

# Rhydycar West, Merthyr Tydfil, CF48 1RW



# **Light Spillage Assessment**

4<sup>th</sup> November 2022

#### **PRESENTED TO**

Marvel Limited

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### **EXECUTIVE SUMMARY**

Tetra Tech Limited have undertaken a Lighting Assessment on behalf of Marvel Limited, for the proposed mixed leisure development on land at Rhydycar West, Merthyr Tydfil, CF48 1RW. The report has been updated following comments received from Merthyr Tydfil County Borough Council.

A light survey was undertaken to quantify pre-existing light levels around the site and determine the ILP environmental zone. Following the environmental light survey, it was concluded that the development is considered as an 'Environmental Zone E1 – Dark area'. The results of the light survey do not feed into the predicted illuminance levels within the DIALux model.

Indicative lighting plans have been designed by Tetra Tech Ltd and used to produce a model of the proposed development within DIALux software in accordance with the appropriate criteria.

The assessment has concluded that the risk of the proposed scheme resulting in exceedances of either the ILP pre-curfew or post-curfew obtrusive light limitations at sensitive ecological receptors and local residential receptors will be negligible.

Following the installation of an appropriate lighting scheme as detailed in this report, the risk of the proposed development resulting in significant exceedances of 1 lux along potential bat foraging/commuting routes is considered to be negligible.

Modelled ULR predicts a sky glow figure (ULR) of 0.0%, which meets the ILP sky glow limitation for an area classified as Environmental Zone E1. As such the indicative lighting scheme meets the ILP sky glow limitations and, therefore, will not result in adverse effects on the dark sky landscape. All external lights used within the model are 3000K and 0% Upward Light Ratio (ULR) making them suitable for Dark Areas.

Furthermore, the impact associated with the internal lighting from the proposed development on the surrounding area and dark sky landscape is low.

The other internal amenity areas, such as restaurants, will be located at lower levels where light spillage is kept to a minimum. A further detailed lighting assessment within these areas would include an internal lighting design plan, focusing on avoidance of further light spillage. However, with modelling undertaken using the internal lights 'LED bulb\_4-5W\_A60\_E27\_830\_FR' located at the windows of the proposed amenity areas to represent a worst-case scenario, the assessment has demonstrated that the restaurant lighting is expected to have negligible effects on the surrounding areas.

The results of the lighting assessment are considered to represent the worst-case scenario with regards to the light spillage from internal and external lighting. Therefore, further mitigation to minimise light spillage is not required.

The assessment has concluded that, with the implementation of the specified indicative lighting scheme, the sky glow levels, and obtrusive light levels at residential and ecological receptors will meet the ILP criteria, and lighting of the development does not conflict with any national or local planning policies.

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# **ACRONYMS/ABBREVIATIONS**

Acronyms/Abbreviations	Definition
CIBSE	Chartered Institute of Building Services Engineers
CIE	Commission on Illumination
CMS	Central Management Systems
ILP	Institution of Lighting Professionals
LDF	Local Development Framework
LP	Local Plan
CS	Core Strategy
DPD	Adopted Development Plan Documents
SPD	Adopted Supplementary Planning Documents
SG	Endorsed Supplementary Guidance Documents
NGR	National Grid Reference
PPS	Planning Policy Statement
PPW	Planning Policy Wales
NPPF	National Planning Policy Framework
Lx	Lux
ULR	Upward Lighting Ratio

### **1.0 INTRODUCTION**

Tetra Tech Limited have undertaken a Lighting Assessment on behalf of Marvel Ltd, in order to quantify potential impacts associated with the proposed mixed leisure development on land at Rhydycar West, Merthyr Tydfil, CF48 1RW.

# **1.1 SITE LOCATION AND CONTEXT**

The development site currently consists of unused land and woodland, the approximate national grid reference of which is 303521, 204688. Marvel Ltd are seeking planning permission for the proposed development at Rhydycar West, Merthyr Tydfil, CF48 1RW.

The proposed site is bounded by:

- Rural land immediately west of the site boundary. There is no existing lighting at this location.
- Rural land immediately north of the boundary and some residential properties approximately 400m north of the boundary. There is no existing lighting at this location.
- Rural land immediately east of the boundary, with the A470 beyond approximately 150m from the boundary. Beyond the A470 is urban commercial development. There is some existing street lighting at the urban commercial development area as well as lighting on the A470.
- Rural land immediately south of the boundary. There is no existing lighting at this location.

Reference should be made to **Figure 1.1** for a visual representation of the application site and surrounding area.

# **1.2 INDICATIVE DESIGN AND ASSESSMENT - OVERVIEW**

The proposed development will require the installation of a number of luminaires that have the potential to increase existing light levels at sensitive locations within the vicinity of the site. The following stages have therefore been undertaken in order to produce a suitable lighting layout and assess potential impacts:

- Baseline survey;
- Quantitative assessment of potential lighting impacts at existing light sensitive receptors bordering the proposed development site, based on the proposed external indicative lighting scheme;
- Formulation of appropriate mitigation measures, where necessary, in order to minimise the potentially detrimental impacts of the proposed lighting scheme.



Figure 1.1 – Site Layout and Boundary

# 2.0 POLICY, LEGISLATION AND RELEVANT AGENCIES

# 2.1 DOCUMENTS CONSULTED

The following documents were consulted during the undertaking of this assessment:

- Guidance Notes for the Reduction of Obtrusive Light, The Institution of Lighting Professionals, 2021;
- Planning Practice Guidance on Light Pollution, Ministry of Housing, Communities & Local Government, 1st November 2019;
- The Conservation of Habitats and Species Regulations, 2017;
- Environmental Protection Act, 1990;
- Statutory Nuisance from Insects and Artificial Light, Guidance on Sections 101 to 103 of the Clean Neighbourhoods and Environment Act 2005, DEFRA 2006;
- BS EN 12464-2: Lighting of Work Places Outdoor Work Places, British Standards Institute, 2007;
- BS EN 13201-4: Road Lighting Methods of Measuring Lighting Performance, 2020;
- BS 5489-1: Code of Practice for the Design of Outdoor Lighting Lighting of Roads and Public Amenity Areas, British Standards Institute, 2013;
- PLG 04- Guidance on Undertaking Environmental Lighting Impact Assessments, ILP, 2013;
- Towards a Dark Sky Standard A Lighting Guide to protect dark skies: from local need to landscape impact, UK Dark Skies Partnership, August 2021;
- Well-being of Future Generations (Wales) Act 2015;
- Future Wales: The National Plan 2040;
- Merthyr Tydfil Replacement Local Development Plan 2016 2031; and,
- Planning Policy Wales Edition 11 (2021) Paragraph 6.8 Guidance on Lighting.

# 2.2 LEGISLATIVE FRAMEWORK

Light pollution was introduced within the Clean Neighbourhoods and Environment Act (2005) as a form of statutory nuisance under the Environmental Protection Act (1990), which was amended to include the following definition:

"(fb) artificial light emitted from premises so as to be prejudicial to health or nuisance."

Although light was described as a statutory nuisance, no prescriptive limits or rules have been set for assessment. Guidance within the National Planning Policy Guidance (England), in the absence of a Technical Advice Note for Wales, with regards to Light pollution has been referred to while producing this assessment as well as documents produced by the International Commission on Illumination (CIE), Institution of Lighting Professionals (ILP) and the Chartered Institute of Building Services Engineers (CIBSE).

# 2.3 DESIGN STANDARDS

### **2.3.1 National Standards**

The appropriate indicative lighting design criteria for the scheme are contained within:

- BS EN 12464-2: Lighting of Work Places Outdoor Work Places, 2014;
- BS 5489-1: Code of Practice for the Design of Outdoor Lighting Lighting of Roads and Public Amenity Areas, 2013;
- BS EN 13201-2: Road Lighting Performance Requirements, 2020 and,

Good lighting design also includes luminaires that have been selected to minimise light intrusion and glare to pedestrians and drivers, as discussed within the ILP document 'Guidance Notes for the Reduction of Obtrusive Light'.

### 2.3.2 Best Practice Design

As well as meeting the statutory design standards outlined in section 2.3.1, the external indicative lighting design has sought to meet a number of criteria to ensure that the environmental effects of artificial lighting are managed to a high standard. These criteria are:

- All external lighting schemes must not have an upward lighting ratio (ULR) of more than 0.0%;
- All new column mounted luminaires shall be fitted with flat glass where appropriate to aid 0.0% upward light discharge;
- Where appropriate, luminaires on the site boundary will be fitted with light baffles to prevent light spill.
- Where possible, lighting will be controlled via Central Management System (CMS) time and light level sensors with controls capable of being adjusted and remotely set to adapt to local needs as required.
- Where possible, lighting has not been proposed on specific roadways when not required.

# 2.4 PLANNING POLICY AND GUIDANCE

### 2.4.1 National Policy

Future Wales - The National Plan 2040 is the national development framework, setting the direction for development in Wales to 2040. It is a development plan with a strategy for addressing key national priorities through the planning system, including sustaining and developing a vibrant economy, achieving decarbonisation and climate-resilience, developing strong ecosystems and improving the health and well-being of our communities.

Planning Policy Wales (PPW) (Edition11) updated November 2021 sets out land use planning policies of the Welsh Government. In regard to lighting, Paragraph 6.8 states that:

There is a need to balance the provision of lighting to enhance safety and security to help in the prevention of crime and to allow activities like sport and recreation to take place with the need to:

- Protect the natural and historic environment including wildlife and features of the natural environment such as tranquillity;
- Retain dark skies where appropriate; Distinctive & Natural Places Planning Policy Wales | Edition 11 160
- Prevent glare and respect the amenity of neighbouring land uses; and

• Reduce the carbon emissions associated with lighting.

Dark sky reserves exist in various parts of Wales, including Snowdonia, Brecon Beacons and the Elan Valley. Dark sky reserves can contribute positively to an area in economic and environmental terms and their characteristics should be taken into account when preparing development plan strategies and policies and when considering individual development proposals.

Lighting to provide security can be particularly important in rural areas or for specific purposes such as defence or to create calming environments. Where this is the case, planning authorities should adopt policies for lighting, including the control of light pollution, in their development plans.

Planning authorities can attach conditions to planning permissions for new developments that include the design and operation of lighting systems, for example, requiring energy-efficient design and to prevent light pollution.

# 2.4.2 Local Policy

Following a review of the adopted Merthyr Tydfil Replacement Local Development Plan 2016 - 2031, the following policies were identified as being relevant to potential light impacts associated with the proposed scheme:

#### "Policy SW11: Sustainable Design and Placemaking

Planning permission will be granted...where it has been demonstrated that:

[...] and create good quality townscape; not result in an unacceptable impact on local amenity, loss of light or privacy, or visual impact, and incorporate a good standard of landscape design [...]

#### Policy ENW4: Environmental Protection

Development proposals will be required to demonstrate they will not result in an unacceptable impact on people, residential amenity, property and / or the natural environment from either:

[...] Noise, vibration, dust, odour nuisance and light pollution [...]"

### 3.0 METHODOLOGY

The Lighting Assessment includes the establishment of baseline ambient light conditions and an evaluation of impacts associated with the indicative lighting scheme. This includes an assessment of change in light obtrusion at existing receptor locations.

Light modelling was undertaken using DIALux software, an independent lighting model which is capable of calculating daylight and artificial lighting scenes in interior and exterior scenarios. The model incorporates ILP, CIE 112 and BS EN 12464-2 calculation methodologies and is commonly used for lighting impact assessment.

# 3.1 INDICATIVE LIGHTING DESIGN

The indicative lighting design used in this assessment is primarily for the proposed car park, access road and walkways. Internal lighting from the proposed sport and leisure centre and hotels has also been included. The assessment considers the effect that this may have on the surrounding environment. The internal lighting is indicative of light spill from an unobstructed window. The design of the lighting has been undertaken in a manner such as to address two potentially conflicting needs; namely, on the one hand, to provide a safe environment for the movement of users when the natural lighting levels fall and, on the other hand, to meet the light obtrusion limitations stated within the relevant standards and guidance in order to avoid any detriment to local amenity and wildlife.

# 3.2 QUANTITATIVE LIGHTING ASSESSMENT

# 3.2.1 Obtrusive Light

Baseline light conditions were determined during a site survey of the existing site and the surrounding area. A lighting model was subsequently developed to represent the proposed external lighting scheme and to enable the obtrusive light from the proposed development to be calculated at local receptors.

The ILP has developed an Environmental Zone classification system for the categorisation of sensitive receptor locations based on typical levels of baseline obtrusive light. This is summarised in **Table 3.1** below.

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 t 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

 Table 3.1 – Environmental Zones

For each Environmental Zone, recommended obtrusive light limits for exterior lighting installations have also been determined. These are summarised in **Tables 3.2** to **3.4**.

**Table 3.2** shows the maximum allowable illuminance in the vertical plane for each Environmental Zone for Precurfew scenarios (after 07:00 hours) and Post-curfew scenarios (after 23:00). **Table 3.3** shows the maximum allowable luminous intensity emitted by the luminaires relative to the position of each luminous intensity receptor location depending on what the environmental zone is.

**Table 3.4** shows the maximum allowable Upward Light Ratio (ULR) for each environmental zone. If the modelled maximum values of vertical illuminance, the modelled maximum luminous intensity and the ULR are below the criteria in the tables below, they pass the assessment.

Light technical parameter	Application	Environmental Zone					
	conditions	E0	E1	E2	E3	E4	
Illuminance in the vertical plane (Ev)	Pre-curfew	n/a	2 lx	5 lx	10 lx	25 lx	
	Post-curfew	n/a	<0.1 lx*	1 lx	2 lx	5 lx	

Table 3.2 - Maximum Values of Vertical Illuminance on Properties

Light	Application conditions		Luminaire group (projected area Ap in m²)					
technical parameter			0 <a<sub>p ≤0.002</a<sub>	0.002 <a<sub>p ≤0.01</a<sub>	0.01 <a<sub>p ≤0.03</a<sub>	0.03 <a<sub>p ≤0.13</a<sub>	0.13 <a<sub>p ≤0.50</a<sub>	A <sub>p</sub> >0.5
		Pre-curfew	0	0	0	0	0	0
	E0	Post-curfew	0	0	0	0	0	0
	<b>F</b> 4	Pre-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500
Maximum	E1	Post-curfew	0	0	0	0	0	0
Iuminous intensity emitted by Iuminaire (I in cd)	E2	Pre-curfew	0.57 d	1.3 d	2.5 d	5.0 d	10 d	7,500
		Post-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	500
	E3	Pre-curfew	0.86 d	1.9 d	3.8 d	7.5 d	15 d	10,000
		Post-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	1,000
	- /	Pre-curfew	1.4 d	3.1 d	6.3 d	13 d	26 d	25,000
	E4	Post-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500
Aid to gauging Ap		2 to 5cm	5 to 10cm	10 to 20cm	20 to 40cm	40 to 80cm	>80cm	
Geometric mean of diameter (cm)		3.2	7.1	14.1	26.3	56.6	>80	
Corresponding AP representative area (m2)		0.0008	0.004	0.016	0.063	0.251	>0.5	

#### Table 3.3 - Limits for the Luminous Intensity of Bright Luminaires

#### NOTE:

- 1. D is the distance between the observer and the glare source in meters;
- 2. A luminous intensity of 0 cd can only be realised by a luminaire with a complete cut off in the designated directions;
- **3.**  $A_P$  is the apparent surface of the light source seen from the observer position;
- 4. For further information refer to Annex C of CIE 150
- 5. Upper limits for each zone shall be taken as those with column  $A_{\rm p}{>}0.5$

#### Table 3.4 - Maximum Values of Upward Light Ratio (ULR) of Luminaires

Light technical		Environmental Zone				
parameter	E0	E1	E2	E3	E4	
Upward light ratio (ULR)/%	0	0	2.5	5	15	

The assessment determined the lighting levels and Environmental Zone classification in the vicinity of the proposed development through the baseline survey. Modelling of the lighting scheme was undertaken and

predicted obtrusive light values compared with the relevant guidelines, as detailed within Tables 3.2 to 3.4.

The potential environmental effects of the proposed development are identified, as far as current knowledge of the site and development allows. The significance of potential environmental effects is assessed according to their scale (magnitude) and the sensitivity of the receptors.

For the purposes of this assessment, the effects of the development are considered to be 'significant' if:

- Ecological assessed sensitive receptors exceed 1 lux;
- The development is predicted to exceed the maximum sky glow ULR at any surrounding receptor; and/or,
- The development is predicted to cause either an exceedance of the ILP obtrusive light trespass limitation at a receptor or if the development is predicted to cause an increase of more than 10% at an existing receptor where the ILP obtrusive light trespass limitation is already being exceeded.

### **4.0 BASELINE**

This section provides a review of the existing lighting levels at the site in order to provide a benchmark against which to assess potential impacts associated with the development.

### 4.1 BASELINE SURVEY

### **4.1.1 Survey Conditions**

A baseline lighting survey was undertaken on 12<sup>th</sup> March 2018. The survey was undertaken before 23:00 to establish the existing pre-curfew lighting conditions. A recent review of the area has concluded that the site surroundings and existing lighting has remained unchanged, and therefore the 2018 baseline results are still considered to be robust.

# 4.1.2 Existing Light Sources

The main existing light sources surrounding the site are from road and vehicle lighting along the A470 to the east of the proposed site and further existing lighting from nearby residential buildings and streetlights.

### 4.1.3 Survey Locations

Light monitoring was undertaken at a number of survey locations to determine variations in baseline light levels within the vicinity of the site. Where possible, monitoring at the boundary of the receptor locations was undertaken to provide the best possible representation of existing light obtrusion. Where this was not possible, monitoring was undertaken at the most appropriate representative location. Reference should be made to **Figure 4.1** for an illustrative site map of the monitoring locations.

The purpose of the survey is fourfold:

- The survey enables quantified light levels at (or as near as possible to) local sensitive receptor locations to be measured;
- The site survey also provides an understanding of any significant landforms and vegetation that can potentially provide a pathway screen between light sources and receptors;
- The survey enables the ILP environmental zone to be determined based on sound, quantified evidence; and,
- The survey enables existing significant sources of artificial light and natural screens to be accounted for outside of the quantified model predictions.



#### Figure 4.1 – Light Monitoring Locations

The survey therefore provides a robust understanding of the current artificial lighting illuminance levels currently experienced around the development site. The light monitoring locations are summarised in

 Table 4.1, below, and the results from the survey are shown in Table 4.2.

A series of measurements were taken at key points; a horizontal ground level measurement and four vertical measurements at 1.5m facing north-east, south and west in general accordance with the recommended monitoring method in the statutory guidance issued by the ILP. Illuminance levels can vary quite significantly over relatively small distances and even with slight changes in the plane of the lens. Therefore, the range of measurements taken over a monitoring length was recorded, to determine the minimum and maximum illuminance at receptor façades.

The light survey helps to quantify the existing light level around the site and determine the ILP environmental zone. The results of the light survey do not feed into the predicted illuminance levels for the DIALux model.

<b>Table 4.1</b> – Baseline Light M	Ionitoring Locations
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Reference	Monitoring Location
L1	Northern boundary of site
L2	Northern boundary of site
L3	North-west within site boundary
L4	North-west within site boundary
L5	Within site boundary
L6	Within site boundary
L7	Eastern boundary of site
L8	Within site boundary
L9	Eastern boundary of site
L10	Eastern boundary of site
L11	Within site boundary
L12	Within site boundary
L13	South-west outside site boundary
L14	South-west outside site boundary
L15	South-west along site boundary
L16	Southern boundary outside of site
L17	Southern boundary outside of site
L18	Southern boundary of site
L19	Eastern boundary of site
L20	Eastern boundary of site

# 4.1.4 Survey Results

The results of the monitoring are displayed in Table 4.2.

Reference	Recorded Illuminance (Lux)					
	Facing Up	Facing North	Facing East	Facing South	Facing West	
L1	0.03	0.00	0.05	0.00	0.00	
L2	0.01	0.00	0.03	0.00	0.00	
L3	0.00	0.00	0.00	0.00	0.00	
L4	0.00	0.00	0.00	0.00	0.00	
L5	0.00	0.00	0.00	0.00	0.00	
L6	0.01	0.00	0.02	0.00	0.00	
L7	0.01	0.00	0.04	0.00	0.00	
L8	0.00	0.00	0.00	0.00	0.00	
L9	0.01	0.00	0.01	0.00	0.00	
L10	0.01	0.00	0.01	0.00	0.00	
L11	0.00	0.00	0.00	0.00	0.00	
L12	0.00	0.00	0.00	0.00	0.00	
L13	0.00	0.00	0.00	0.00	0.00	
L14	0.00	0.00	0.00	0.00	0.00	
L15	0.00	0.00	0.00	0.00	0.00	
L16	0.00	0.00	0.00	0.00	0.00	
L17	0.00	0.00	0.00	0.00	0.00	
L18	0.00	0.00	0.00	0.00	0.00	
L19	0.01	0.00	0.01	0.00	0.00	
L20	0.01	0.00	0.01	0.00	0.00	

Table 4.2 – Survey Results

Following the environmental lighting survey, in accordance with the ILP guidance limits outlined within **Table 3.2**, it was concluded that the development is considered as an 'Environmental Zone E1 – Dark area'. Therefore, the worst case permitted light trespass limit at an offsite receptor in the pre-curfew period (typically considered to be 07:00-23:00) is 2 lux and in the post-curfew period (typically considered to be 23:00-07:00) is <0.1 lux, however, as the development includes a public road this can go up to 1 lux, as stated within the ILP Guidance Note 01/21.

# 4.2 RECEPTORS

The term 'receptors' includes any persons, locations or systems that may be susceptible to changes in environmental factors as a consequence of the development.

# **4.2.1 Residential Receptors**

During the site survey, key residential properties were identified which have the potential to be affected by obtrusive light from the proposed development, as shown in **Table 4.3**. Reference should be made to

**Figure 4.2** for an illustration of the residential receptors used for the purposes of this assessment. All the identified residential receptors are considered to be within ILP Environmental Zone E1. Each receptor was input into the model at a height of 4.0m (bungalows and single-storey building at height of 1.5m) at a distance of 10 cm from the building façade to represent illuminance at first-floor window level, representing a typical bedroom, which is deemed to be the most sensitive receptor room. It should be noted that the receptors detailed below are the closest residential receptors to the proposed site that have the potential to be affected by the proposed lighting.

ID	Location	ILP Environmental Zone
R1	6, Lewis Square, Abercanaid, Merthyr Tydfil, CF48 1YN	E1
R2	Webber House, Abercanaid, Merthyr Tydfil, CF48 1Y	E1
R3	2, Glynderus Close, Abercanaid, Merthyr Tydfil, CF48 1XA	E1
R4	Pitwood House, Abercanaid, Merthyr Tydfil, CF48 1YL	E1
R5	Pitwood House, Abercanaid, Merthyr Tydfil, CF48 1YL	E1
R6	Ty Wern, Cae'R Wern, Merthyr Tydfil, CF48 1AE	E1
R7	30, Penlan View, Merthyr Tydfil, CF47 8NJ	E1
R8	Belmont House, Dixon Street, Merthyr Tydfil, CF48 1TQ	E1
R9	Blaencanaid Farm, Heolgerrig, Merthyr Tydfil, CF48 1RW	E1



#### Figure 4.2 – Modelled Residential Receptors

### 4.2.2 Ecological Receptors

Lighting associated with the operational phase of the proposed development has the potential to impact on receptors of ecological sensitivity (both within undeveloped parts of the site and within the vicinity of the site). The Conservation of Habitats and Species Regulations (2017) and subsequent amendments require competent authorities to review planning applications and consents that have the potential to impact on European designated sites (e.g. Special Areas of Conservation). For the purposes of this assessment, it was determined that a number of bat species utilise the site and surrounding area. In order to represent a worst-case scenario, the assessment has assumed that potential bat species on site will be highly sensitive to artificial light.

For the purposes of the assessment, ecological receptor locations have been included at 37 points within and surrounding the site, these locations have been confirmed by the project ecologist. **Table 4.4** below provides a reference for these locations whilst a full spatial illustration of modelled ecological receptors is included in **Figure 4.3**.

#### Table 4.4 – Ecological Receptors

ID	Description
E1 – E20	SSSI
E21 – E32	SINC
E33	Cwm Pit and head of railway
E34	Vale of Neath
E35 – E37	Cyfartha balance pond



#### Figure 4.3 – Modelled Ecological Receptors

# **5.0 LIGHTING ASSESSMENT**

Potential impacts associated with the proposed indicative lighting scheme at locations in the vicinity of the site were assessed as described in the following sections.

# 5.1 OBTRUSIVE LIGHT MODELLING

Building plans were provided and were used to produce an indicative lighting design within a DIALux model of the proposed development. Reference should be made to **Figure 5.1** for the indicative lighting layout and

**Figure 5.2** for a 3D representation of the proposed development model. Buildings surrounding the development site were also included in the model at heights of 8m (2-storey building) and 4m (1-storey building).

The assessment has considered the types of lighting used for the proposed amenity areas and has been considered worst-case, as shown below. The proposed internal hotel rooms have been illuminated to replicate a worse-case scenario.

- Internal lighting for the proposed hotels and leisure centre: LED bulb\_4-5W\_A60\_E27\_830\_FR
- Lighting modelled in proposed car park: DW Windsor Pharola Dark Sky LED Bollard 1m
- Lighting modelled on roads/pathways to proposed lodges: DW Windsor Pharola Dark Sky LED Bollard 1m
- Lighting modelled on proposed access road: DW Windsor Kirium Pro Mini 16LED 6m
- Lighting modelled on proposed roundabout: DW Windsor Kirium Pro Mini 8LED 6m
- Lighting modelled on proposed eastern road off access roundabout: DW Windsor Kirium Pro Mini 8LED 5m
- Lighting modelled on proposed western road off access roundabout: DW Windsor Kirium Pro Mini 8LED 4m

All external lights used within the model have 0% Upward Light Ratio (ULR) making them suitable for Dark Areas.

The BCT/ILP guidance states that lights considered to "'Warm white' (more yellow/orange colour) at around 3000°K and as low as 2700°K can now be used with little reduction in lumen output. LED typically features no UV component and research indicates that while lower UV components attract fewer invertebrates, warmer colour temperatures with peak wavelengths greater than 550nm (~3000°K) cause less impacts on bats (Stone, 2012, 2015a, 2015b). All external lighting included within the assessment is 3000K and consistent with the 'warm white' colour recommendation specified within the BCT/ILP guidance.

The assessment considers the effect of the proposed development in the pre-curfew and post-curfew periods. The assessment consists of a comparison between assumed baseline illuminance levels at each of the receptor locations against the predicted light obtrusion from the proposed development determined in the lighting model. The assumed baseline illuminance levels are ILP Environmental Zone E1.

It should be noted that a worst-case assessment has been undertaken, with lighting from all aspects of the proposed development illuminated simultaneously and with results measured against the post-curfew criteria. Once operational, areas such as the waterpark and leisure centre will not be illuminated during the post curfew

period. As such, the overall impact of lighting from the scheme will be better than that determined by the worstcase assessment.

Where it was not practicable to measure existing illuminance at the receptor location, monitoring results from the nearest equivalent representative monitoring locations are used.

The ULR of the proposed development has been calculated and referenced to the maximum permitted limitations for the relevant Environmental Zones of the receptor locations, as detailed in **Table 3.2** to **Table 3.4** 







Figure 5.2 – 3D Visual Representation of Proposed External Lighting Model

The model is only able to accurately represent the effects of solid structures such as buildings and walls on light obtrusion. Non-solid barriers such as trees and hedges cannot be accurately modelled and therefore the effects of these are dealt with qualitatively outside the model calculations.

# **5.1.1 Model Results**

### 5.1.1.1 Residential Receptors

Table 5.1 below, compares the modelled lighting arrangements to the ILP pre-curfew and post-curfew criteria limits for ILP Environmental Zone E1, in accordance with the classifications detailed in **Tables 3.2** to **3.4**.

ID	ILP Pre-curfew Criteria (Lx)	ILP Post-curfew Criteria (Lx)	Predicted Model Illuminance (Ix)
R1	2.00	<0.01	0.01
R2	2.00	<0.01	0.01
R3	2.00	<0.01	0.01
R4	2.00	<0.01	0.01
R5	2.00	<0.01	0.00
R6	2.00	<0.01	0.00
R7	2.00	<0.01	0.00
R8	2.00	<0.01	0.00
R9	2.00	<0.01	0.01

Tabla	51_	Posidontial	Pecontor	Accoccmont	Poculte
able	5.1 -	Residential	Receptor	Assessment	Results

The ILP pre-curfew and post-curfew results do not exceed Zone E1 criteria at any residential receptor locations. The proposed development is not predicted to result in any adverse impacts with respect to local sensitive residential receptors.

### 5.1.1.2 Ecological Receptors

While some bat species, such as Pipistrelle are more tolerant with light levels above this criterion, it reflects worst-case assumptions concerning the sensitivity of those species present to background illuminance levels. It is understood that most bat emergence require light levels below 1 lux for late emerging species, up to 14 lux for those that emerge earlier (Noctule and Pipistrelle). These lighting levels of 1 lux are required to ensure that bat commuting, and foraging routes are not adversely affected, and that dark corridors beyond the limits of the site are retained. As such, the assessment criteria represent a worst-case scenario in terms of impacts on emergence, commuting and foraging (Bat Conservation Trust, 2011).

Following consultation with the project ecologists, it has been determined that the main bat flight corridors in the baseline conditions are located east-west along the stream courses and dismantled railway/mineral lines and north-south following the downslope sides of tips and the corresponding woodland edges. There are no known bat flight paths through the proposed development area, therefore, the bats will continue to use the existing flight paths around the boundary of the site. The lighting design has taken this into account by limiting the amount of light spill outside of the red line area.

The Bat Conservation Trust guidance states:

"Where 'complete darkness' on a feature or buffer is required, it may be appropriate to consider this to be where illuminance is below 0.2 lux on the horizontal plane and below 0.4 lux on the vertical plane. These figures are still lower than what may be expected on a moonlit night and are in line with research findings for the illuminance found at hedgerows used by lesser horseshoe bats, a species well known for its light-averse behaviour (Stone, 2012)."

As detailed in **Table 5.2** below, the highest lux level recorded was 0.05 at E3. Therefore, complete darkness will be maintained for the sensitive ecological receptors surrounding the site.

When determining the likely impacts of lighting associated with the proposed development on sensitive ecological receptors, the assessment has considered the effect of lighting pre-mitigation. Impacts are considered potentially significant where predicted illuminance exceeds 1 lux at ecological receptors. If this is the case, further consideration should be given to mitigation measures. **Table 5.2** shows the modelled lighting arrangements for the ecological receptors surrounding the site vicinity.

ID	Predicted Model Illuminance (Ix)
E1	0.01
E2	0.01
E3	0.05
E4	0.02
E5	0.01
E6	0.03
E7	0.01
E8	0.00
E9	0.00
E10	0.01
E11	0.00
E12	0.01
E13	0.00
E14	0.00
E15	0.00
E16	0.00
E17	0.00
E18	0.00
E19	0.01
E20	0.01
E21	0.00
E22	0.00
E23	0.00
E24	0.00
E25	0.00
E26	0.00
E27	0.01
E28	0.02
E29	0.02
E30	0.00
E31	0.00
E32	0.01
E33	0.01
E34	0.01
E35	0.01
E36	0.01
E37	0.01

Table 5.2 – Ecological Receptor Assessment Results

As illustrated in **Table 5.2**, light trespass associated with the proposed site does not exceed 1 lux at any of the 37 modelled ecological receptor locations adjacent to the site boundary. As such the proposed development is not predicted to result in any impact with respect to local sensitive ecological receptors.

# 5.1.2 Dark Sky/Sky Glow Assessment

The model has been used to calculate the predicted Upward Lighting Ratio (ULR) of the proposed external lighting scheme. Model outputs predict a sky glow figure (ULR) of 0.0%. As illustrated in **Table 3.2** to **Table 3.4**, the ILP sky glow limitation for an area classified as Environmental Zone E1 is 0.0% ULR. As such the indicative lighting scheme meets the ILP sky glow limitations and, therefore, will not result in adverse effects on the dark sky landscape. **Figure 5.3** illustrates a false colours image of the proposed site.





# **6.0 MITIGATION**

The following measures have been included within the indicative lighting design to reduce lux levels and source intensity of the proposed lights at ecological and residential receptor locations, and reduce exposure to lighting and the impact from the proposed development.

- The indicative lighting specification includes use of warm white colour temperature LED source lighting to reduce the amount of blue light component and avoid detrimental impacts on the local bat population.
- The indicative lighting design includes placement of columns at a zero-degree tilt to ensure the downward distribution of light directly towards the road and reduce backwards spillage of light into the existing hedgerows and treeline.
- Low level lighting bollards are proposed on the primary route areas.
- The indicative lighting design has also not illuminated all road sections to keep areas intrinsically dark and will implement controls which would only activate lighting in these zones in response to pedestrian or vehicle movement.

The lighting assessment undertaken is representative of the worst-case scenario with regards to the light spillage from internal and external lighting. With the above measures incorporated into the lighting design, lighting of the proposed development is not predicted to result in adverse effects at nearby residential or ecological receptors. Therefore, further mitigation to minimise light spillage is not required.

### 7.0 CONCLUSIONS

Tetra Tech Limited have undertaken a Lighting Assessment on behalf of Marvel Limited, for the proposed mixed leisure development on land at Rhydycar West, Merthyr Tydfil, CF48 1RW. The report has been updated following comments provided by Merthyr Tydfil County Borough Council.

A light survey was undertaken to quantify pre-existing light levels around the site and determine the ILP environmental zone. Following the environmental light survey, it was concluded that the development is considered as an 'Environmental Zone E1 – Dark area'. The results of the light survey do not feed into the predicted illuminance levels within the DIALux model.

Indicative lighting plans have been designed by Tetra Tech Ltd and used to produce a model of the proposed development within DIALux software in accordance with the appropriate criteria.

The assessment has concluded that the risk of the proposed scheme resulting in exceedances of either the ILP pre-curfew or post-curfew obtrusive light limitations at sensitive ecological receptors and local residential receptors will be negligible.

Following the installation of an appropriate lighting scheme as detailed in this report, the risk of the proposed development resulting in significant exceedances of 1 lux along potential bat foraging/commuting routes is considered to be negligible.

Modelled ULR predicts a sky glow figure (ULR) of 0.0%, which meets the ILP sky glow limitation for an area classified as Environmental Zone E1. As such the indicative lighting scheme meets the ILP sky glow limitations and, therefore, will not result in adverse effects on the dark sky landscape. All external lights used within the model are 3000K and 0% Upward Light Ratio (ULR) making them suitable for Dark Areas.

Furthermore, the impact associated with the internal lighting from the proposed development on the surrounding area and dark sky landscape is low.

The other internal amenity areas, such as restaurants, will be located at lower levels where light spillage is kept to a minimum. A further detailed lighting assessment within these areas would include an internal lighting design plan, focusing on avoidance of further light spillage. However, with modelling undertaken using the internal lights 'LED bulb\_4-5W\_A60\_E27\_830\_FR' located at the windows of the proposed amenity areas to represent a worst-case scenario, the assessment has demonstrated that the restaurant lighting is expected to have negligible effects on the surrounding areas.

The results of the lighting assessment are considered to represent the worst-case scenario with regards to the light spillage from internal and external lighting. Therefore, further mitigation to minimise light spillage is not required.

The assessment has concluded that, with the implementation of the specified indicative lighting scheme, the sky glow levels, and obtrusive light levels at residential and ecological receptors will meet the ILP criteria, and lighting of the development does not conflict with any national or local planning policies.

# **APPENDIX A – REPORT CONDITIONS**

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