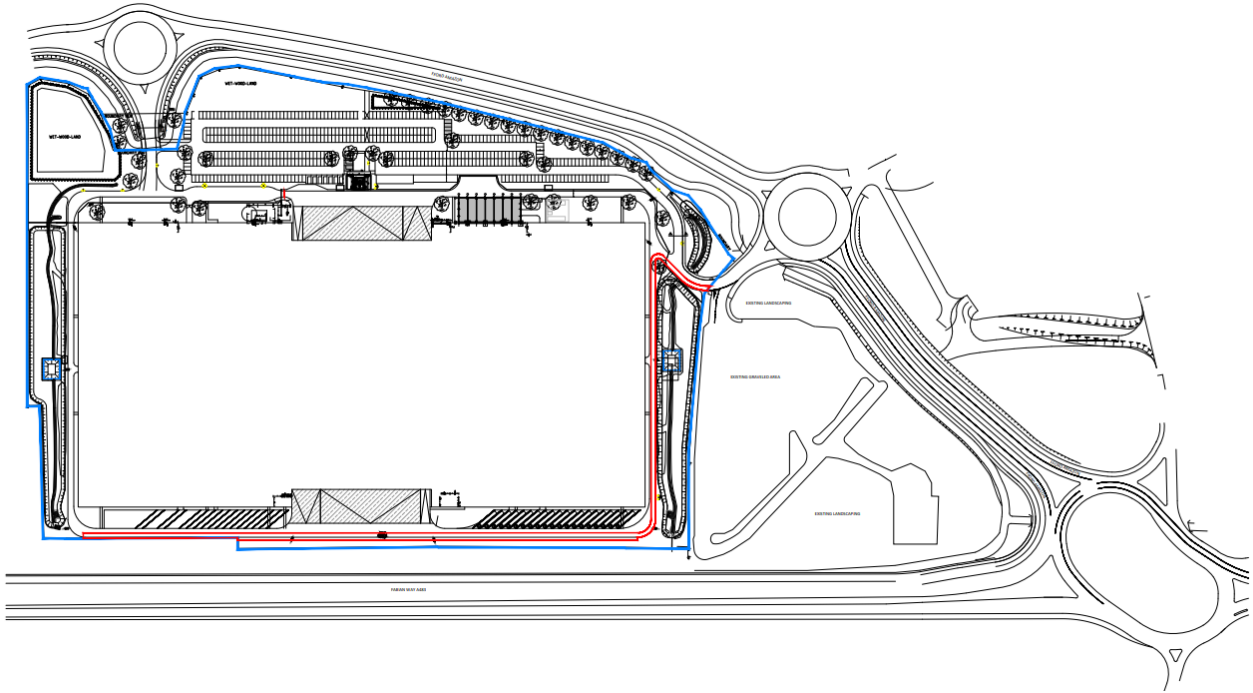


Ffordd Amazon, Skewen, Swansea, SA1 8QX



Lighting Assessment

4th July 2023
784-B042245

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EXECUTIVE SUMMARY

Tetra Tech were commissioned by Amazon to prepare a Lighting Assessment for the proposal of a new external lighting scheme at Ffordd Amazon, Skewen, Swansea, SA1 8QX.

Detailed lighting plans have been designed by Ashton Smith and used to produce a model of the proposed development within DIALux software in accordance with the appropriate criteria.

Following the installation of an appropriate lighting scheme as detailed in this report, the risk of the proposed development resulting in exceedances of 1 lux along potential bat foraging/commuting routes and dark corridors is low at all ecological receptor locations.

The assessment demonstrates that there is a low risk of significant adverse impacts on local sensitive ecological receptors, and that the proposed external lighting scheme does not conflict with any national or local planning policies regarding lighting.

A Glare Rating assessment has also been undertaken. At all locations assessed, the predicted glare associated with proposed lighting will be either unnoticeable or noticeable at a level not considered to result in disturbance.

The dark skies assessment illustrates that the Upward Light Ratio (ULR) for the proposed development is 0.0%. This is below the 5% ULR criteria for the Environmental Zone E3. As such the indicative lighting scheme is not considered to result in detrimental impacts on the dark sky landscape.

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ACRONYMS/ABBREVIATIONS

Acronyms/Abbreviations	Definition
CIBSE	Chartered Institute of Building Services Engineers
CIE	Commission on Illumination
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
NPPF	National Planning Policy Framework
Lx	Lux
ULR	Upward Lighting Ratio

1.0 INTRODUCTION

Tetra Tech were commissioned by Amazon to prepare a Lighting Assessment for the proposal of a new external lighting scheme at Ffordd Amazon, Skewen, Swansea, SA1 8QX

1.1 SITE LOCATION AND CONTEXT

The site consists of an Amazon warehouse, the approximate national grid reference of which is 271047 193477.

The proposed development is bounded by:

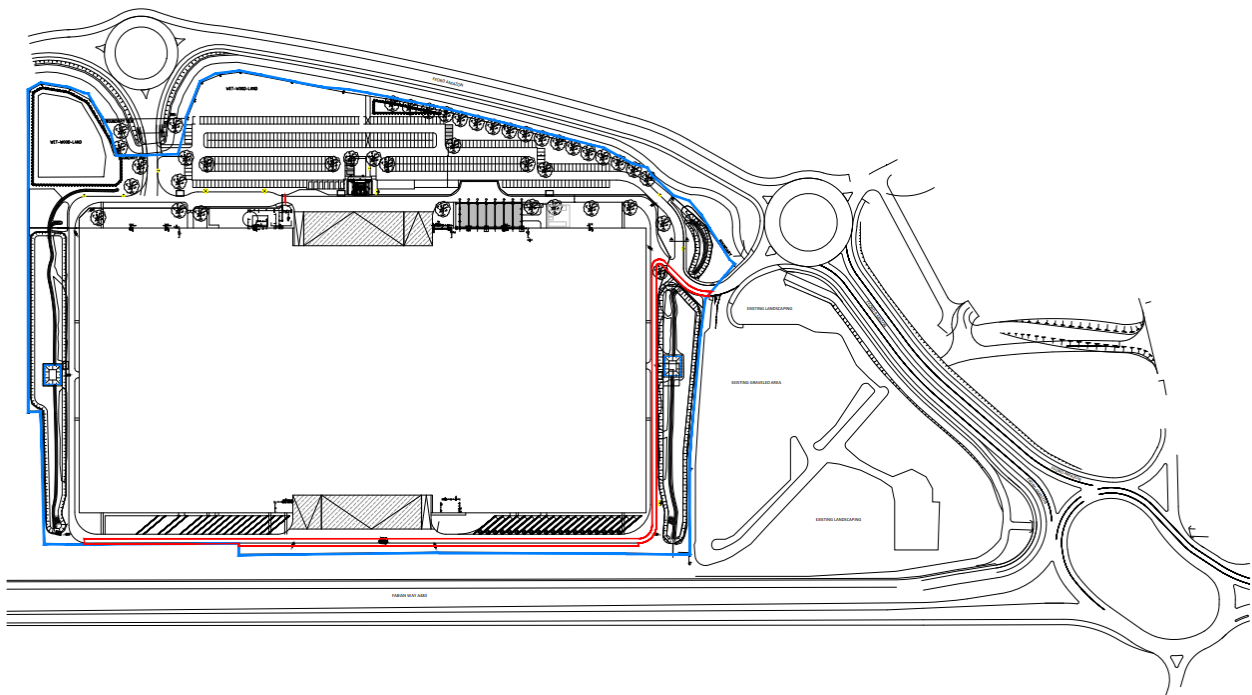
- Ffordd Amazon, a railway line and woodland to the north. There is some existing street lighting along Ffordd Amazon.
- Kearns Storage to the east. There is some existing street lighting at this location.
- Fabian Way (A483) to the south. There is existing street lighting present at this location.
- Amazon overflow car park, woodland and industrial estate to the west. There is some existing lighting present at this location.

Reference should be made to **Figure 1-1** for a location map of the site and surrounding area.

1.2 LIGHTING 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 lighting design;
- Formulation of appropriate mitigation measures, where necessary, in order to minimise the potentially detrimental impacts of the proposed lighting scheme.

Figure 1-1 – Site Location**Figure 1-2 – Site Layout**

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, 2014;
- BS EN 13201-4: Road Lighting – Methods of Measuring Lighting Performance, 2015;
- BS 5489-1: Code of Practice for the Design of Outdoor Lighting - Lighting of Roads and Public Amenity Areas, British Standards Institute, 2020;
- PLG 04- Guidance on Undertaking Environmental Lighting Impact Assessments, ILP, 2013;
- Bats and artificial lighting in the UK, Institution of lighting professionals, Bat Conservation Trust, 2018;
- 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;
- Neath Port Talbot County Borough Council Core Local Development Plan (2011-2026);
- Planning Policy Wales Edition 11 (2021) – Paragraph 6.8 – Guidance on Lighting; and,
- Future Wales: The National Plan 2040.

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 lighting design criteria for the scheme are contained within the following documents:

- 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, 2020.
- BS EN 13201-2: Road Lighting - Performance Requirements, 2015.

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 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 as follows:

- All external lighting schemes must not have an upward lighting ratio (ULR) of more than 5%.
- All new column mounted luminaires shall be fitted with flat glass where appropriate to aid 5% 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.

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) (Edition 11), 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 Neath Port Talbot County Borough Council Local Development Plan (2011-2026), the following policies were identified as being relevant to potential light impacts associated with the proposed scheme:

“Policy EN 8

Pollution and Land Stability

Proposals which would be likely to have an unacceptable adverse effect on health, biodiversity and /or local amenity or would expose people to unacceptable risk due to the following will not be permitted:

- *Air pollution;*
- *Noise pollution;*
- *Light pollution;*
- *Contamination;*
- *Land instability;*
- *Water (including groundwater) pollution.*

Proposals which would create new problems or exacerbate existing problems detailed above will not be acceptable unless mitigation measures are included to reduce the risk of harm to public health, biodiversity and/or local amenity to an acceptable level.”

3.0 METHODOLOGY

The Lighting Assessment includes the establishment of baseline ambient light conditions and an evaluation of impacts associated with the lighting design. 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 LIGHTING DESIGN

The lighting scheme for the development was designed in accordance with the previously outlined standards and guidance. 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 employees 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. Following desktop survey, the design also aimed to minimise light spillage to the dark corridors surrounding the site.

Modelling for the assessment includes luminaires considered appropriate for the proposed industrial development, as shown below.

- Sylvania Zephyr – Large Zephyr 5500Lm 4k CLI Grey 0050081 at 6m.

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**.

Table 3-1 – 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 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

For each Environmental Zone, recommended obtrusive light limits for exterior lighting installations have also been determined. These are summarised in **Table 3-2** to **Table 3-4**.

Table 3-2 shows the maximum allowable illuminance in the vertical plane for each Environmental Zone for pre-curfew 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.

Table 3-2 – Maximum Values of Vertical Illuminance on Properties

Light technical parameter	Application conditions	Environmental Zone				
		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

* If the installation is for public (road) lighting then this may be up to 1 lx.

Table 3-3 – Limits for the Luminous Intensity of Bright Luminaires

Light technical parameter	Application conditions		Luminaire group (projected area A_p in m ²)					
			$0 < A_p \leq 0.002$	$0.002 < A_p \leq 0.01$	$0.01 < A_p \leq 0.03$	$0.03 < A_p \leq 0.13$	$0.13 < A_p \leq 0.50$	$A_p > 0.5$
Maximum luminous intensity emitted by luminaire (I in cd)	E0	Pre-curfew	0	0	0	0	0	0
		Post-curfew	0	0	0	0	0	0
	E1	Pre-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500
		Post-curfew	0	0	0	0	0	0
	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
	E4	Pre-curfew	1.4 d	3.1 d	6.3 d	13 d	26 d	25,000
		Post-curfew	0.29 d	0.63 d	1.3 d	2.5 d	5.1 d	2,500
Aid to gauging A_p			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

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 $A_p > 0.5$

Table 3-4 – Maximum Values of Upward Light Ratio (ULR) of Luminaires

Light technical parameter	Environmental Zone				
	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. Modelling of the lighting scheme was undertaken and predicted obtrusive light values compared with the relevant guidelines, as detailed within **Table 3-2** to **Table 3-4**.

The roads will be lit in accordance with the relevant legislation. **Table 3-5** shows the relevant guidance when lighting roads and pedestrianised areas.

Table 3-5 – P Lighting Class

Class	Horizontal Illuminance		E ₀ GR _L	
	<i>E_a</i> [minimum maintained] lx	<i>E_{min}</i> [maintained] lx	<i>E_{vmin}</i> [maintained] lx	<i>E_{scmin}</i> [maintained] lx
P1	15,0	3,00	5,0	5,0
P2	10,0	2,00	3,0	2,0
P3	7,50	1,50	2,5	1,5
P4	5,00	1,00	1,5	1,0
P5	3,00	0,60	1,0	0,6
P6	2,00	0,40	0,6	0,2
P7	Performance not determined	Performance not determined		

a - To provide for uniformity, the actual values of the maintained average illuminance shall not exceed 1,5 times the minimum E value indicated for the class

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:

- Sensitive ecological receptors exceed 1 lux;
- The development is predicted to exceed the maximum sky glow ULR at any surrounding receptor; and,
- 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.

3.2.2 Glare

The DIALux model has also been used to calculate predicted Glare Ratings at proposed receptors along Fabian Way to the south of the application site based upon exact calculation according to CIE 112. CIE 112 contains a nine-point glare assessment scale which is summarised in **Table 3-6**, below.

The Table should not be used to specify definitive glare restriction limits, but it does provide insight in the practical meaning of differences in glare ratings for the purposes of evaluating predicted glare.

Table 3-6 – CIE Glare Assessment Guidance

Glare Control Mark	Impact	Glare Rating (GR)
1	Unbearable	90
2		80
3	Disturbing	70
4		60
5	Just Admissible	50
6		40
7	Noticeable	30
8		20
9	Unnoticeable	10

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 22nd June 2023. The survey was undertaken an hour after sunset at 23:00 to establish conditions that are representative of the existing post curfew lighting conditions.

4.1.2 Existing Light Sources

Existing light sources surrounding the site are external lights from building lights on the Amazon warehouse building, and streetlighting.

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 locations of all the light monitoring locations are summarised in **Table 4-1** below, and the results from the survey are contained 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.

Table 4-1 – Base Light Monitoring Locations

Reference	Monitoring Location	Key Local Sources of Light
L1	On Site Southern boundary	Streetlights along Fabian Way
L2	On Site Southern boundary	Streetlights along Fabian Way
L3	On Site Southern boundary	Streetlights along Fabian Way
L4	On Site Southern boundary	Streetlights along Fabian Way
L5	On Site Southern boundary	Streetlights along Fabian Way
L6	On Site Southern boundary	Streetlights along Fabian Way
L7	On Site Southern boundary	Streetlights along Fabian Way
L8	On Site Southern boundary	Streetlights along Fabian Way
L9	On Site Southern boundary	Streetlights along Fabian Way
L10	Fabian Way	Streetlights along Fabian Way
L11	Fabian Way	Streetlights along Fabian Way
L12	Fabian Way	Streetlights along Fabian Way
L13	Fabian Way	Streetlights along Fabian Way
L14	Fabian Way	Streetlights along Fabian Way
L15	Fabian Way	Streetlights along Fabian Way
L16	Fabian Way	Streetlights along Fabian Way
L17	Fabian Way	Streetlights along Fabian Way

4.1.4 Survey Results

The results of the monitoring are displayed in **Table 4-2**. It should be noted that the high lux levels monitored at locations L7 and L12 are attributed to close proximity to existing luminaires.

Table 4-2 – Survey Results

Reference	Recorded Illuminance (Lux)					Sky Quality (visual magnitudes per square arcsecond)
	Facing Up	Facing North	Facing East	Facing South	Facing West	
L1	11.70	1.70	4.80	4.10	0.80	12.49
L2	12.60	14.70	14.30	1.30	7.60	14.84
L3	10.90	14.30	31.30	1.70	7.30	15.24
L4	16.18	53.40	30.30	3.00	17.70	14.20
L5	12.07	19.35	68.10	10.80	32.20	12.57
L6	19.40	20.20	16.70	16.80	37.70	13.96
L7	106.0	110.10	10.50	23.50	189.90	12.58
L8	16.35	35.26	11.08	3.06	12.97	12.49
L9	42.10	28.50	28.20	3.60	17.00	8.86
L10	15.19	42.00	36.60	2.70	8.10	14.26
L11	13.51	37.94	14.77	3.50	13.89	13.92
L12	187.10	66.10	21.50	129.60	256.30	11.11
L13	9.19	15.76	8.06	1.61	8.89	12.99
L14	7.33	14.53	3.78	0.91	5.99	12.76
L15	7.15	15.15	6.26	0.95	5.75	12.44
L16	7.80	17.80	14.50	1.30	4.70	15.22
L17	4.50	11.80	8.80	0.70	2.20	15.93

Following the environmental lighting survey it was concluded that the proposed development site and the surrounding area should be classified as 'Environmental Zone E3 – Medium District Brightness', in accordance with the ILP guidance limits outlined within **Table 3-2** for Sky Quality. This is considered representative of Well inhabited rural and urban settlements, small town centres of suburban locations. Therefore, the permitted light trespass limit at an offsite receptor in the pre-curfew period (typically considered to be 07:00-23:00) is 10 lux and in the post curfew period (typically considered to be 23:00-07:00) is 2 lux.

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 Ecological Receptors

Lighting associated with the operational phase of the proposed development has the potential to impact on receptors of ecological sensitivity 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 National Site Network (NSN) designated sites (e.g. Special Areas of Conservation). For the purposes of this assessment, it was determined that a number of bat species could utilise the hedgerows and trees surrounding the site for commuting/foraging purposes. 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 18 points along the length of hedgerows and trees around and within the boundary of the site, at heights of 4m. Following consultation with the project ecologist, the ecological receptors include locations where historical treelines and vegetation with bat roosting potential are to be kept. **Table 4-3** below, provides a reference for these locations whilst a full spatial illustration of modelled ecological receptors is included in **Figure 4-2**.

Table 4-3 – Ecological Receptors

ID	Description
E1 – E13	Treeline south of Amazon depot
E14 – E18	Treeline east of Amazon depot

Figure 4-2 – Modelled Ecological Receptors



4.2.2 Glare Rating Observers

Modelling was also undertaken to include 10 GR Observers to calculate the Glare Rating of the luminaires surrounding the site. The GR Observers have been positioned along Fabian Way to the immediate south of the site to assess the potential impacts of glare on the road users. **Figure 4-3** below provides an illustration of the modelled GR observer points.

Figure 4-3 – Modelled Glare Receptors



5.0 LIGHTING ASSESSMENT

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

5.1 OBTRUSIVE LIGHT MODELLING

The lighting design is displayed in **Figure 5-1**. A lighting plan has been designed by Ashton Smith and included within a DIALux model of the proposed development in accordance with appropriate criteria. Reference should be made to **Figure 5-2** and **Figure 5-3** for a 3D representation of the proposed 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 lighting design includes the luminaire listed below:

- Sylvania Zephyr – Large Zephyr 5500Lm 4k CLI Grey 0050081 at 6m.

The model is only able to accurately represent the effects of solid structures such as buildings and walls on light obstruction. 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.

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 obstruction from the proposed development determined in lighting model. The assumed baseline illuminance levels are ILP Environmental Zone E3.

Where it was not practicable to measure existing illuminance at the receptor location, monitoring results from the nearest equivalent representative monitoring location 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 5-1 – External Lighting Layout

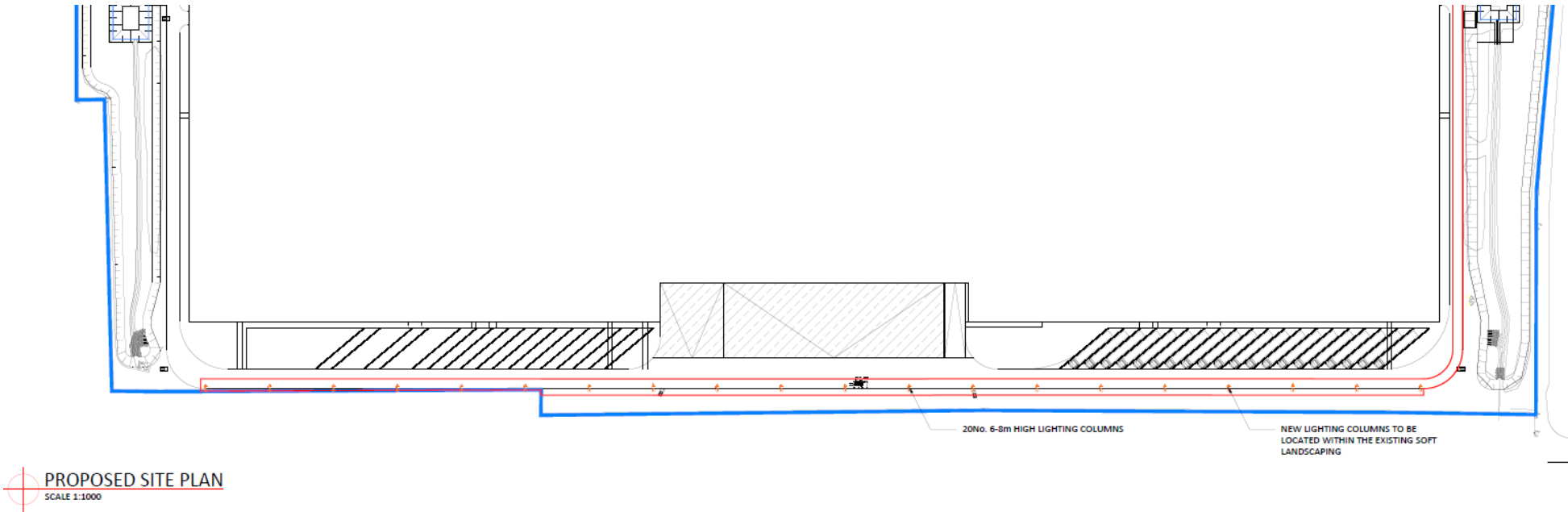
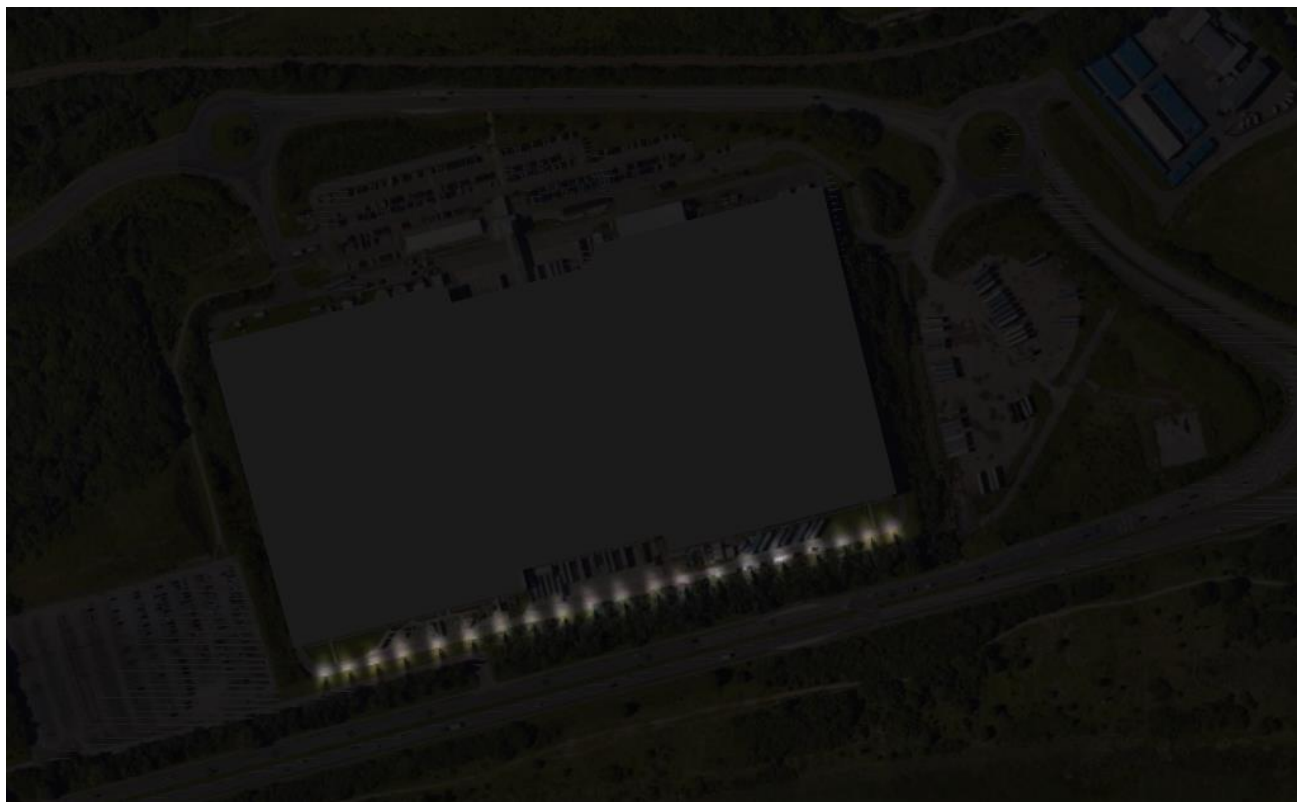
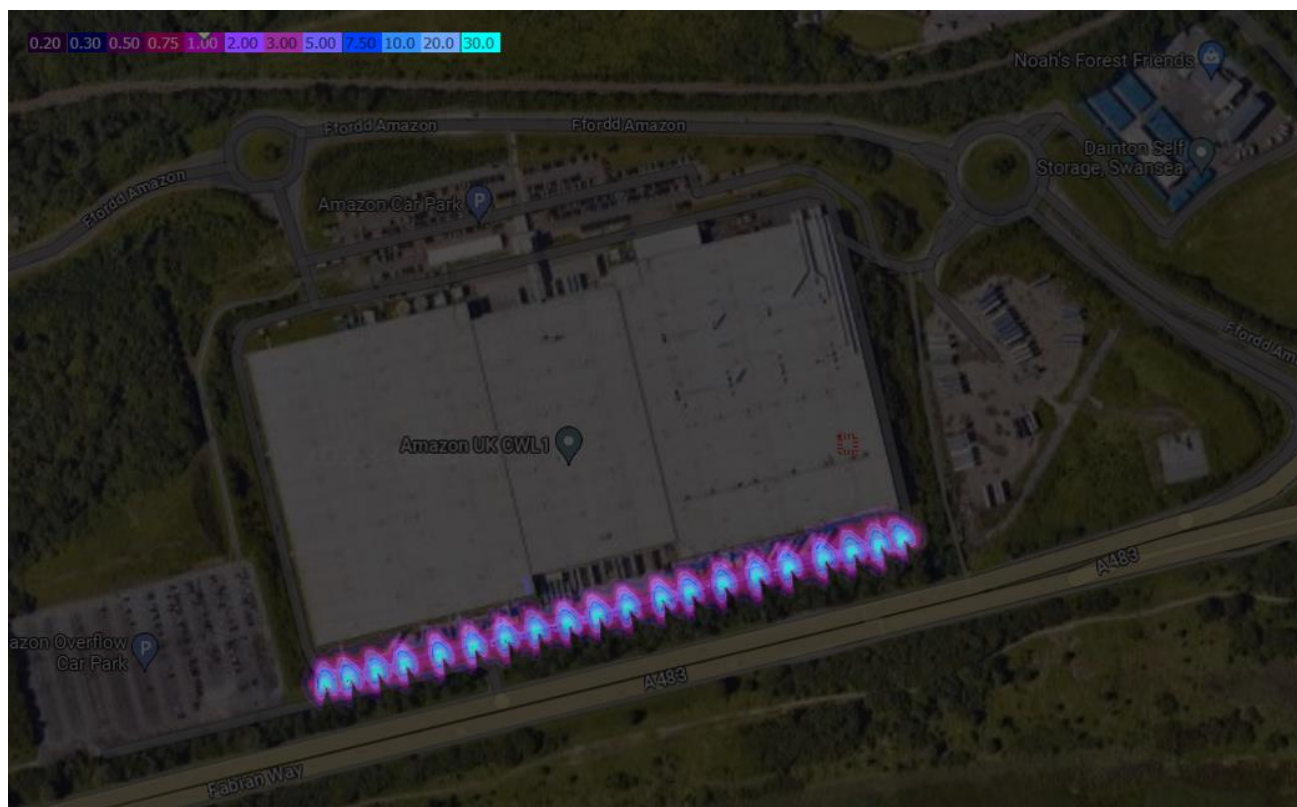


Figure 5-2 – Visual Representation of Proposed External Lighting Model**Figure 5-3 – Visual Representation of Lux Contours**

The model is only able to accurately represent the effects of solid structures such as buildings and walls on light obstruction. 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.

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**.

5.1.1 Model Results

5.1.1.1 Ecological Receptors

It is believed that most bat emergence requires 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 impacted and that dark corridors beyond the limits of the site are retained. 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. As such, the assessment criteria represent a worst-case scenario in terms of impacts on emergence, commuting and foraging (Bat Conservation Trust, 2018).

When determining the likely impacts of lighting associated with the proposed development on sensitive ecological receptors, the assessment has considered the effect of lighting without 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 5-1** shows the modelled lighting arrangements for the ecological receptors surrounding the site vicinity and within the site.

Table 5-1 – Ecological Receptor Assessment Results

ID	Predicted Model Illuminance
E1	<0.01
E2	0.02
E3	0.19
E4	0.40
E5	0.23
E6	0.45
E7	0.43
E8	0.35
E9	0.74
E10	0.34
E11	0.40
E12	0.36
E13	0.02
E14	0.01
E15	<0.01
E16	<0.01
E17	<0.01
E18	<0.01

As shown by the results in **Table 5-1**, light trespass associated with the proposed development does not exceed 1 lux at any of the 18 modelled ecological receptor locations adjacent to the site boundary and within the proposed site, with the maximum predicted model illuminance of 0.74 lux at E9. As such, lighting from the proposed development is not predicted to result in any significant adverse impacts with respect to local sensitive ecological receptors.

5.1.2 Glare Rating Assessment

The model has been used to calculate the predicted glare directly from the luminaires associated with the site using the CIE 112 Glare Rating method. **Table 5-2** below summarised the results of this assessment.

Table 5-2 – Glare Rating Receptor Assessment Results

ID	Predicted Model Glare Rating	Impact
G1	25	Noticeable
G2	29	Noticeable
G3	28	Noticeable
G4	32	Noticeable
G5	33	Noticeable
G6	32	Noticeable
G7	33	Noticeable
G8	35	Noticeable
G9	22	Noticeable
G10	<10	Unnoticeable

In accordance with CIE 112, at all locations assessed the predicted glare associated with proposed lighting will be either unnoticeable or noticeable but not to a level considered to result in disturbance. Therefore, no further assessment is required.

5.1.3 Dark Sky 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 E3 is 5% ULR. As such the indicative lighting scheme meets the ILP sky glow limitations and is therefore not considered to result in detrimental impacts on the dark sky landscape.

6.0 CONCLUSIONS

Tetra Tech were commissioned by Amazon to prepare a Lighting Assessment for the proposal of a new external lighting scheme at Ffordd Amazon, Skewen, Swansea, SA1 8QX

Detailed lighting plans have been designed by Ashton Smith and used to produce a model of the proposed development within DIALux software in accordance with the appropriate criteria.

Following the installation of an appropriate lighting scheme as detailed in this report, the risk of the proposed development resulting in exceedances of 1 lux along potential bat foraging/commuting routes and dark corridors is low at all ecological receptor locations.

The assessment demonstrates that there is a low risk of significant adverse impacts on local sensitive ecological receptors, and that the proposed external lighting scheme does not conflict with any national or local planning policies regarding lighting.

A Glare Rating assessment has been undertaken. At all locations assessed, the predicted glare associated with proposed lighting will be either unnoticeable or noticeable at a level not considered to result in disturbance.

The dark skies assessment illustrates that the Upward Light Ratio (ULR) for the proposed development is 0.0%. This is below the 5% ULR criteria for the Environmental Zone E3. As such the indicative lighting scheme is not considered to result in detrimental impacts on the dark sky landscape.

APPENDIX A – REPORT CONDITIONS

This Report has been prepared using reasonable skill and care for the sole benefit of Amazon (“the Client”) for the proposed uses stated in the report by Tetra Tech Limited (“Tetra Tech”). Tetra Tech exclude all liability for any other uses and to any other party. The report must not be relied on or reproduced in whole or in part by any other party without the copyright holder’s permission.

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The whole of the report must be read as other sections of the report may contain information which puts into context the findings in any executive summary.

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