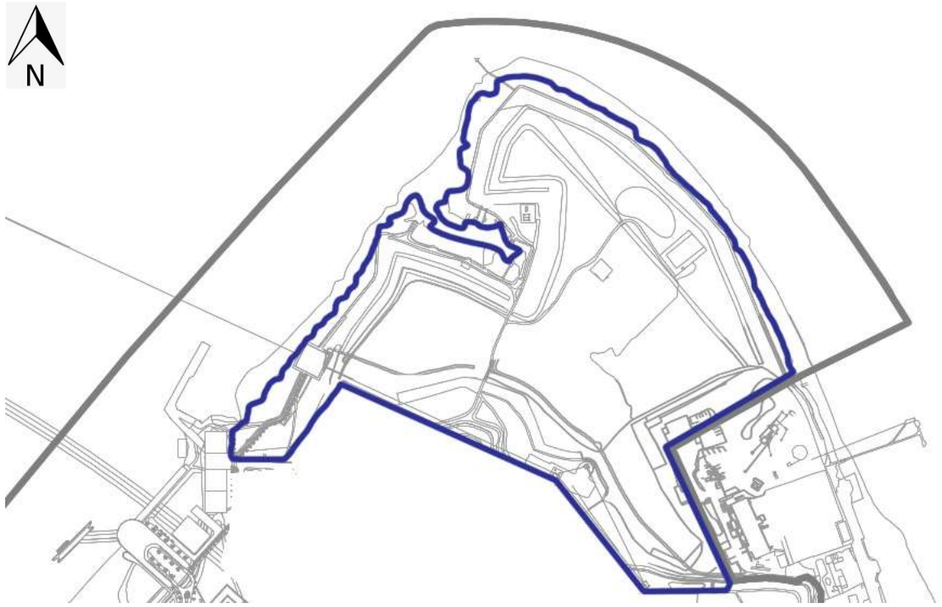


Figure 6—12 Broadness Marsh area

Figure 6—13 Close-up envisaged glow plan for Broadness Marsh

Table 6—3 Lighting strategy for the Broadness Marsh

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
Resort buffer zone	E3 Buffer zone	P4	2700K	Varies	Lighting limited only to areas where required for security and safety purposes. This area should act as a dark corridor to protect the marshes from the Principal Development light spill.
Decked viewing platform at base of pylon	E2	P4	2500K	1.20m	Lighting should be done from low-level sources and highly shielded luminaires to avoid light spill onto the water edge or direct view of the sources from the adjacent marshes.
Shared path (England Coast Path) from ferry port to base of pylon only	E2	P4	2500K	1.20m	Track to be illuminated from low-lever light sources to provide a safe and secure connection route between the mooring community and other areas around. Dwelling spaces (meeting nodes) can be illuminated from furniture-integrated lighting.
Nature trail	E2	N/A	N/A	N/A	This trail crosses salt marsh habitats and should be kept dark at night to protect species living in this area.
Salt marsh extension and natural mosaics	E2	N/A	N/A	N/A	Areas to be kept dark at night.

Figure 6—14 shows a detailed section through the shared path. The path will require illumination from both sides because of its width. Dense low-level vegetation is proposed to the both sides to help minimise light towards the marsh.

Low-level, properly shielded warm lighting will make these paths more inviting and secure and enhance the link between the Ferry Port and both the mooring community in Broadness Marsh and the residential area to the west of Black Duck Marsh.

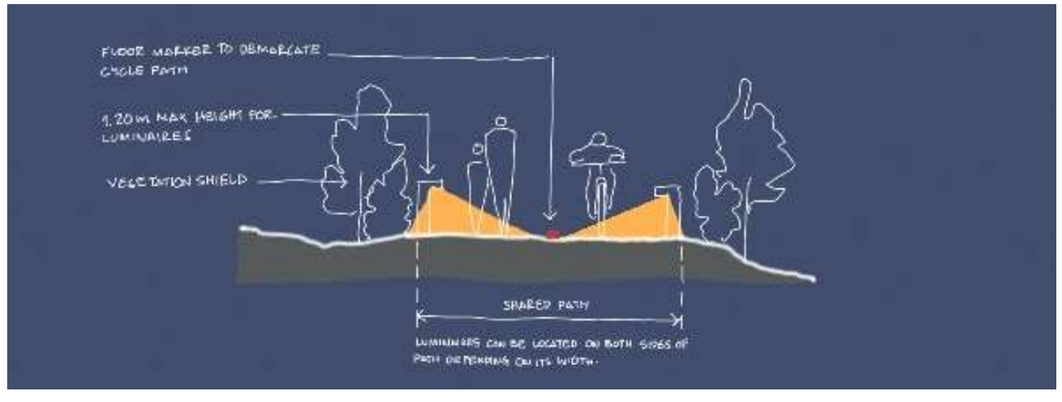


Figure 6—14 Schematic section of potential lighting system for shared path reaching only the base of the Kent Pylon

6.1.4 Botany Marsh

Like the Broadness Marsh, the lighting aim in this area should be aligned with the idea of habitat enhancement to improve the condition and diversity of the existing habitats. Lighting will be limited only to the entry points on the west and south of the marsh.

Figure 6—15 Botany Marsh area

Figure 6—16 Close-up envisaged glow plan for Botany Marsh

Table 6—4 Lighting strategy for Botany Marsh

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
Resort buffer zone	E3 Buffer zone	N/A	2700K	Varies	Lighting limited only to areas where required for security and safety purposes. This area should act as a dark corridor to protect the marshes from the Principal Development light spill.
Playing field	E2	N/A	N/A	N/A	Playing field should be kept dark at night to discourage its use.
Shared path (England Coast Path)	E2	N/A	N/A	N/A	Track to be always kept dark
Nature trail	E2	N/A	N/A	N/A	This trail crosses marsh habitats and should be kept dark at night to protect species living in this area.
Natural brownfield mosaics	E2	N/A	N/A	N/A	Areas to be kept dark at night.
East and South Gateways	E2	P4	2500K	4.00m	Gateway shall be illuminated from column-mounted sources to indicate destination arrival. Furniture can have concealed integrated lighting. Luminaires shall be properly shielded and face away from marshes and river shore.

6.1.5 London Resort

The central areas will encompass the London Resort. This area is formed by the Resort, the passenger terminals, hotels and a conferention centre. As a high activity district, the environmental lighting zone applied to this area is E4.

As a private development, the Resort has the possibility of designing the lighting to suit their requirements for operation, business case, security and safety. However, in order to achieve an environmentally responsible design, the following lighting recommendations for the public realm are provided.

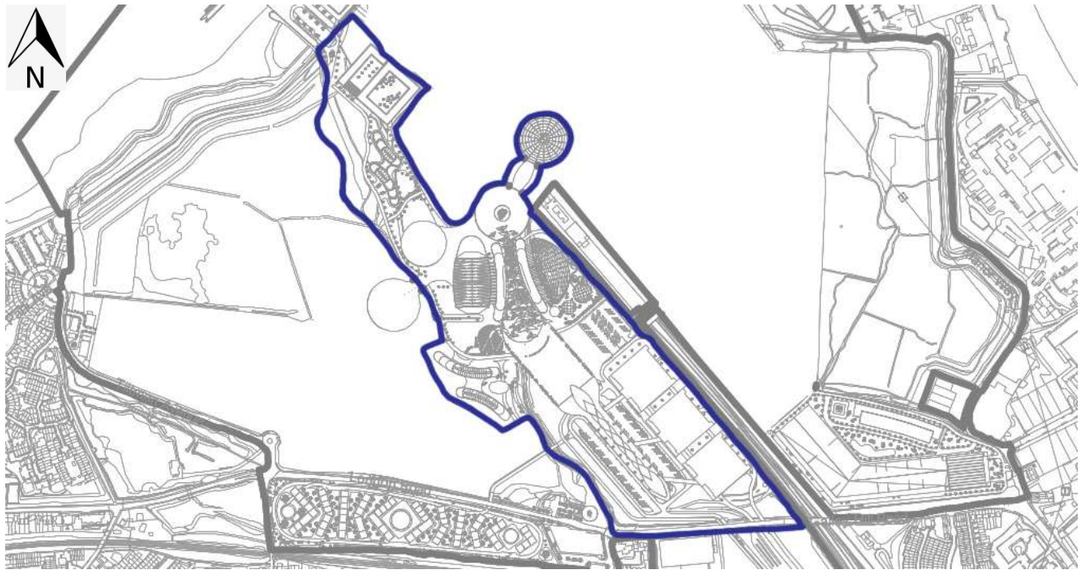


Figure 6—17 London Resort area

Figure 6—18 Close-up envisaged glow plan for London Resort

Table 6—5 Lighting strategy for London Resort

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
Resort public realm - plazas	E4	P3	3000K	4.00m	Open plazas should be illuminated at night to promote their use and should also have infrastructure for event lighting. General lighting should be flexible to allow management to create lighting scenes that can set the mood for different events. In case of events, they should be temporary and light on ground floor should not exceed 50lux. Event luminaires shall always be aimed to the ground.
Resort public realm – pedestrian pathways	E4	P4	3000K	4.00m	The Resort inner pathways should be fully illuminated to promote their use and generate a safe and secure environment for visitors and staff. Changes of level (ramps and stairs) should always be properly lit.
Resort public realm – water features	E4	N/A	Varies	Vertical surfaces	Water bodies with animals shall not be illuminated. Locate luminaires on vertical surfaces to avoid light spill onto night sky
Resort public realm - Landscaping	E4	N/A	3000K	1.20m	Landscape lighting is an important component for the placemaking of each area within the Resort. It helps to enhance and reinforce the character of the resort and creates a welcoming environment for guests and staff alike. Luminaires should always be aimed downwards. Uplighters shall only be used for trees with thick canopies.
Resort – building facades	E4	N/A	Varies	Varies	Lighting to facades of different buildings within the resort will be an important component on creating the image and character of the place. Lighting should be properly aimed so there is minimal light spill onto the night sky. Glare control accessories should be used. Avoid uplighting onto areas with no roof.
Resort – building external leisure areas	E4	P4	3000K	4.00m	External areas can be illuminated in the following way: Low-rise lighting columns, lighting bollards, linear and point-based lighting integrated in hard/soft landscape elements. Circulation and dwelling areas to be illuminated using handrail integrated lighting, wall recessed luminaires, low level bollards or floor markers. In areas with low activity levels
Resort buildings – balconies and terraces	E4	N/A	3000K maximum	Ceiling or 1.20m	Balconies and terraces can be illuminated from highly shielded luminaires located on the ceiling or for a better control of the light spill onto the environment, use of wall-mounted sources.
Resort passenger terminal – external areas	E4	50 lux	3000K	Ceiling mounted	Lighting should be properly shielded, and glare control accessories should be used so there is minimal spill onto the night sky and surrounding environment. Covered walkways should have lighting fixtures installed on ceilings facing downwards and external walkways can be illuminated from columns with controlled optical distribution.
Vehicular roads	E4	Refer to circulation lighting strategy	3000K	6 to 8m depending on road	All roads to be evenly lit. Refer to circulation strategy for more information.

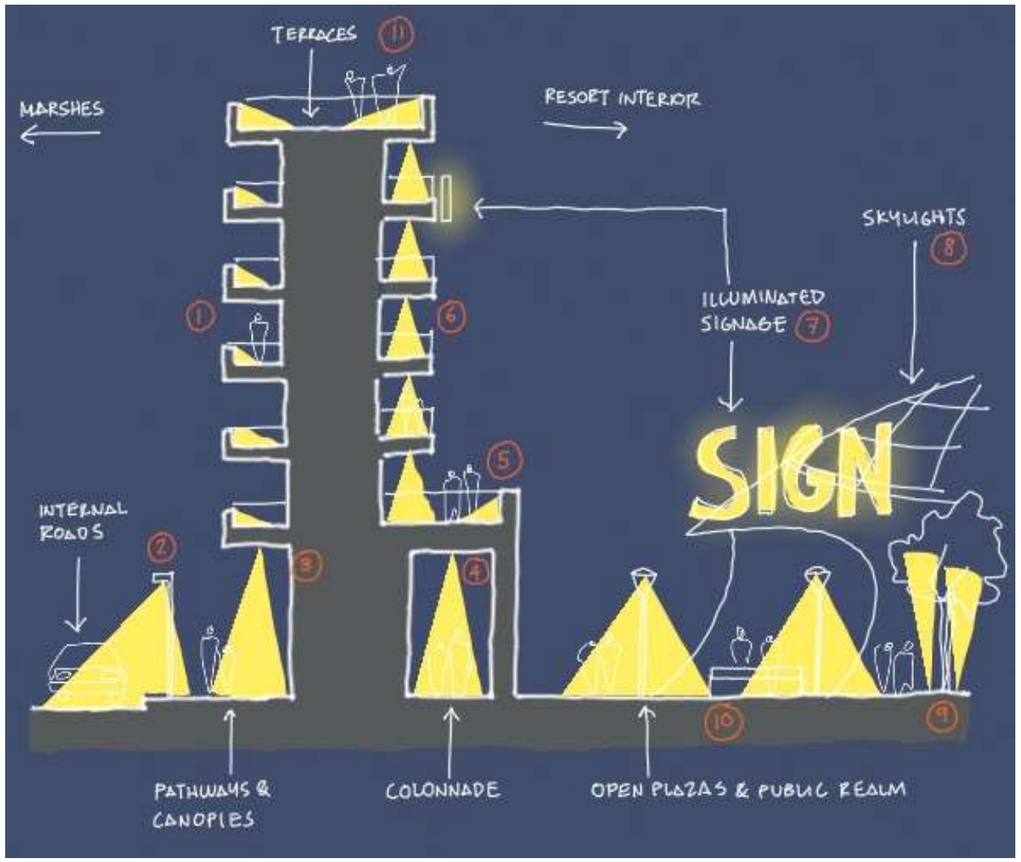


Figure 6—19 Indicative section through resort

Figure 6-19 depicts common situations that are expected to be encountered in the general design of the London Resort central area. The following are recommendations to help minimise light pollution in this area:

1. Balconies facing the marshes or other natural reserves, and all top of building terraces should be illuminated from their balustrades. This will avoid the direct view of the light source from these areas.


Figure 6—20 Precedent images of balustrades with integrated lighting

2. Roads and car parks should be lit to the recommended light levels using luminaires with focused and controlled optical distribution. The luminaires should also have integrated shielding.

Figure 6—21 T Precedent image of lighting columns illuminating streets and car park areas

3. Canopies should provide space for illuminating the pavement with recessed luminaires.

Figure 6—22 Precedent image of canopy-integrated lighting

4. Colonnades can be illuminated with recessed luminaires with focused and controlled optical distribution.

Figure 6—23 Precedent image of colonnades with luminaires with a highly accurate optical distribution

5. Terraces can be illuminated from balustrade-mounted low-level luminaires

6. Balconies facing the central area of the resort can be illuminated from highly shielded ceiling-recessed luminaires.

7. Illuminated signage needs to follow the recommendations from the ILP PLG05,2014 which establishes the maximum permitted recommended illuminance for illuminated signage and screens. For digital screens, when the content may change then the rate of change should be limited to once every five seconds. Moving images, animation, video or full motion images should not be displayed at locations where they could present a hazard. During daytime, sign luminance should never exceed 5.000cdm2. See Figure 6—25.

Figure 6—24 Illuminated facades and large format signage should follow the recommendations from Figure 6—25

Table 4: Maximum permitted recommended luminance (cdm^{-2})					
Illuminated area (m^2)	Zone E0	Zone E1	Zone E2	Zone E3	Zone E4
Up to 10	0	100	400	600	600
Over 10	0	n/a	200	300	300

Figure 6—25 Extract table from ILP PLG05.2014 Maximum permitted recommended illuminance

8. Skylights should be able to be closed or covered at night so the spill of light onto the night sky is minimised.

9. Uplighters shall only be used in roofed areas or under trees with very dense canopies. Their output should be dimmed during autumn and winter.

Figure 6—26 Precedent image of inground luminaires used to highlight access points or gateways

10. Open plazas and pathways can be illuminated from low-level columns or catenary lighting. Height should not be more than 8.0m Furniture integrated lighting is recommended.

Figure 6—27 Precedent images of open plazas and pathways illuminated from low level sources

6.1.6 Staff accommodation, BOH areas and training facilities

The staff accommodation area will have its unique character. The public realm will be characterised by an organic design language that will be employed in the spaces between buildings to create a soft and friendly spill out zones and other active spaces. Lighting should promote the use of these spaces after dark by the incorporation of a design proposal that considers security and safety. Lighting shall also be designed in a way that obtrusive light is minimal on the building vertical surfaces.

The public realm around training facilities and BOH areas will provide an attractive space for employees to enjoy during breaks and will act as an urban node or meeting space. Lighting shall be provided to enhance the use at night and promote economic activity in retail units (if existing). Careful consideration must be taken so there is minimal light spill onto building facades and night sky.

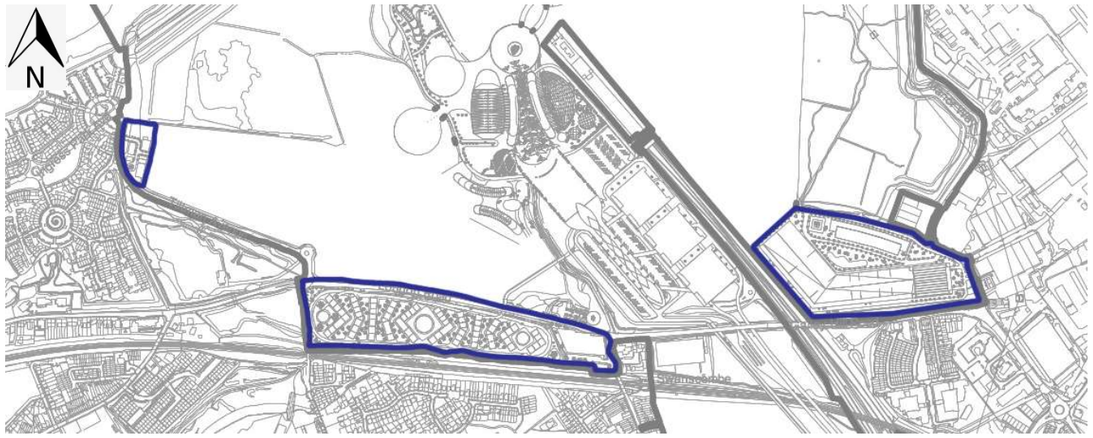


Figure 6—28 Staff accommodation, BOH areas and training facilities

Figure 6—29 Close-up envisaged glow plan for staff areas

Table 6—6 Lighting strategy for staff accommodation, BOH and training facilities

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
Public realm - plazas	E3	P4	2700K	4.00m	Open plazas should be illuminated at night to promote their use and should also have infrastructure for event lighting. Event luminaires shall always be aimed to the ground.
Public realm - pathways	E3	P4	2700K	4.00m	The pathways should be fully illuminated to promote their use and generate a safe and secure environment for visitors and staff. Changes of level (ramps and stairs) should always be properly lit.
Vehicular roads	E3	P3	2700K	6.00m	Roads should be evenly lit

The precedent images on Figure 6—30 show different ways of illuminating the public realm around the staff accommodation and training areas. Low-level and discreet lighting can make these zones comfortable, safe and secure and enhance their use by staff in the hours of darkness.

Figure 6—30 Precedent images

6.1.7 Central Area and Ebbsfleet International Terminal

This area will have the new Resort Road and People Mover Road which will run north to south parallel to the train tracks. These roads will be landscaped with swathes of trees, earth sculptures and land art which will create a sense of arrival in this journey.

The river Ebbsfleet will run parallel to this road and there will be opportunities to enhance the river corridor to improve the habitat of a wide range of animal species.

Lighting in this area should be limited to functional aspects where needed (depending on the design of the road and the number of junctions along it). Certain areas of land art can be highlighted at night too with the use of highly shielded luminaires with controlled optical distribution.

The Bamber pit will become a natural reserve with a new waterbody and nature trail accessed from the existing public right of way. These areas should be kept dark and illumination should only be limited to the existing public right of way.

The Sports Ground Pit will become an infrastructure hub and the landscape areas around it will be managed to maximise biodiversity in the pit.

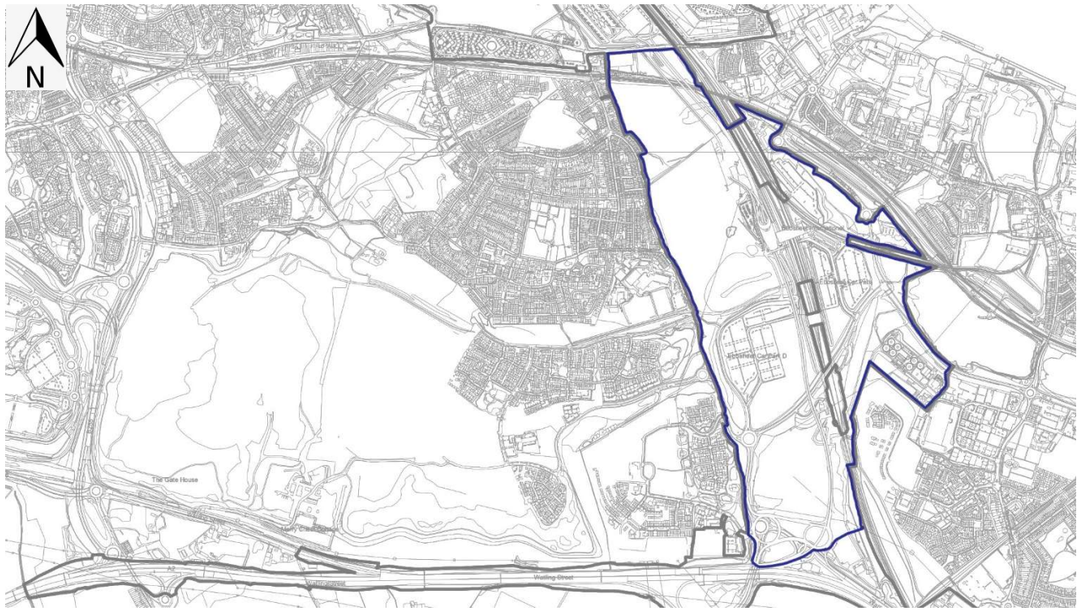


Figure 6—31 Central area and Ebbsfleet International Terminal

Figure 6—32 Close-up envisaged glow plan for terminal

Table 6—7 Lighting strategy for terminal area

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
Resort Road	E2	From A2 to Ebbsfleet station: M3 From Ebbsfleet station to Ferry Port: P1	2500K in E2 area and 3000K in E4 area	Refer to circulation strategy. subject to lighting design, client and planning approval	The roads linking the Ferry Port to the Resort car park and to the Ebbsfleet Station are required to have a higher illuminance level due to the potential presence of a land train, local buses, cars, cycles and pedestrians on the side. A higher intensity will also aid with legibility and the character of this road, as the main link between the different infrastructure areas of the project.
Land art	E2	No higher than what is permitted by the lighting environmental zone.	3000K*	1.20m	Lighting to be provided if client/artist requires it. Lighting should be focused on the piece of art rather than using area lighting. A higher colour temperature
Bamber pit nature trail	E3	N/A	N/A	N/A	Area to be kept dark at night to protect the natural reserve
Sports Ground Pit public realm	E3	Varies per sport type	2700K	4.00m	Lighting should be limited to where strictly necessary and ornamental lighting shall be

					aimed away from the soft landscaping to aid with the increasing of biodiversity.
Reconfigured roundabouts	E2	C2	2500 K	8.0m subject to lighting design, client and planning approval	Lighting should be provided where required dependant on the England Highway Code. Luminaire should have integrated shielding and minimal backwards light distribution to minimise light spill onto the natural environment.

Figure 6—33 below shows a schematic section of the Resort Road when passing over the Bamber Pit lake. The section assumes that the road will be elevated and will carry buses, cars, lorries and the land train. At this stage it is not possible to establish the exact location of the lighting columns, but it is important to mention that the luminaires should have proper shielding and a very accurate light distribution.

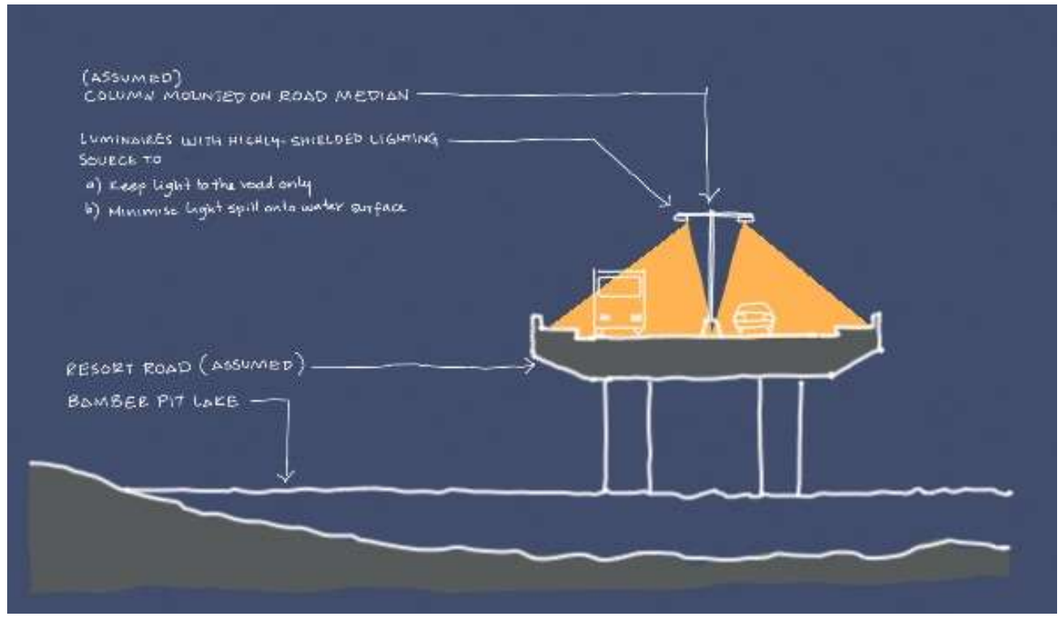


Figure 6—33 Section through Resort Road

6.1.8 A2 Corridor

This area will see a reconfiguration of roundabouts that will give opportunity to replace existing lighting for luminaires with a better controlled optical distribution and a warm light colour temperature.

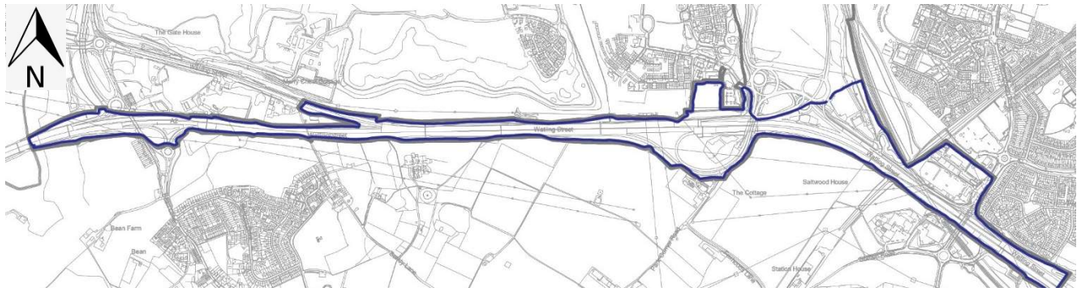


Figure 6—34 Vehicular route A2 corridor area

Table 6—8 Lighting strategy for A2 surrounding areas

Area *(based on EDP landscape strategy)*	**Environmental Lighting Class**	**Area Lighting Class**	**Light Colour Temperature**	**Max. Light Source Mounting Height**	**Illumination Strategy**
Reconfigured roundabouts* if applicable	E2	C2	2500 K	8.0m subject to lighting design, client and planning approval	Lighting should be provided where required dependant on the England Highway Code. Luminaire should have integrated shielding and minimal backwards light distribution to minimise light spill onto the natural environment.

Figure 6—35 Precedent image for lighting of roads in the A2 surrounding areas. Dense vegetation on both sides of the road blocks the light and shields the natural environment in the interior areas of the natural reserves

6.1.9 Resort Gates

The Resort Gates are being designed by Paramount and will include many different zones and thematic attractions. The lighting proposal within these areas should aim to minimise the light spill onto the natural environment surrounding the parks and the night sky.

The boundaries of these Gates are catalogued as Environmental Lighting Zones E3 as they act as a buffer to protect the marshes. They should be a dark corridor that blocks most of the light coming from the park.

EDP have advised the inclusion of a 10m planting zone within the Resort to reduce land take from the marsh areas. Lighting in these buffer zones should be limited to safety and security issues and should only be operating when required.

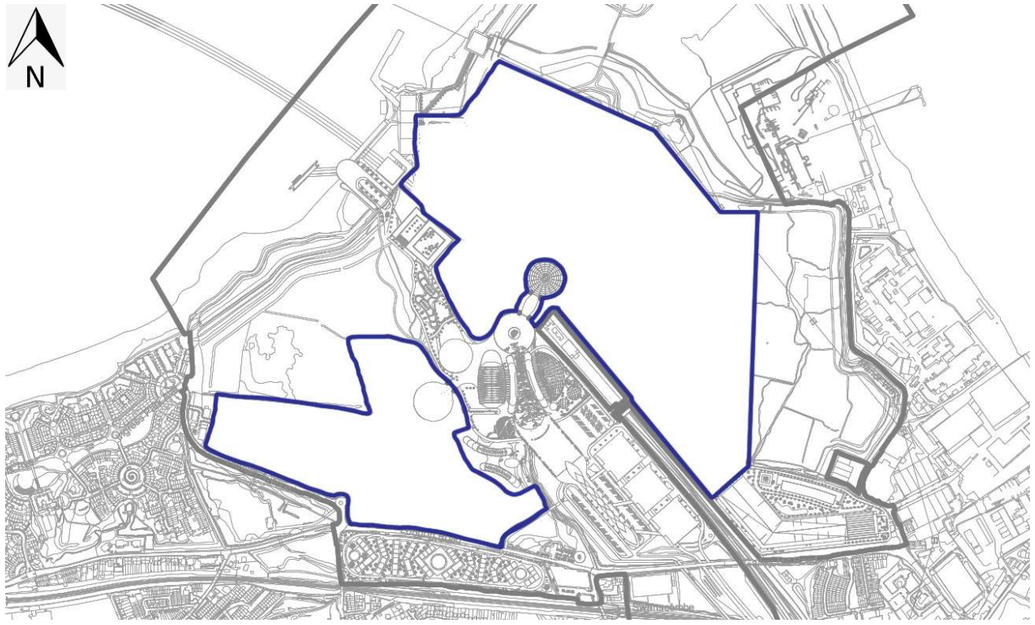


Figure 6—36 Resort Gates

6.1.9.1 Lighting recommendations for the Thematic Parks in the Resort Gates

As a private development, the Resort Gates have the possibility of designing the lighting to suit their requirements for operation, business case, security and safety. However, in order to achieve an environmentally responsible design, the following recommendations are provided:

- Pedestrian pathways should be illuminated with low-level columns, bollards, catenary lighting or other low-level sources to help with wayfinding and provide lighting only to where it is needed. The uniformity of the light on the ground plane should be high enough to help with the identification of potential hazards.
- Changes of level (stairs, ramps, platforms) shall be properly illuminated to avoid falls and easily identify potential trip hazards
- The colour temperature shall be constant amongst circulation areas.
- Plazas and event areas should have the possibility of having infrastructure for event lighting. All event lighting should always be aiming downwards to limit light spill onto the night sky.
- Internal service and other vehicular road should have similar illuminance levels to the roads inside the Resort and in the Associated Development, particularly if these roads including parking bays, loading bays or pedestrian crossing points. A detailed lighting assessment will be done during the detailed design stage.
- All luminaires should be pointing downwards.
- All attraction luminaires should be turned off after curfew
- The use of uplighters should be limited to roofed areas or trees with very dense canopies in order to avoid the spill of unnecessary light onto the night sky.
- Figure 6—37 below shows the limited extent of lighting on the perimeter road between the thematic parks and the buffer zone. The illuminated areas should be limited to access points, parking bays (if present), and public transport stops (if present). This with the aim of reducing hazards whilst keeping the light only to where is required.

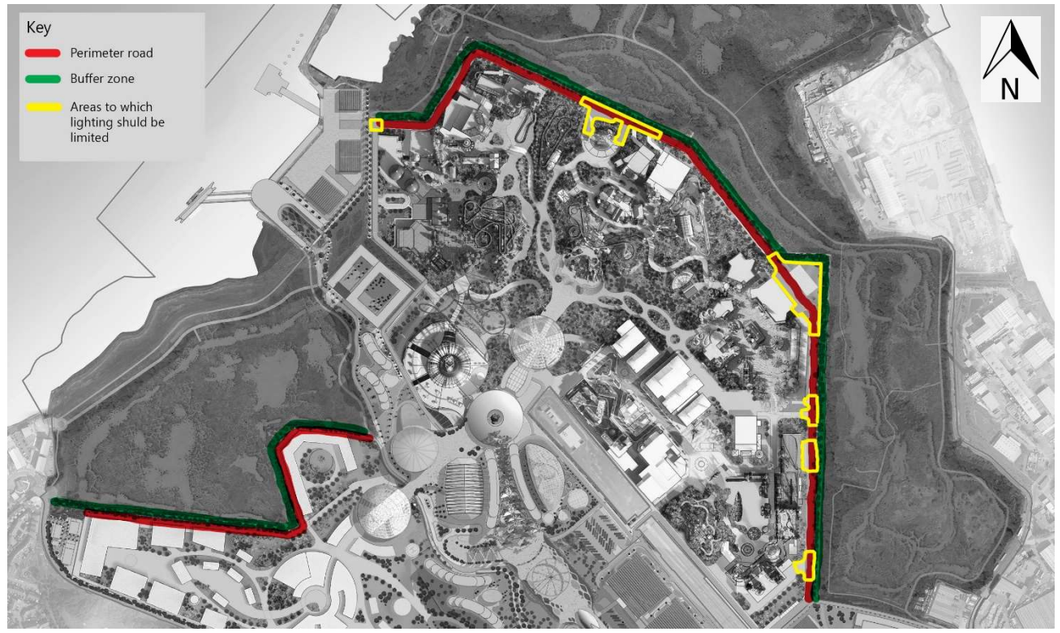


Figure 6—37 Lighting strategy for Resort Gate's perimeter road

Figure 6—38below shows a schematic section through the perimeter road between the West Gate and the Botany Marsh. The section provides an indicative position for the luminaires as they should always be facing away from the marsh.

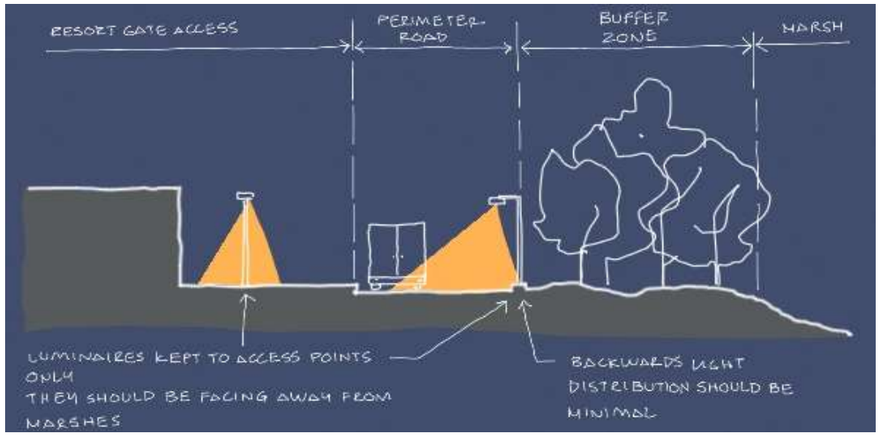


Figure 6—38 Schematic section of area for reference

7 Software lighting analysis and assumptions

Using 3D lighting calculation (Relux) and CAD software (AutoCAD) plans were created/extracted to create certain lighting conditions that would allow to demonstrate the effect of artificial lighting on the environment. The following factors and assumptions have been used in the calculation:

- Surrounding trees have not been included in the calculation as the various species and shapes cannot be accurately modelled. It is assumed most will be deciduous and the amount of cover offered will be reduced during the winter season. However, it should be noted that the old and new trees in this area will provide further reduction to any spill light and visual impact of the brightness to the Proposed Development;
- This assessment technique simulates and calculates the proposed combined total lighting lumen output (worst case scenario) of the Proposed Development. The assessment considers the street lighting, pathway lighting and ferry port lighting. All lighting has been assessed at 100% output;
- The result renderings have been shown in 'pseudo colour' format. This visually demonstrates where the lighting (illuminance) will potentially be distributed and by how much.
- Virtual light metres have also been exported to clearly identify lighting levels (lux) on specific areas of the site so a comparison can be made against the baseline study.
- All lighting calculation areas are set at 0.00m (unless stated otherwise), on the same plane as the luminaires, considering this the worst-case scenario. In real conditions, different sensitive zones are at different height levels to the luminaires across the site.
- Calculations were all done assuming a maintenance factor for luminaires of 0.67
- All calculations are facing north.

7.1 Calculation planes

Three different types of calculation planes are placed to measure the effects of light:

- The plane where the lighting class applies corresponds to the area being lit. This can be a shared path, a road or in the case of the Ferry Port, the pontoon.
- The shielding zone: this calculation plane has been placed next to the lit area to measure the amount of light that this potential shielding zone receives. It has a width of 5.00m
- The protected environment. This calculation plane is placed to measure the maximum levels of light that the protected environment areas can receive.

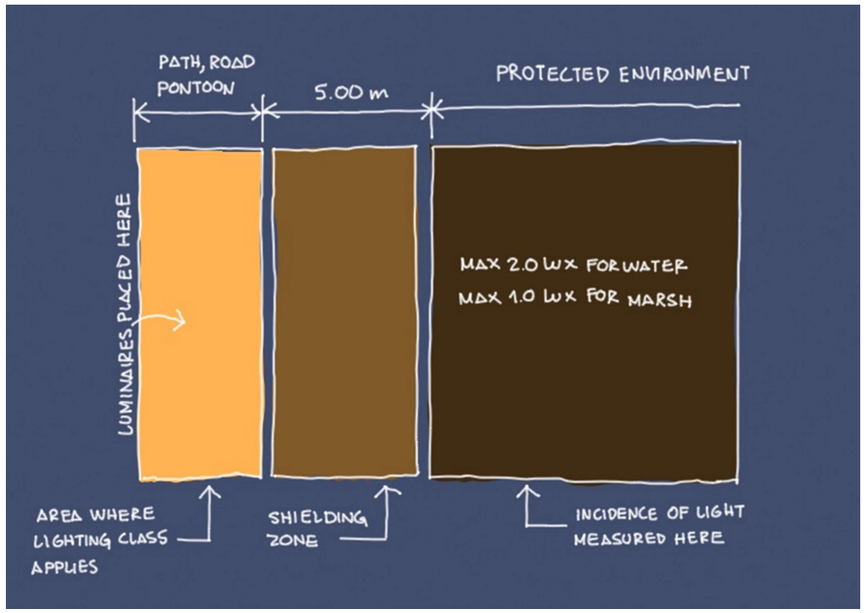


Figure 7—1 Scheme showing the different calculation planes

7.2 Areas to be analysed

The following areas are analysed as they are close to sensitive receptors. Area 1 is close to the marsh, existing residential buildings and the Thames Shoreline. Area 2 is next and on the Thames Shoreline. Area 3 is by the Black Duck Marsh and Area 4 involves a new road crossing over an existing body of water.

Figure 7—2 Map showing areas to be analysed

7.2.1 Area 1

The aim of the analysis of Area 1 is to understand the potential effect that artificial lighting can have in the following areas:

- Marshes
- Thames shoreline
- Residential buildings

The result of the incidence of light on the marshes and the Thames shoreline can also be applicable to areas in Broadness and Botany marshes.

The following spaces were illuminated:

- Shared pathway: typical section on a path that is 5.0m wide, utilising photometric files of a luminaire located at 1.20m, CCT of 2500K, and a lumen output of 500lm per fixture.
- Gateway: typical area utilising photometric files of a luminaire located at 4.00m, CCT of 2500K and lumen output of 1400lm per fixture.

This area is located within the Environmental Lighting Zone E2 and E3.

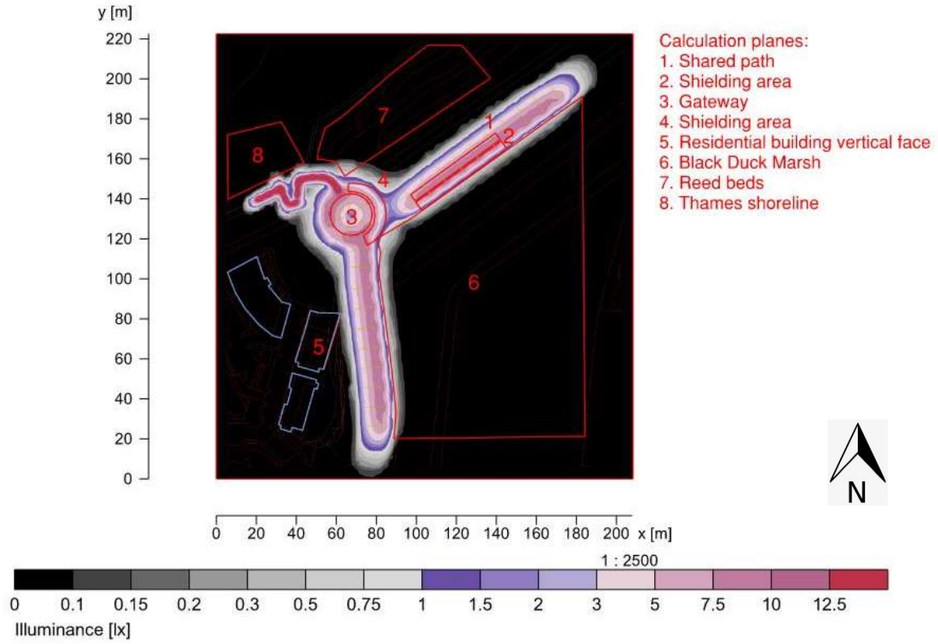
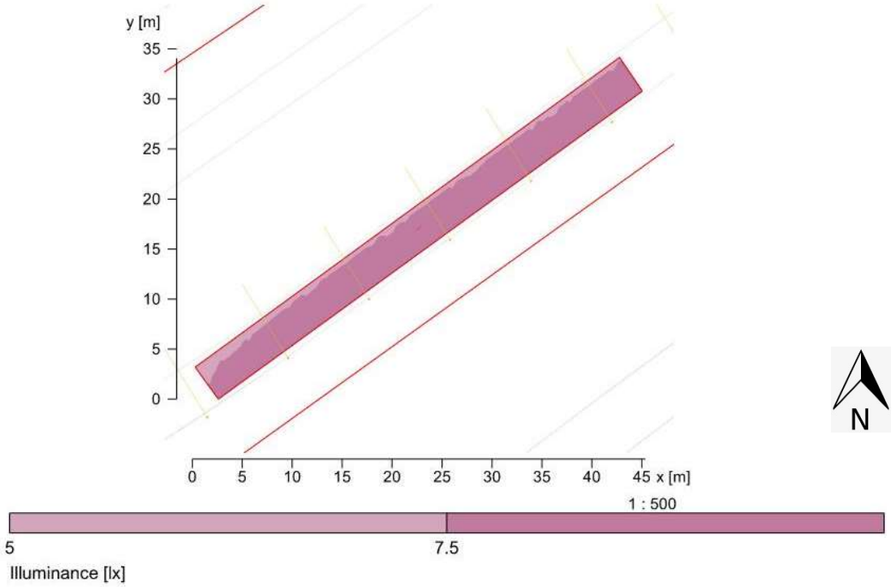


Figure 7—3 Extract of plan showing the analysed areas and the result. This image shows the overall scale of pseudo colours utilised by the calculation software across the site

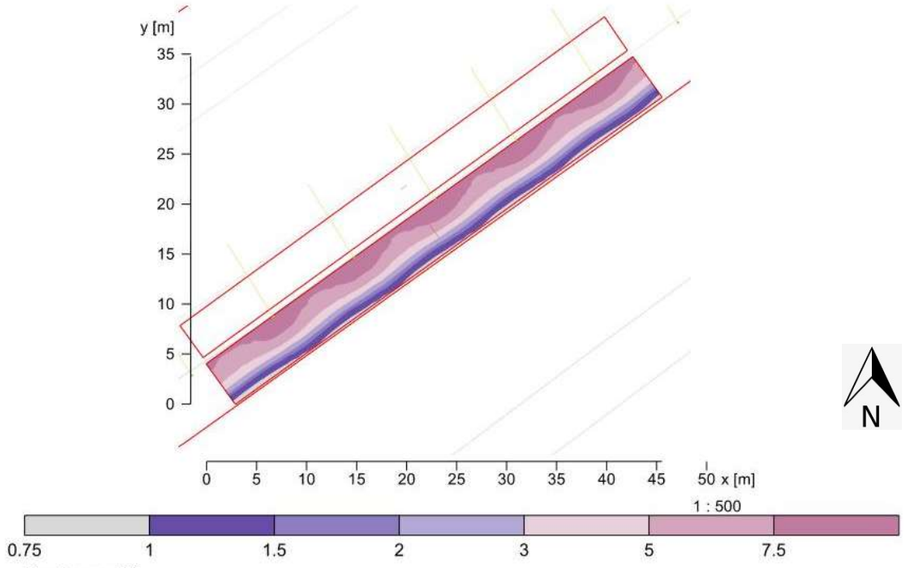
Area 1 results



Height reference plane		: 0.00 m
Average illuminance	Em	: 8.1 lx
Minimum illuminance	Emin	: 5.92 lx
Maximum illuminance	Emax	: 9.48 lx
Uniformity Uo	Emin/Em	: 1 : 1.37 (0.73)
Diversity Ud	Emin/Emax	: 1 : 1.60 (0.62)

Figure 7—4 Results for shared path (typical section)

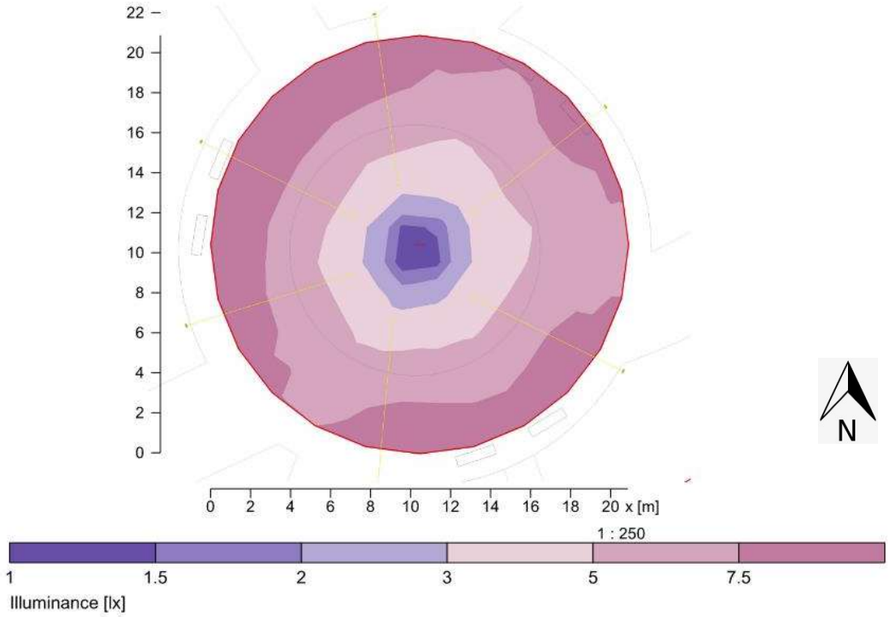
These preliminary results indicate that illuminating this shared path with 1.20m bollards on both sides will provide an average illuminance of 8.1 lux (above minimal requirement of 5 lux established in the circulation strategy for this path)



Height reference plane		: 0.00 m
Average illuminance	Em	: 4.75 lx
Minimum illuminance	Emin	: 0.82 lx
Maximum illuminance	Emax	: 9.16 lx
Uniformity Uo	Emin/Em	: 1 : 5.83 (0.17)
Diversity Ud	Emin/Emax	: 1 : 11.24 (0.09)

Figure 7—5 Results for shielding area between shared path and Black Duck Marsh

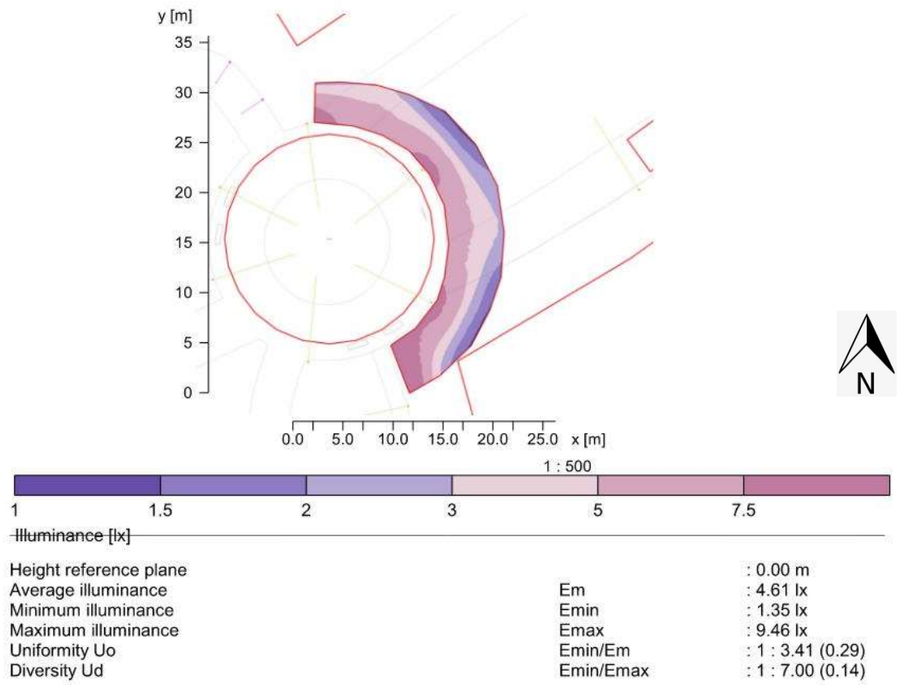
The result indicates that in the 5.00m offset between the shared path and Black Duck Marsh, the amount of light decreases from 9.2 lux to 0.82 lux. The amount of light that the Black Duck Marsh receives from the low-level sources can be further reduced if there is dense vegetation planted in this area.



Height reference plane		: 0.00 m
Average illuminance	Em	: 6.04 lx
Minimum illuminance	Emin	: 1.14 lx
Maximum illuminance	Emax	: 9.82 lx
Uniformity Uo	Emin/Em	: 1 : 5.32 (0.19)
Diversity Ud	Emin/Emax	: 1 : 8.65 (0.12)

Figure 7—6 Calculation result for Gateway

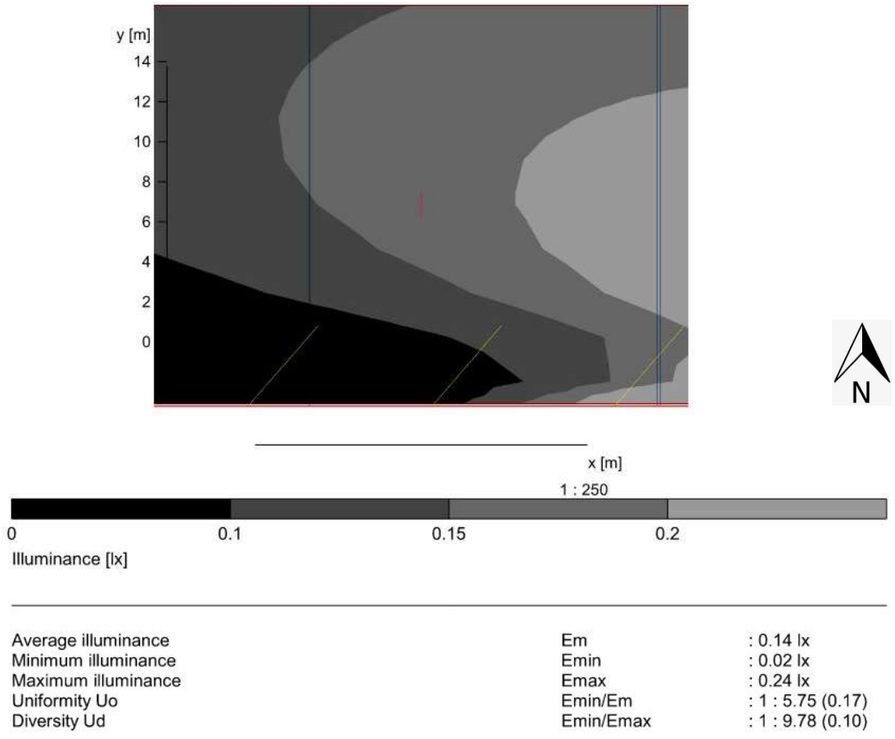
For this example, this gateway is being illuminated with luminaires from a height of 4.00m. This illuminating method provides 6 lux on average (above the 5lux required for this area)



Height reference plane		: 0.00 m
Average illuminance	Em	: 4.61 lx
Minimum illuminance	Emin	: 1.35 lx
Maximum illuminance	Emax	: 9.46 lx
Uniformity Uo	Emin/Em	: 1 : 3.41 (0.29)
Diversity Ud	Emin/Emax	: 1 : 7.00 (0.14)

Figure 7—7 Calculation result for shielding zone around Gateway

The area surrounding the gateway also shows a pronounced reduction of illuminance. Light levels drop from 9.5lux in areas where 4.00m columns are close to the path bollards, to 1.35lux.



Average illuminance	Em	: 0.14 lx
Minimum illuminance	Emin	: 0.02 lx
Maximum illuminance	Emax	: 0.24 lx
Uniformity Uo	Emin/Em	: 1 : 5.75 (0.17)
Diversity Ud	Emin/Emax	: 1 : 9.78 (0.10)

Figure 7—8 Incidence of light on vertical surfaces (building façade)

A vertical calculation plane was positioned on the residential elevation closest to the luminaire to understand the incidence of artificial lighting on the building. The calculation results above and below show the illuminance and luminance on the vertical elevation is below the limit established by the lighting environmental zone.

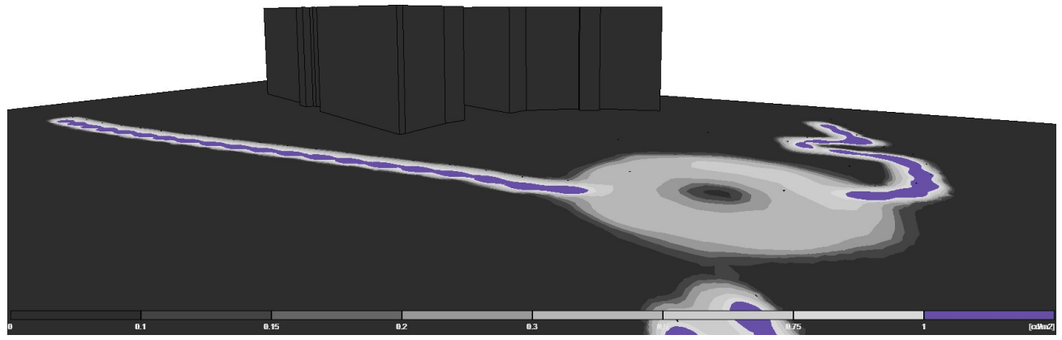
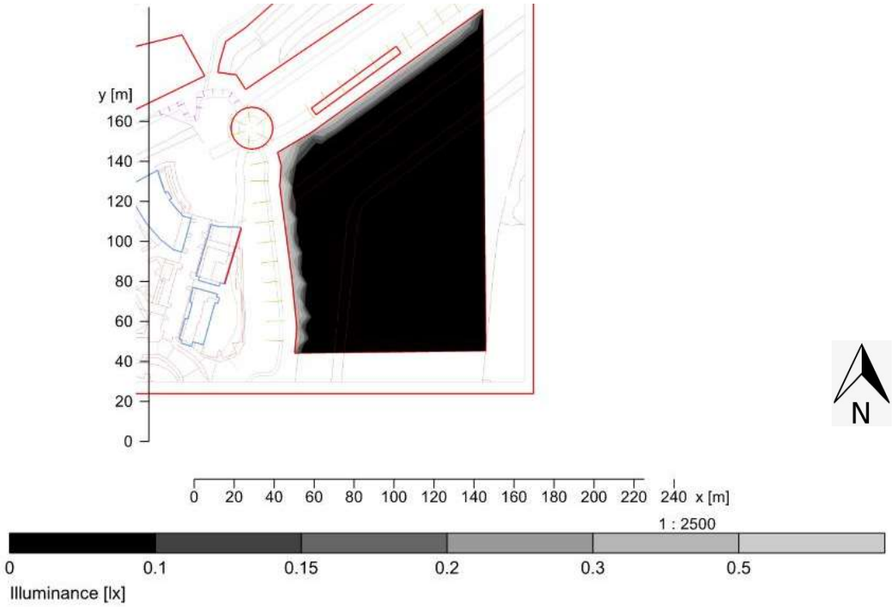


Figure 7—9 Calculation result showing the incidence of light on closest residential façade to luminaires

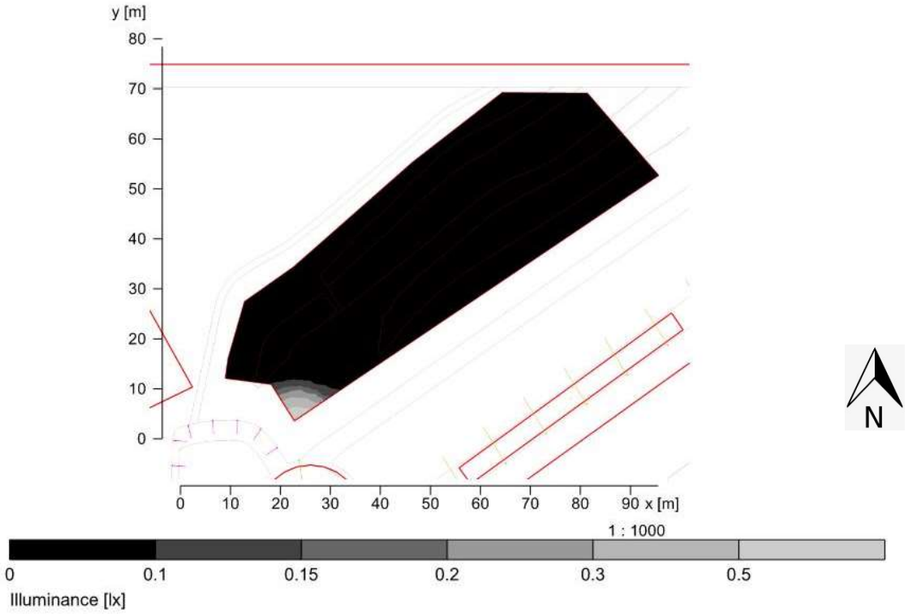
The image above shows that the average luminance on vertical surfaces is between 0 and 0.1 cd/m2



Height reference plane		: 0.00 m
Average illuminance	Em	: 0.03 lx
Minimum illuminance	Emin	: 0 lx
Maximum illuminance	Emax	: 0.61 lx
Uniformity Uo	Emin/Em	: ---
Diversity Ud	Emin/Emax	: ---

Figure 7—10 Incidence of artificial lighting on marshes

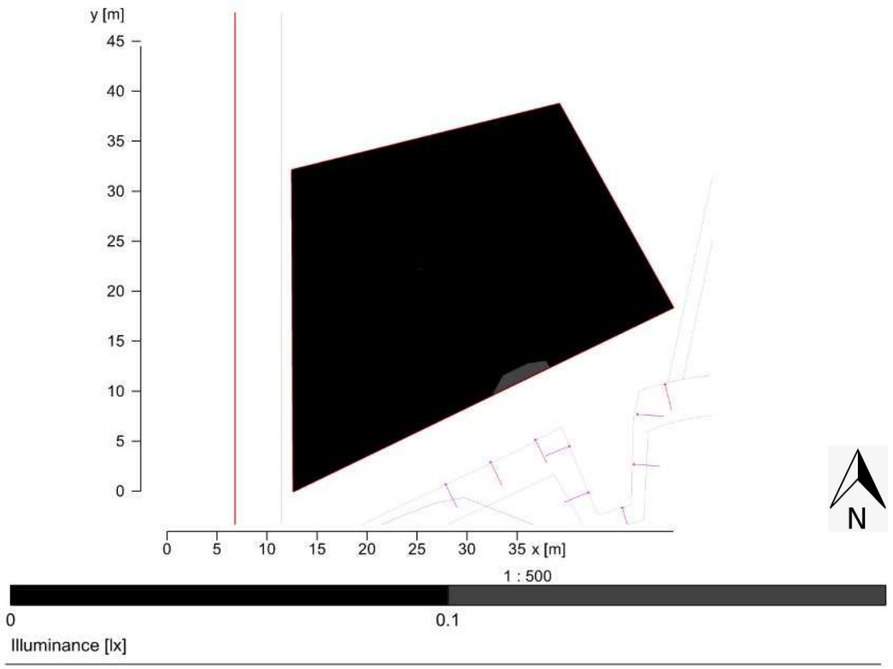
A calculation plane to evaluate the amount of light that could be received by the marshes was established with an offset of 5.0m from the luminaire sources. The calculation result shows that the maximum illuminance received in the marshes can be up to 0.61lux, which is below the 1.0lux level threshold of permitted lighting.



Height reference plane		: 0.00 m
Average illuminance	Em	: 0.01 lx
Minimum illuminance	Emin	: 0 lx
Maximum illuminance	Emax	: 0.63 lx
Uniformity Uo	Emin/Em	: ---
Diversity Ud	Emin/Emax	: ---

Figure 7—11 Incidence of light on reedbeds

This lighting calculation result shows that the maximum levels of light received in the marshes (if they were at the same level as the luminaires) is 0.63lux. It is below the threshold of 1 lux.



Height reference plane		: 0.00 m
Average illuminance	Em	: 0 lx
Minimum illuminance	Emin	: 0 lx
Maximum illuminance	Emax	: 0.1 lx
Uniformity Uo	Emin/Em	: ---
Diversity Ud	Emin/Emax	: ---

Figure 7—12 Incidence of artificial lighting on the Thames shoreline

This lighting calculation result indicates that light emitted from low-level sources has a minimum impact on the shoreline of the River Thames.

Result note

Additional calculations were performed utilising luminaires mounted at a general height of 4.00m. Illuminance values are raised across all protected areas but not significantly. However, lighting sources at higher levels are more visible and can attract and disturb animal habitats, create a completely different environment, and provide more obtrusive lighting on residential elevations.

There is an additional risk associated with the 4.0m mounting height and it is the careful selection of the luminaire type. These results were achieved using a luminaire designed for dark-skies and sensitive natural environments, so very similar luminaires would have to be used during further design stages.

7.2.2 Area 2

The aim of the analysis of Area 2 is to understand the potential effect that artificial lighting can have in the River Thames. This area is located within the Environmental Lighting Zone E2.

The following spaces were illuminated:

- Gangway to waiting deck: typical area utilising photometric files of a handrail-integrated luminaire every 3.0m at a mounting height of 1.20m over the gangway finish floor level. The CCT is 2500K and the output is 500lm. The gangway is also illuminated from ceiling mounted luminaires with the same CCT and an output of 1300lm.
- Boarding deck is illuminated in a similar way to the gangway.

For this calculation it was assumed that the boarding deck and gangways were located at 1.00m over the water.

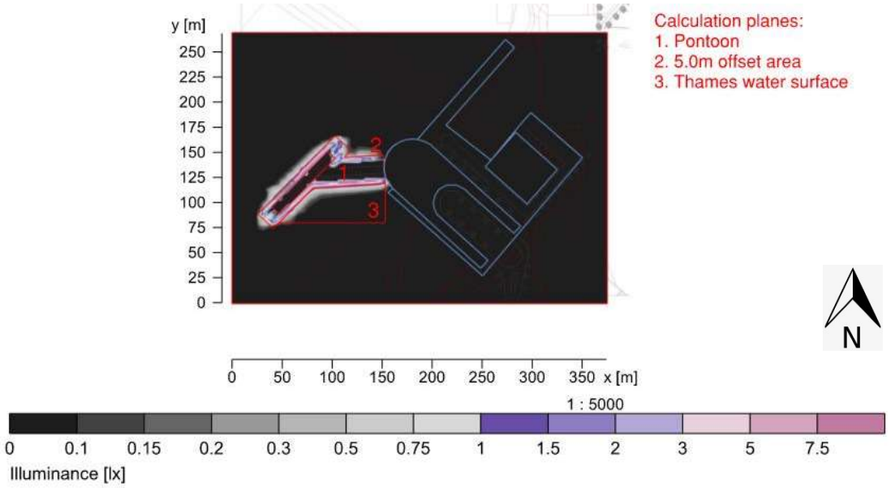


Figure 7—13 Extract of plan showing the analysed areas and the result. This image shows the overall scale of pseudo colours utilised by the calculation software across the site

Area 2 results

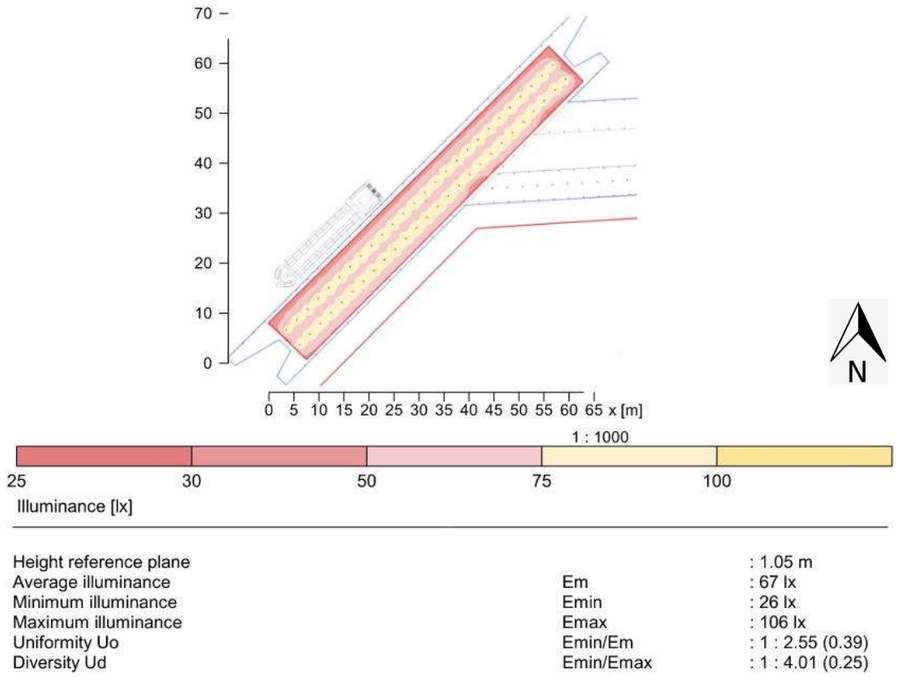
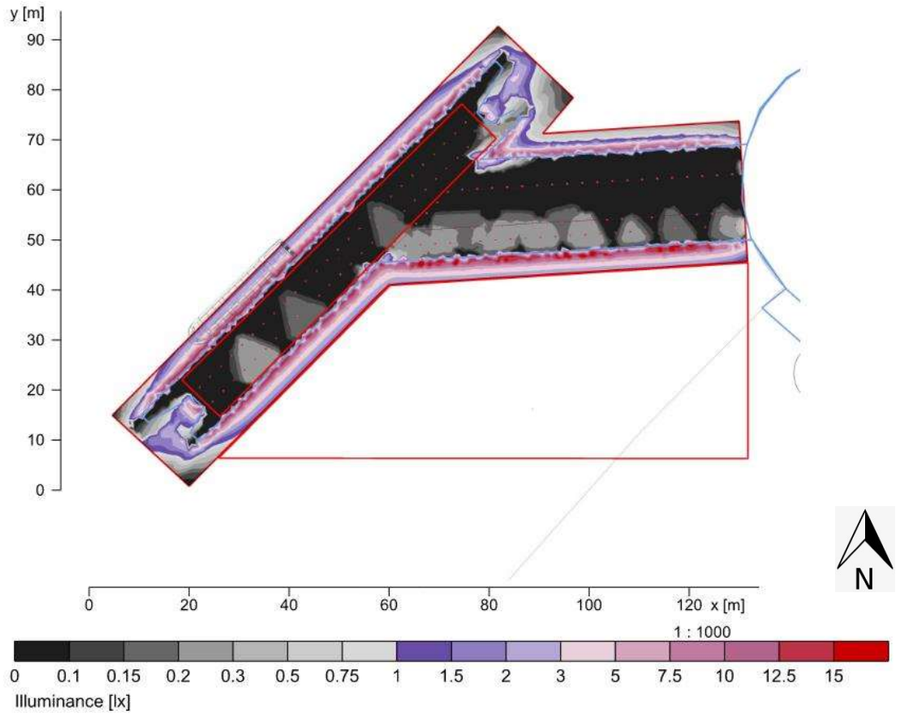


Figure 7—14 Results for boarding deck (applies all boarding decks)

For the purposes of this calculation, the boarding deck (which is surrounded by water) was illuminated to achieve the levels established in the BS EN 12464-2,2014 in which the minimum illuminance level required for passenger areas in passenger harbours is 50lux with a uniformity of 0.40.

These levels were achieved utilising handrail integrated luminaires and ceiling recessed fixtures.

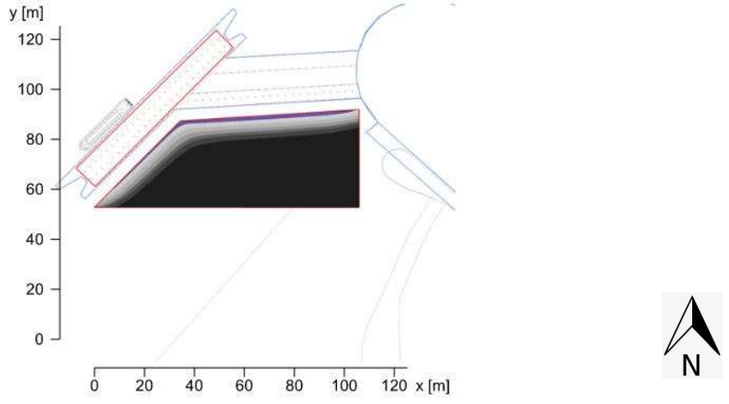


Height reference plane		: 0.00 m
Average illuminance	Em	: 1.7 lx
Minimum illuminance	Emin	: 0 lx
Maximum illuminance	Emax	: 16.5 lx
Uniformity Uo	Emin/Em	: ---
Diversity Ud	Emin/Emax	: ---

Figure 7—15 Incidence of artificial lighting on 5.00m offset area

The offset area is receiving a maximum illuminance of 16.5lux but this decreases to reach 1.7lux when 5.00m away. This decrease in lighting levels is due to the use of luminaires with highly accurate distribution.

The levels of light can be decreased further if solid balustrades are introduced.



Height reference plane		: 0.00 m
Average illuminance	Em	: 0.15 lx
Minimum illuminance	Emin	: 0 lx
Maximum illuminance	Emax	: 1.61 lx
Uniformity Uo	Emin/Em	: 1 : 46.85 (0.02)
Diversity Ud	Emin/Emax	: 1 : 498.78 (0.00)

Figure 7—16 Incidence of gangway and boarding deck lighting on water

The calculation area has an offset to the edge of the ferry port of 5.00 as per the marsh's calculation plane in Area 1. The maximum levels of illuminance registered are 1.61 lux, which is lower than the 2.00 lux maximum permitted on the water.

This result only acknowledges the impact of external lighting and doesn't consider the Ferry Terminal building internal lighting.

7.2.3 Area 3

The aim of the analysis of Area 3 is to understand the potential effect that artificial lighting can have in the east side of the Black Duck Marsh

The following spaces were illuminated:

- Connection road: typical section of a road that is approximately 6.00m, utilising photometric files of a luminaire located at 4.00m, CCT of 2700K, and a lumen output of 1500lm per fixture. Each fixture is 10m apart.

This area is located within the Environmental Lighting Zone E2 and E3 buffer. The results only analyse the effect of public realm lighting.

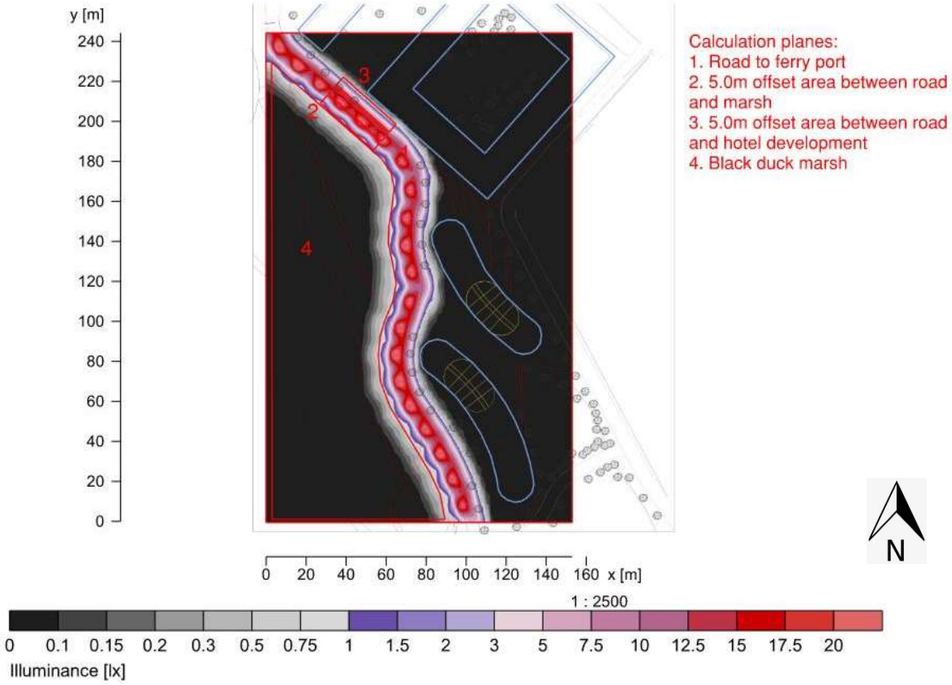
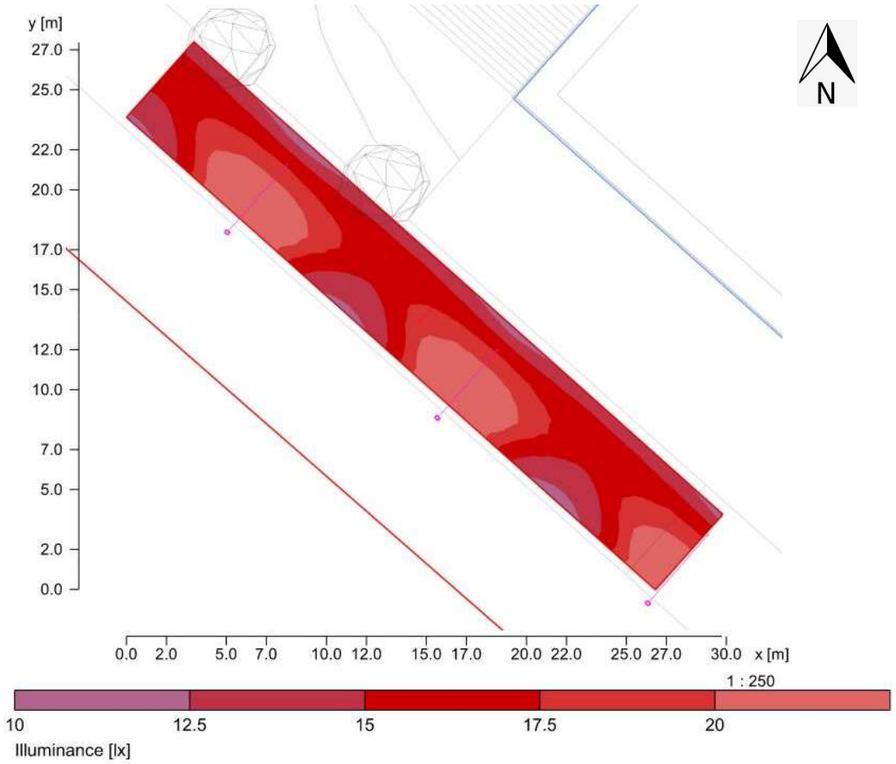


Figure 7—17 Extract of plan showing the analysed areas and the result. This image shows the overall scale of pseudo colours utilised by the calculation software across the site

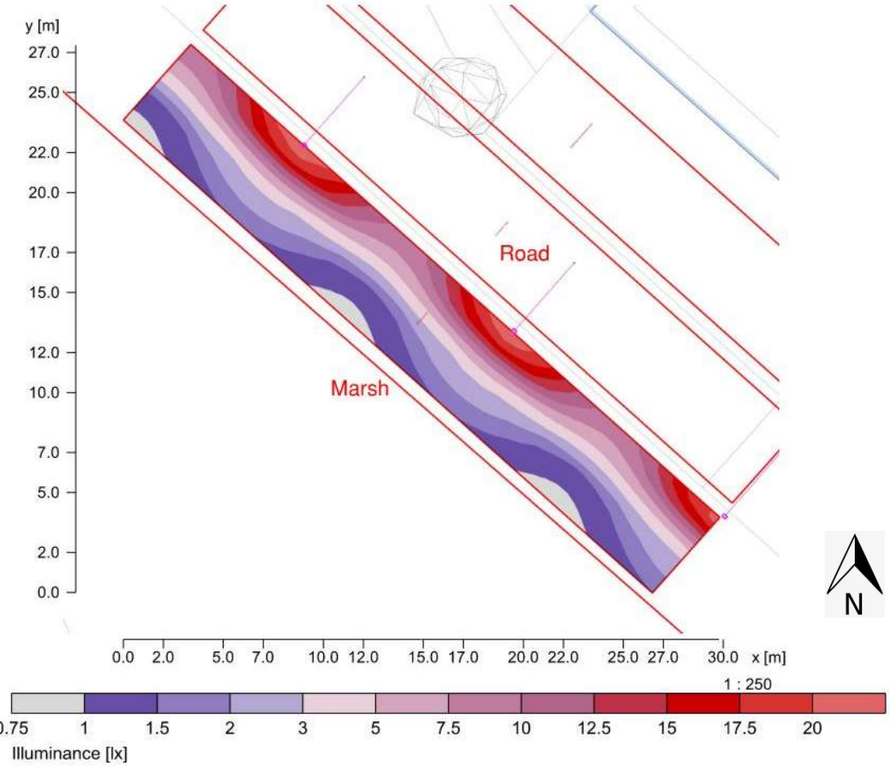
Area 3 results



Height reference plane		: 0.00 m
Average illuminance	Em	: 16.4 lx
Minimum illuminance	Emin	: 11.4 lx
Maximum illuminance	Emax	: 24.3 lx
Uniformity Uo	Emin/Em	: 1 : 1.44 (0.70)
Diversity Ud	Emin/Emax	: 1 : 2.13 (0.47)

Figure 7—18 Results for connection road

For this calculation, luminaires with a CCT of 2700K were mounted at 6.00m over the ground and at 14.0m centre to centre. The achieved illuminance is 16.4lux and complies with the parameters established in the circulation strategy. Luminaires were placed on the west side of the road facing the hotel buildings.



Height reference plane		: 0.00 m
Average illuminance	Em	: 5.5 lx
Minimum illuminance	Emin	: 0.8 lx
Maximum illuminance	Emax	: 20.6 lx
Uniformity Uo	Emin/Em	: 1 : 6.48 (0.15)
Diversity Ud	Emin/Emax	: 1 : 24.53 (0.04)

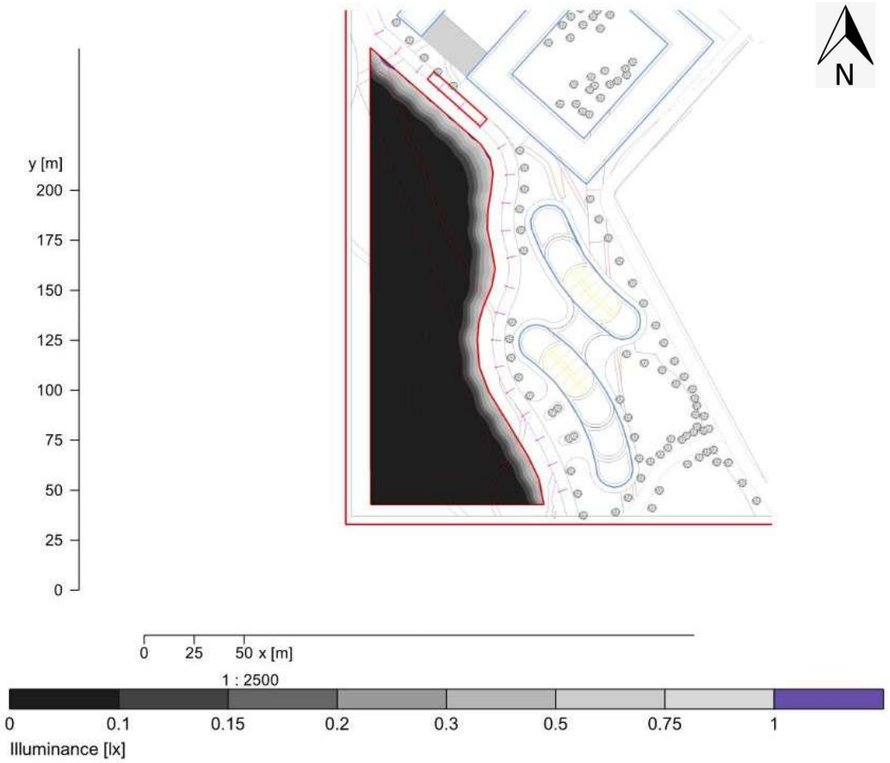
Figure 7—19 Incidence of artificial lighting on offset area between road and Black Duck Marsh

This calculation result shows that the light in this area decreases from a maximum of 20 lux to a minimum of 0.8 lux. The luminaires used for this calculation have a very accurate light distribution focusing the light on the road.

Height reference plane		: 0.00 m
Average illuminance	Em	: 3.35 lx
Minimum illuminance	Emin	: 0.33 lx
Maximum illuminance	Emax	: 8.29 lx
Uniformity Uo	Emin/Em	: 1 : 10.24 (0.10)
Diversity Ud	Emin/Emax	: 1 : 25.39 (0.04)

Figure 7—20 Incidence of artificial lighting on offset area between road and hotel development

The area between the Access Road and the hotel development receives a maximum illuminance of 8.3 lux that fades to 3.35 lux. The light can be further mitigated if trees are used on both sides of the road.



Height reference plane		: 0.00 m
Average illuminance	Em	: 0.08 lx
Minimum illuminance	Emin	: 0 lx
Maximum illuminance	Emax	: 1.31 lx
Uniformity Uo	Emin/Em	: ---
Diversity Ud	Emin/Emax	: ---

Figure 7—21 Incidence of artificial lighting on west side of Black Duck Marsh

As per the other areas in this section, an offset of 5.00m is allowed for the creation of the calculation plane that analyses the amount of light that the west side of this marsh can receive as spilled light from the public realm luminaires. The calculation shows that the maximum illuminance achieved is 1.31lux, which above the threshold allowed for this area.

It is important to acknowledge that this calculation was performed without any type of shielding or barrier elements between the luminaires and the edge of the marsh. The levels of light received by the edge of the marsh can be decreased if there are trees or any other type of barriers blocking the direct view to the light sources.

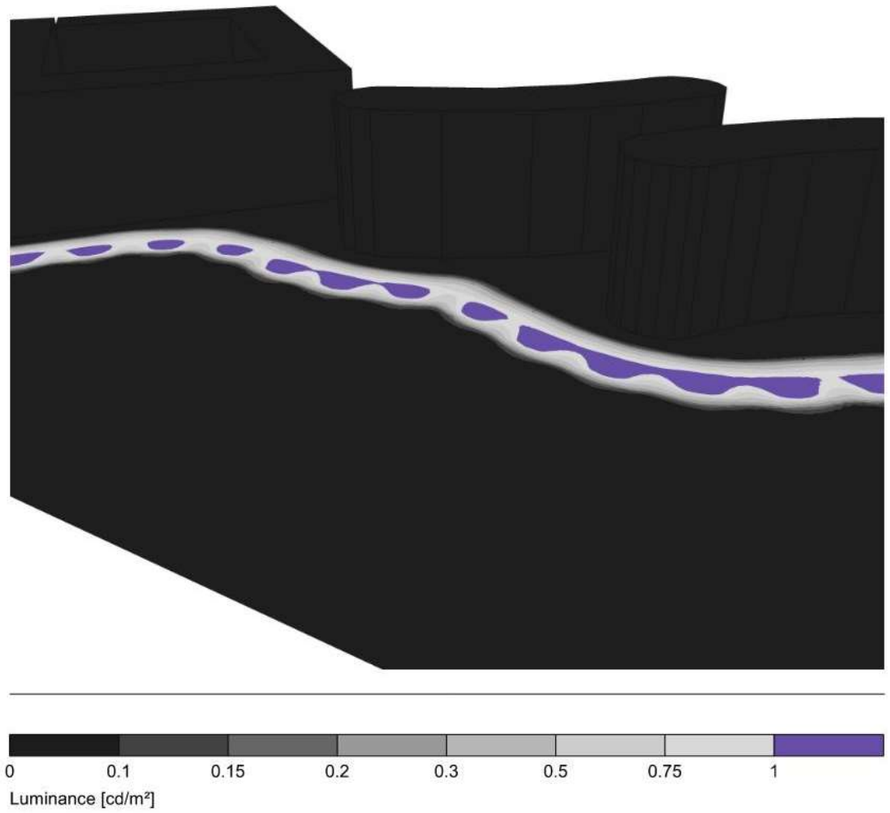


Figure 7—22 Calculation result showing the incidence of light on vertical surfaces

The result calculation above shows the luminance levels on buildings are below the threshold established for this environmental lighting zone, when the artificial light only comes from the road luminaires.

7.2.4 Area 4

The aim of the analysis of Area 4 is to understand the potential effect that artificial lighting can have in the natural environment and in specific on the existing waterbody in the Bomber Pit that is crossed by the new Resort Road.

The following spaces were illuminated:

- Resort road: typical section of a road that is approximately 13.00m. The assumed height of the road is 5.00m from the water surface, utilising photometric files of a luminaire located at 6.00m, CCT of 2500K, and a lumen output of 3300lm per fixture. Each fixture is 14m apart.
- It is assumed that this road will be used by coaches and the land train.

This area is located within the Environmental Lighting Zone E2. The results only analyse the effect of road lighting on the water surface and adjacent green areas.

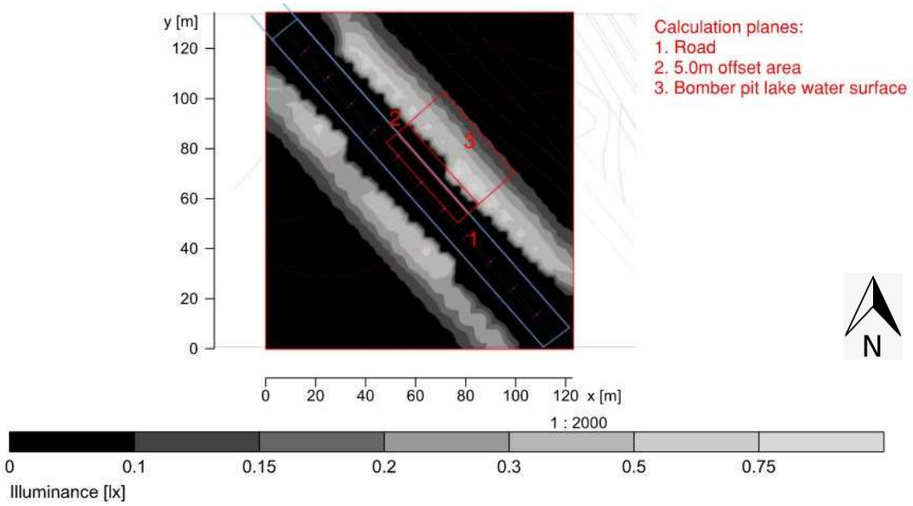


Figure 7—23 Extract of plan showing the analysed areas and the result. This image shows the overall scale of pseudo colours utilised by the calculation software across the site

Area 4 results

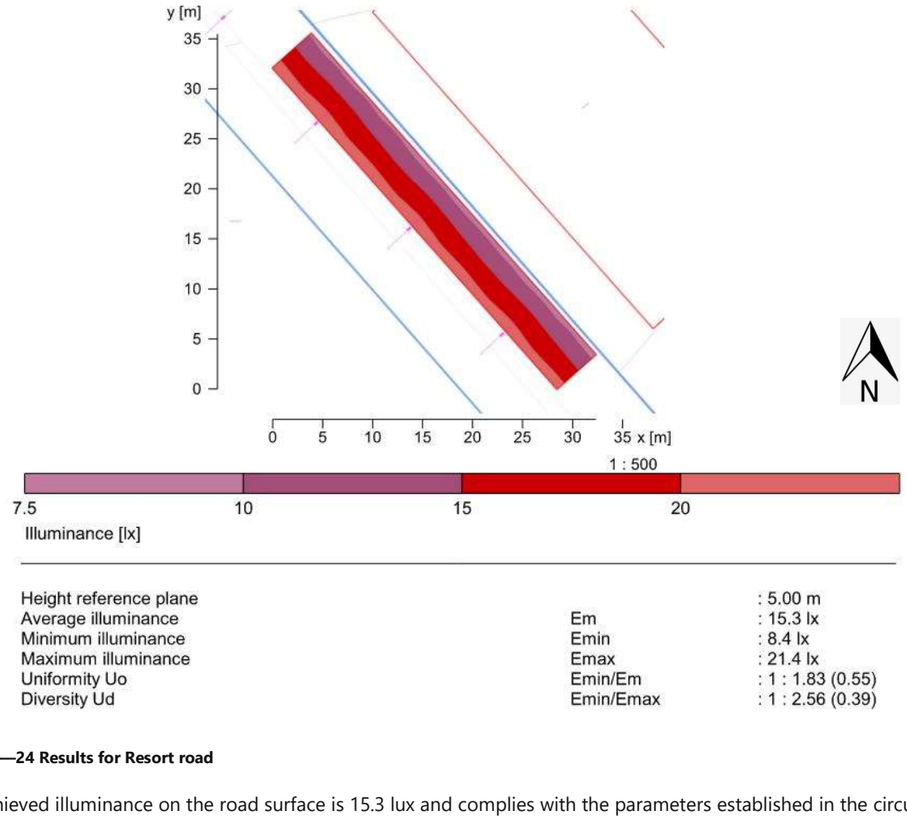


Figure 7—24 Results for Resort road

The achieved illuminance on the road surface is 15.3 lux and complies with the parameters established in the circulation strategy. Luminaires were placed on the assumed median of the bridge.

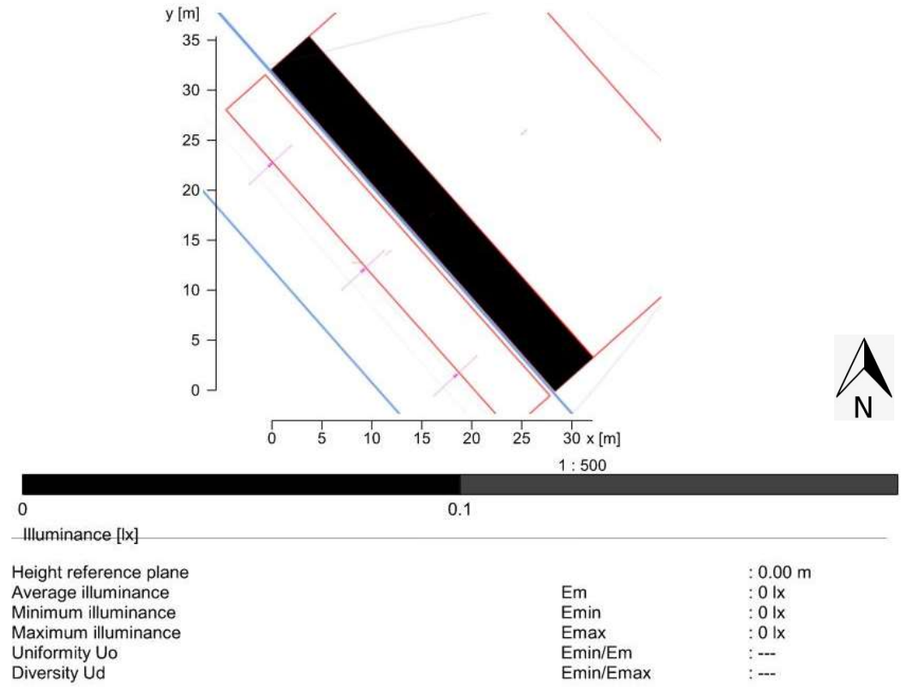


Figure 7—25 Incidence of artificial lighting on offset area

The offset area is not receiving any artificial light because of the shadow cast by the bridge surface.

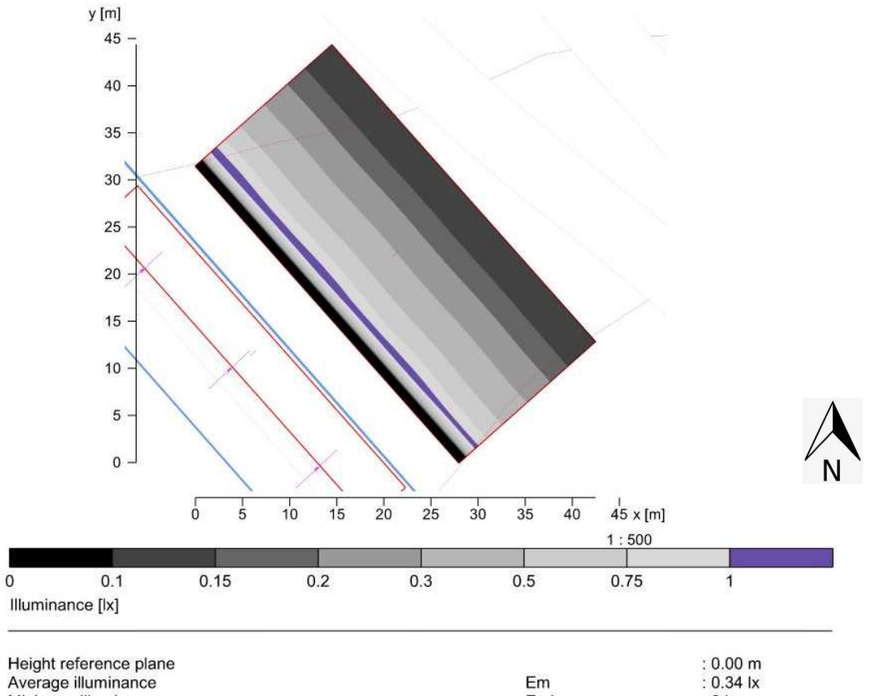


Figure 7—26 Incidence of artificial lighting on water surface and green areas of Bomber Pit

The calculation plane was located at 0.00m (same level as water surface) and it is 11.0m below the luminaires. The offset from the border of the calculation plane to the edge of the road is 5.00.

The result indicates that the water surface is receiving a maximum illuminance of 1.10lux, which is below the threshold of 2.0 lux established for water bodies.

This is achieved utilising a luminaire with highly accurate optical distribution that focuses on throwing the light sideways instead of pushing the light forward or backward.

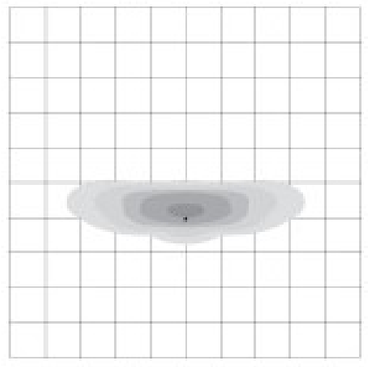


Figure 7—27 Image showing the light distribution of the luminaire selected for this calculation

8 The London Resort Tilbury Terminal and Car Park

The London Resort Tilbury Terminal and Car Park will act as a key gateway for visitors arriving from the north side of River Thames. It will include multi-storey car parks with green roofs, a walkway to transfer on foot directly to the ferry concourse and an enhanced public realm.

8.1 Essex Project Site Location

The London Resort Tilbury terminal is located to the east of the Tilbury Docks and to the west of the Tilbury Fort, a military fort built in the 16th century to protect London's seaward approach. The River Thames is located on the south and to the north is the town of Tilbury.

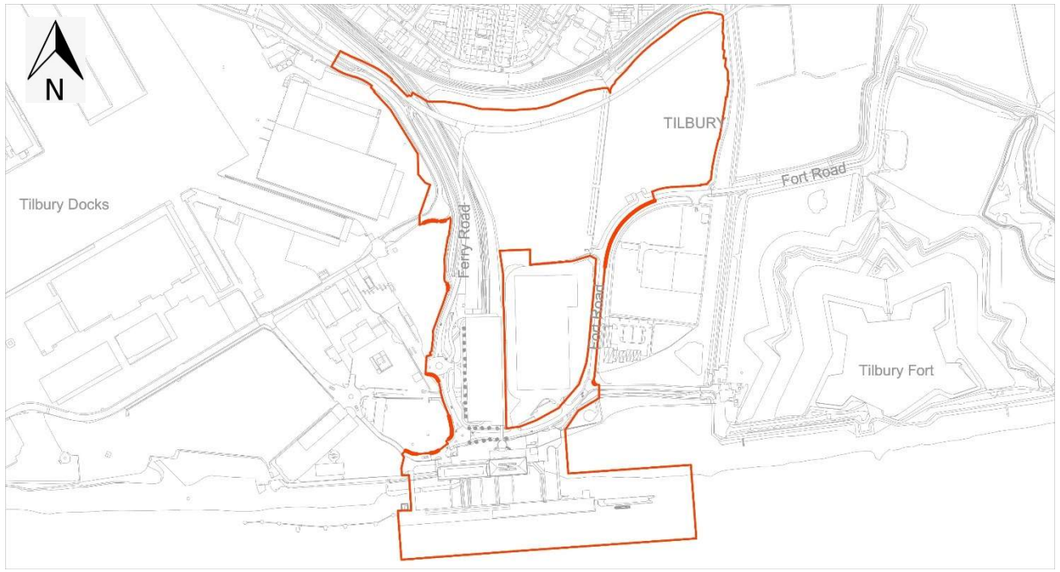


Figure 8—1 Location of London Resort Tilbury Terminal and Car Park

8.2 Existing baseline lighting conditions

Please refer to section 3.4.

8.3 Sensitive receptors

There is one area within the Order Limits that is considered a sensitive receptor and two areas outside the Order Limits that can be considered as sensitive receptors, as they might get affected (directly or indirectly) by the development.

Sensitive receptors in this case are:

1. **Fort and marshes (external sensitive receptor):** The Tilbury Fort and the marshes located on the east to the terminal which have the potential to be home to different wildlife species that include migratory birds, invertebrates, reptiles, voles and others.
2. **River Thames (internal sensitive receptor):** Impact of light on the water surface and surrounding areas.
3. **Neighbouring residential (external sensitive receptor):** Residential buildings and houses near the development. The wider neighbourhood will be considered within the lighting computational analysis further developed in this document.

Figure 8—2 Location of sensitive receptors

8.4 Environmental Lighting Zones

The following are the environmental lighting zones designated for this area:

8.4.1.1 Environmental Zone E1

No artificial lighting. Maintain the river in its current condition. This applies only to the area of the river which is within the CDO Order Limits. This classification aims to avoid the spill of unnecessary lighting onto the water possibly affecting the current natural environment.

8.4.1.2 Environmental Zone E2

This environmental zone is applied to mitigate the glow coming from the Principal Development and neighbouring communities to protect the natural areas that are to be conserved and enhanced. The aim is also to mitigate lighting in such a way that no lighting sources (lamps) are visible from animal habitats, as well as to reduce glow and minimise glare to create a comfortable and safe environment for visitors and the local fauna.

8.4.1.3 Environmental Zone E3

This environmental zone is designated to areas of the Proposed Development that have lower levels of intensity and activity. Residential zones for staff and training centres. The objective is to provide the necessary levels of light to create a safe and comfortable environment without over illuminating and reducing the spill of light onto buildings and areas of the E2 Environmental Lighting Zone.

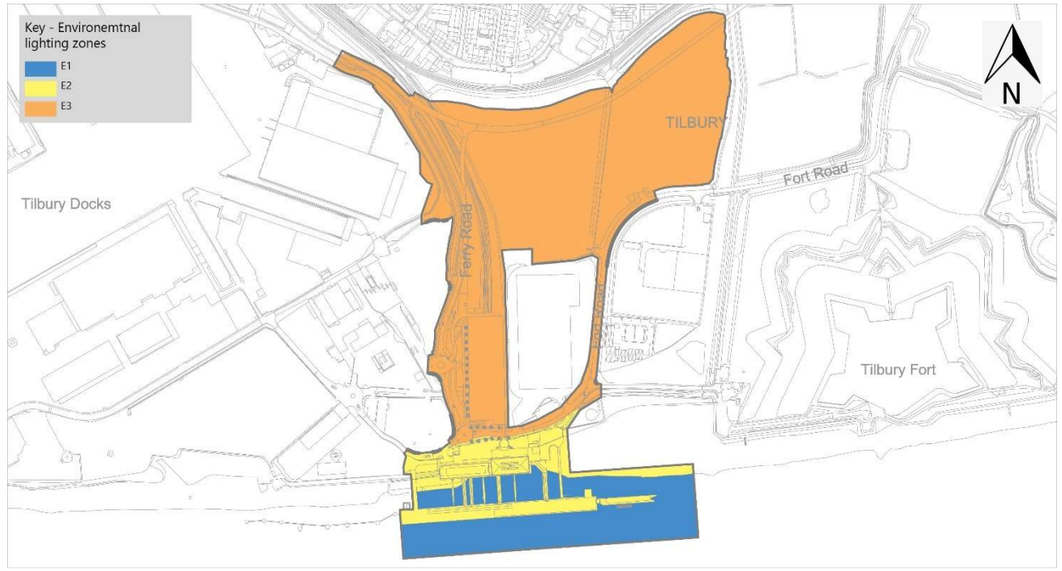


Figure 8—3 Environmental lighting zones

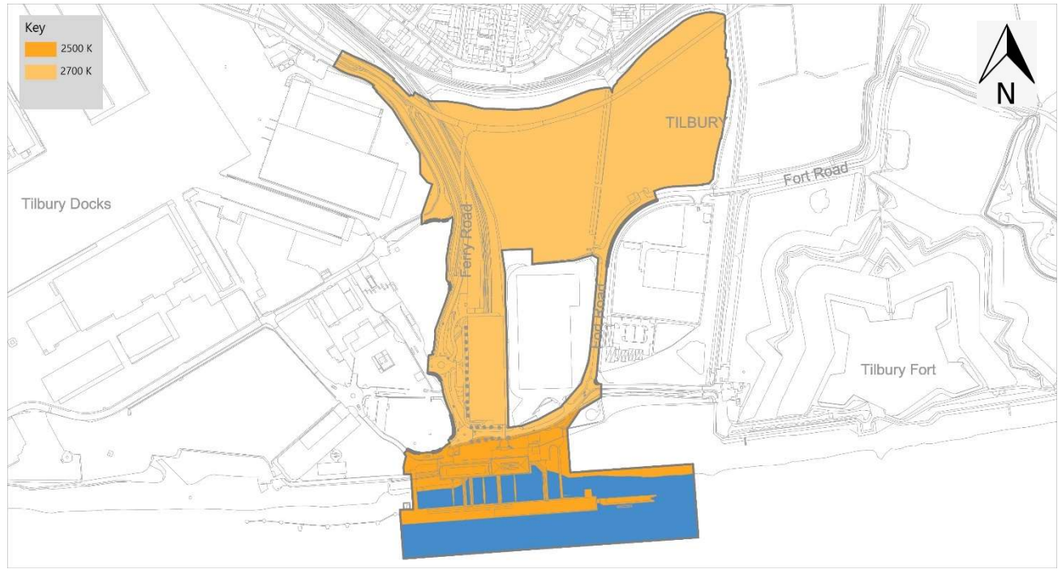


Figure 8—4 Light colour temperature areas

8.5 Light Colour Temperature

Warm light is proposed to be used across all the area with special importance in the Thames Shoreline as in the areas adjacent for the Principal Development for the following reasons:

- Warm light is mentally associated with safety, history, communion, relaxation and intimacy, which are pivotal elements in the natural visitor experience around the London Resort. Both ferry terminals should have the same language in terms of colour temperature and intensity.
- Warm light will highlight the earthy and red tones of the bricks used to build the heritage building. Luminaires with a similar language are recommended in the immediate area to the Terminal building.
- Area lighting (for the external car park to the north of the terminal) of a warmer colour temperature can be less disruptive for the neighbouring communities to the north.

Therefore, the following ranges of colour temperature have been associated to the different Lighting Environmental Zones:

- Lighting environmental zone E1: no light
- Lighting environmental zone E2: 2500K
- Lighting environmental zone E3: 2700K

8.6 Shielding

8.6.1 Areas with Integrated shielding

Areas within environmental lighting zone E3 require a full cut-off shield. The solid housing should not have any translucent parts or diffused materials which will allow for lighting escaping towards the dark sky. These luminaires allow light to be accurately cast downwards into the desired area without major levels of light spill. Spread lenses, snoots, internal/external louvres, honeycomb louvres and other glare mitigation and light control measures can be used in these luminaires to further limit the spread of light beyond a targeted area.

8.6.2 Areas Integrated and external shielding

Areas within the Lighting Environmental Zones E1 and E2 need further mitigation measures to be adopted in order to fully shield the light from direct line of sight from the Thames shoreline. 100% light source shielding can be achieved using physical landscape and architectural barriers (such as: dense shrubs and dense low-level vegetation, dunes, bunds, berms, etc.) and, furniture-integrated (or otherwise recessed) luminaires, solid balustrade, solid or very dense screens, and dunes and others, in combination with full cut-off fixtures.

8.7 Circulation Strategy

As per the Principal Development, the lighting design for the roads and circulation areas in the Ferry Terminal should seek to minimise the amount and intensity of light applied to fulfil the various functional and aesthetic objectives demanded by each application.

The classifications below are assigned to the potential new roads being proposed for the terminal and for the extensive car park, should the developer wish to upgrade the existing luminaires.

Figure 8—5 Lighting classification for roads and circulation areas

8.7.1 P3 routes and areas

This classification is applied to public realm areas around the terminal buildings.

8.7.2 P1 routes

This classification is applied to Ferry Road and the bifurcation through the northern edge of the car parl.

A higher intensity will also aid with legibility and the character of this road, as the main link between the different infrastructure areas of the project.

8.7.3 C2 areas

This lighting classification is given to all junctions, crossing points, public transport stops and other areas that present a risk.

8.7.4 Car parks

The lighting classification that applies to this zone has the requirements for a car park area with a high vehicular volume

8.7.5 Pedestrian bridges and stairs

Refer to Table 8—1 Lighting class description for lighting values.

8.8 Lighting recommendations

As a private development, the London Resort Tilbury Terminal has the possibility of designing the lighting to suit their requirements for operation, business case, security and safety. However, in order to achieve an environmentally responsible design, the following recommendations are provided:

- Pedestrian pathways should be illuminated with low-level columns, bollards, catenary lighting or other low-level sources to help with wayfinding and provide lighting only to where it is needed. The uniformity of the light on the ground plane should be high enough to help with the identification of potential hazards.
- Changes of level (stairs, ramps, platforms) shall be properly illuminated to avoid falls and easily identify potential trip hazards
- The colour temperature shall be constant in circulation areas.
- Plazas and event areas should have the possibility of having infrastructure for event lighting. All event lighting should always be aiming downwards to limit light spill onto the night sky.
- All luminaires should be pointing downwards.
- All attraction luminaires should be turned off after curfew – curfew times to be advised and agreed by Operation Management in liaison with local authority
- The use of uplighters should be limited to roofed areas or trees with very dense canopies in order to avoid the spill of unnecessary light onto the night sky.
- Internal roads should be fully lit with specific attention to junctions, crossing points, loading and unloading areas and other zones that might pose a risk for pedestrians and motorists alike.

Table 8—1 Lighting class description

Lighting classification	Average horizontal illuminance	Uniformity	Notes
P3	7.50 lux	0.25	The lighting for these areas can be provided from 6 to 8 m column. Final height dependent on the type of vehicular restrictions for these roads.
P1	15.00 lux	0.25	The height of the columns on the link road from the Resort to the Ferry port shall be limited to 6.0m due to its proximity to the Black Duck Marsh. Other areas under this lighting classification can be illuminated from 8.0m columns.
C2	20 lux	0.40	It is recommended that the lighting to these conflict areas is to be provided from 8.00m columns in order to minimise the spill of light. Final height to be dependent on lighting design for the road, client and planning approval
Car park	20 lux	0.25	It is recommended that the lighting to these conflict areas is to be provided from 8.00m columns in order to minimise the spill of light.
Bridge for pedestrians	30 lux	0.25	Lighting delimitate walking platform and help with the identification of potential hazards.

9 Conclusion and Summary

9.1 Evaluation compared to existing baseline

The following summary and conclusion are provided in four areas of the Principle Development located within Swanscombe Marsh, the transport infrastructure connecting the Principal Development south towards the A2, the existing areas of the A2 south east and west of the proposed development and the Tilbury Terminal and Car Park area of development.

9.2 Principle Development and Associated Development

The area proposed for the Principle Development and Associated Development forming part of the Kent Project Site is predominantly located within the Swanscombe Marsh Peninsular. Swanscombe Marsh is currently an area unilluminated by artificial light sources during the hour of darkness and predominantly a dark area during night-time. Whilst the area has previously been utilised for industrial use in the past. It is currently disused other than the small community located by the moorings north east, with various forms of wildlife and natural habitats, which have since been established throughout the area. The Landscape Strategy (document ref xx) by EDP consultants provides further details of the natural habits and wildlife.

It is evident that the implementation of any form of artificial lighting within this area would have an impact on the existing site conditions. The development of the Principle Development and Associated Development would therefore have a major impact on existing conditions.

To maintain the wellbeing and continued existence of wildlife and natural habitats, of designated areas as identified within this report, which are to be maintained and a lighting strategy is developed to ensure these areas are maintained with minimal intrusion of undue light spill or obtrusion. Any lighting application within these areas are limited main causeways ways and pedestrian route are applied with consideration, and generally at low level, with good control of light distribution and also colour temperature to ensure minimal disruption from the artificial lighting.

To ensure the area preserved for natural habitats and wildlife are preserved a classification of Environmental Lighting Zones have been developed to maintain these areas, with areas to of sensitive receptors to be maintained unilluminated during the hours of darkness.

The area surrounding the Principle Development and Associated Development are present to industrial developments from which artificial light sources are visible from majority of the areas to the North, East and South of the Swanscombe Marsh with some light sources containing an element of glare emanating from unshielded and poorly directed luminaires.

Taking into consideration the existing area of the Proposed Development is currently unilluminating, in context with the illumination of surrounding areas from the industrial developments the Proposed Development would not have a major impact on the existing lighting character of the general area other than perhaps the various in the colour lighting utilised for displays, Park Rides and activity centres.

The Outline Lighting Strategy (document ref xx) would mitigate the possibilities of undue light spill and obtrusive light within the dedicated Lighting Environmental Zones proposed being a potential nuisance. However, the presence of the Principle Development and Associated Development would have an impact on the visual prominence within an area which is currently unilluminated. Benefits would include the accessibility to areas within the Swanscombe Marshes which are currently limited with no illumination and lack of way finding or signage to assist the public in navigation within this area.

9.3 Ebbsfleet Transport Corridor

The area south of Swanscombe Marsh provide the main transport link between the Resort and the Railway Hub and A2 road connections. The proposed transport route runs parallel with the existing railways line to the east and an area of brownfield land to the west. The area of brownfield land is currently unilluminated and not accessible to the general public. The Outline Lighting Strategy (document ref xx) takes into consideration the sensitivity for the area of brownfield land with existing wildlife and natural habitats together with adjacent railway lines to ensure the lighting addressing the roadways and transport route are to be illuminated with mitigation of any undue light spill or obtrusive light onto either the brownfield land or railway lines, with light directed only to the areas required for illumination. Lighting impact is considered to be moderate.

9.4 A2 Roadway

It is expected that there would be an increase in the frequency of vehicles utilising the A2 to access the Proposed Development from the south. The areas of A2 east and west of the Proposed Development are well shielded with dense foliage and trees and the increase in traffic is considered to be of negligible impact on existing conditions.

9.5 Tilbury Terminal and Car Park

The Essex Project Site located at the Tilbury Terminal and Car Park provides for parking facilities from which visitors can access the Resort via ferry. The area of development currently accommodates a large industrial storage facility, external storage and large extrarenal car park for the majority of the areas of the Proposed Development. Due to similar usage for car parking, the Proposed Development is considered to have negligible impact on existing conditions. The proposed lighting strategy would mitigate undue light spill and obtrusive light, providing an improvement on the existing site conditions.

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