Steamer Point in Christchurch, Dorset, BH23 4JQ

Lighting Assessment – Proposed Planning Appeal Revised Layout

22nd June 2021

PRESENTED TO

Pennyfarthing Homes

PRESENTED BY

Tetra Tech
Executive Park,
Avalon Way, Anstey,
Leicester,
LE7 7GR

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EXECUTIVE SUMMARY

Pennyfarthing Homes has commissioned Tetra Tech Limited to prepare a Lighting Assessment to quantify potential impacts associated with the planning application for a proposed residential development at Steamer Point in Christchurch, Dorset, BH23 4JQ.

This assessment follows previous reports which concluded that the risk of the proposed residential development resulting in ecological disturbances will be high without mitigation. With the implementation of mitigation measures described in Section 6, the risk of the proposed development resulting in significant exceedances of 0.4 lux along the wildlife and landscape corridor to the east and south of the site is considered to be low.

With inclusion of the mitigation measures in the Lighting Management Plan the assessment demonstrates that the proposed development does not conflict with any national or local planning policies.

This assessment has been using new methodology (ILP Guidance Note 1 – for the reduction of obtrusive light 2021) and the new layout compared to previously assessed (December 2020).

The updated layout submitted under the Wheatcroft Planning principles does not alter the findings of the original lighting assessment dated December 2020.

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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 Limited (formerly WYG) has been commissioned by Pennyfarthing Homes to prepare a Lighting Assessment to quantify potential impacts associated with the planning application for a proposed residential development at Steamer Point in Christchurch, Dorset, BH23 4JQ.

This assessment has been updated to review the updated layout submitted under the Wheatcroft principle.

1.1 SITE LOCATION AND CONTEXT

The development is for 9 houses and 17 apartments at Steamer Point. The approximate grid reference of the site is 419591:092842. The site is in a suburban location to the east of Christchurch. Pennyfarthing Homes is seeking planning permission for the development of a proposed development at Steamer Point in Christchurch, Dorset, BH23 4JQ.

The site of the proposed development is bounded by:

- Forest area of Steamer Point Nature Reserve and residential properties along Freshwater Road to the north;
- Forest area of Steamer Point Nature Reserve, with the town of Highcliffe in the borough of Christchurch beyond to the east;
- Friars Cliff Beach and the English Channel to the south; and,
- Residential properties to the west along Seaway Avenue and Medina Way.

Reference should be made to Figure 1 for a visual representation of the application 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:

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

Figure 1 - *Site Boundary and Layout*

2.0 POLICY, LEGISLATION AND RELEVANT AGENCIES

2.1 DOCUMENTS CONSULTED

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

- ILP Guidance Note 1 – for the reduction of obtrusive light 2021,
- National Planning Policy Framework, Ministry of Housing, Communities & Local Government, February 2019;
- 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;
- Artificial Lighting and Wildlife Interim Guidance: Recommendations to Help Minimise the Impact of Artificial Lighting, Bat Conservation Trust, 2014;
- 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, 2003;
- 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; and,
- New Forest Local Plan: 2016-2036, Adopted July 2020.
- Bats and artificial lighting in the UK, Institution of lighting professionals, Bat Conservation Trust, 2018.
- Christchurch and East Dorset Local Plan, Part 1 – Core Strategy, Adopted April 2014.

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 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:

- 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; and,
- BS EN 13201-2: Road Lighting - Performance Requirements, 2003.

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:

- All external lighting schemes must not have an upward lighting ratio (ULR) of more than 2.5%;
- All new column mounted luminaires shall be fitted with flat glass where appropriate to aid 2.5% 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

The National Planning Policy Framework (NPPF), February 2019 principally brings together and summarises the suite of Planning Policy Statements (PPS) and Planning Policy Guidance (PPG) which previously guided planning policymaking. The NPPF broadly retains the principles of PPS 23: Planning and Pollution Control and with regard to light pollution, paragraph 180 states that:

> “*180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account 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:

[…] c. limits the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation."

The National Planning Practice Guidance web-based resource was launched by the Department for Communities and Local Government (DCLG) on 6 March 2014 and updated for lighting on the 1st November 2019 to support the National Planning Policy Framework and make it more accessible. It states that "for maximum benefit, the best use of artificial light is about getting the right light, in the right place and providing light at the right time". In light of this guidance, the assessment has considered the following implications of the proposed lighting design:

"Does an existing lighting installation make the proposed location for a development unsuitable? For example, this might be because:

- *the artificial light has a significant effect on the locality;*
- *users of the proposed development (e.g. a hospital) may be particularly sensitive to light intrusion from the existing light source.*
- *Will a new development, or a proposed change to an existing site, be likely to materially alter light levels in the environment around the site and/or have the potential to adversely affect the use or enjoyment of nearby buildings or open spaces?*
- *Will the impact of new lighting conflict with the needs of specialist facilities requiring low levels of surrounding light (such as observatories, airports and general aviation facilities)? Impacts on other activities that rely on low levels of light such as astronomy may also be a consideration but will need to be considered in terms of both their severity and alongside the wider benefits of the development.*
- *Is the development in or near a protected area of dark sky or an intrinsically dark landscape where new lighting would be conspicuously out of keeping with local nocturnal light levels, making it desirable to minimise or avoid new lighting?*
- *Would new lighting have any safety impacts, for example in creating a hazard for road users?*
- *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.*
- *Does the proposed development include smooth, reflective building materials, including large horizontal expanses of glass, particularly near water bodies? (As it may change natural light, creating polarised light pollution that can affect wildlife behaviour.)*

If the answer to any of the above questions is 'yes', consideration should be made for:

- *where the light shines;*

- *when the light shines;*
- *how much light shines; and,*
- *possible ecological impact."*

2.4.2 Local Policy

Following a review of the Christchurch and East Devon Local Plan, the following policy was identified as being relevant to potential light impacts associated with the proposed scheme:

"Policy ME1"

Safeguarding Biodiversity and Geodiversity

The following criteria should be addressed when development is proposed:

- *Avoidance of harm to existing priority habitats and species through careful site selection, artificial lighting design, development design and phasing of construction and the use of good practice construction techniques.*

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 used in this assessment shows internal lighting from the proposed residential development and the effect that this may have on the surrounding environment. The internal lighting is indicative of light spill from an open window. The design of the lighting has been undertaken in a manner to address the light obtrusion limitations stated within the relevant standards and guidance in order to avoid any detrimental effect to local amenity and wildlife.

3.2 QUANTITATIVE LIGHTING ASSESSMENT

3.2.1 Obtrusive Light

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 locally sensitive ecological 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 interior lighting installations have also been determined. These are summarised in Table 3.2-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

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

Light technical parameter	Application conditions		Luminaire group (projected area Ap 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 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

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 potential environmental effects of the proposed development are identified, in so 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:

- The development is predicted to exceed 0.4 lux along potential bat foraging/commuting routes.

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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 survey was undertaken at the proposed development site on Monday 15th June 2020. Due to the time of year the survey was undertaken after 23:00 to establish the existing post curfew lighting conditions. The conditions were overcast and dry throughout the survey. The survey was conducted using a Digital Lux Meter which meets CIE photopic spectral response, with a maximum resolution of 0.01 lux.

4.1.2 Existing Light Sources

Existing light sources surrounding the site are street lighting and property lighting associated with Penny Way, Freshwater Road and Seaway Avenue.

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 2 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 2 - *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 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 northeast, 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	South of the site	Street/Residential Lighting
L2	South of the site	Street/Residential Lighting
L3	South of the site	Street/Residential Lighting
L4	South of the site	Street/Residential Lighting
L5	South of the site	Street/Residential Lighting
L6	South of the site	Street/Residential Lighting
L7	South of the site	Street/Residential Lighting
L8	South of the site	Street/Residential Lighting
L9	East of the site	Street/Residential Lighting
L10	East of the site	Street/Residential Lighting
L11	East of the site	Street/Residential Lighting
L12	East of the site	Street/Residential Lighting
L13	East of the site	Street/Residential Lighting
L14	North of the site	Street/Residential Lighting
L15	North of the site	Street/Residential Lighting
L16	North of the site	Street/Residential Lighting
L17	North of the site	Street/Residential Lighting
L18	North of the site	Street/Residential Lighting
L19	North of the site	Street/Residential Lighting
L20	East of the site	Negligible Lighting
L21	East of the site	Negligible Lighting
L22	East of the site	Negligible Lighting
L23	East of the site	Negligible Lighting
L24	East of the site	Negligible Lighting

4.1.4 Survey Results

The results of the monitoring are displayed in Table 4.2.

Table 4.2 - *Survey Results*

Reference	Recorded Illuminance (Lux)				
	Facing Up	Facing North	Facing East	Facing South	Facing West
L1	0.02	0.00	0.00	0.00	0.00
L2	0.04	0.00	0.00	0.00	0.00
L3	0.01	0.01	0.00	0.00	0.00
L4	0.01	0.01	0.00	0.00	0.00
L5	0.01	0.00	0.00	0.00	0.01
L6	0.01	0.00	0.00	0.00	0.01
L7	0.03	0.00	0.00	0.00	0.01
L8	0.03	0.01	0.00	0.00	0.01
L9	0.01	0.00	0.01	0.00	0.00
L10	0.00	0.00	0.00	0.00	0.02
L11	0.01	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	0.01	0.00	0.00	0.00	0.01
L16	0.01	0.00	0.00	0.00	0.00
L17	0.50	0.87	1.78	0.07	0.24
L18	0.02	0.02	0.00	0.00	0.02
L19	0.01	0.02	0.00	0.00	0.03
L20	0.01	0.01	0.00	0.00	0.01
L21	0.00	0.00	0.00	0.00	0.00
L22	0.00	0.00	0.00	0.00	0.00
L23	0.00	0.00	0.00	0.00	0.00
L24	0.00	0.00	0.00	0.00	0.00

Following the environmental lighting survey, it was concluded that the proposed development site and the surrounding area should be classified as 'Environmental Zone E2 – Low District Brightness', in accordance with the ILP guidance limits outlined within Table 3.2 for Sky Quality. This is considered representative of relatively dark outer 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 5 lux and in the post curfew period (typically considered to be 23:00-07:00) is 1 lux.

4.1.5 Future Baseline

Should the development not go ahead it is important to note that there is potential for lighting onsite to vary from the results presented in Table 4.2. During the survey the existing lighting, both internal and external, was not operational. There is potential for these lights to be re-installed alongside external security lighting. If this was to happen, due to the proximity of existing windows and glazing to the boundaries of the site (particularly the southern boundary), lighting levels along the boundaries of the site will be expected to be significantly higher than those presented in Table 4. The area of the glazing on the southern elevation of the two-storey office block is 59.5 sqm (29.75 sqm per floor), with no windows on the eastern elevation. The south facing windows on the single storey office to the west of the 2-storey office building is 23.19 sqm.

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

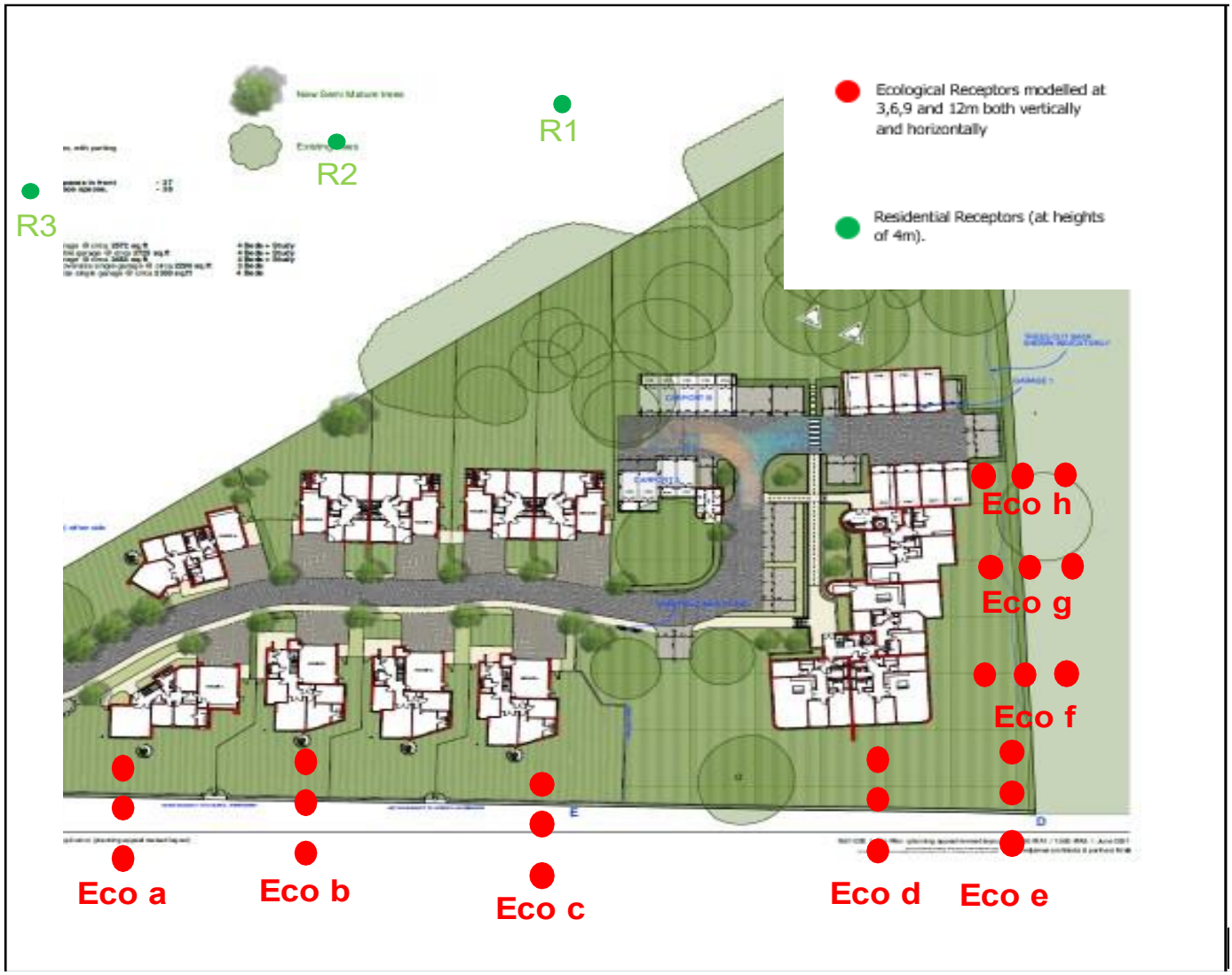
During the site survey, key residential properties were identified which have the potential to be affected by obtrusive light from the proposed development, as shown in Table 4.3. Reference should be made to Figure 3 for an illustration of the residential receptors used for the purposes of this assessment. All the identified residential receptors are considered to be within ILP Environmental Zone E2. 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 considered to be the most sensitive receptor room

Table 4.3 - *Residential Receptors*

ID	Description	ILP Environmental Zone
R1	30 Freshwater Road	E2
R2	24 Freshwater Road	E2
R3	14 Freshwater Road	E2

Figure 3 - *Modelled Ecological and Residential Receptors*



All the identified residential receptors are considered to be within ILP Environmental Zone E2. 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 in order to represent illuminance at first floor window level, representing a typical bedroom, which is considered to be the most sensitive receptor room.

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 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 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 53 points around the proposed development site, with particular note to the Steamer Point Nature Reserve tree lines to the east and south of the development site. These receptors were modelled vertically and horizontally at heights of 3m, 6m, 9m and 12m to get an understanding of light distributions at different heights. Table 4.4 below provides a reference for these locations whilst a full spatial illustration of modelled ecological receptors is included in Figure 3. The Modelled receptors have included the 15m dark corridor buffer zone, hedgerows, treelines, areas of high roosting potential for bats and foraging areas for bats.

Table 4.4 - *Ecological Receptors*

ID	Description
Eco A	South of development site
Eco B	South of development site
Eco C	South of development site
Eco D	South of development site
Eco E	South of development site
Eco F	East of development site
Eco G	East of development site
Eco H	East of development site

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

An indicative lighting plan has been designed by Tetra Tech Ltd. and implemented within a DIALux model of the proposed development to within the appropriate criteria. Reference should be made to Figure 7 – Figure 9 for 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 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.

A lighting design using low level dark sky bollards has been produced and is indicatively presented in Figure 5 of Appendix A.

It is important to note that this assessment is considered to be a worst-case scenario, having no curtains being drawn throughout and with every room illuminated at the same time.

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 Table 3.2 – Table 3.4

Table 5.1 - *Residential Receptor Assessment Results*

ID	ILP Pre-curfew Criteria (Lx)	ILP Post-curfew Criteria (Lx)	Predicted Model Illuminance (lx)
R1	5.00	1.00	0.10
R2	5.00	1.00	0.10
R3	5.00	1.00	0.03

The ILP pre-curfew and post-curfew criteria do not exceed Zone E2 at any residential receptor locations. The proposed development is not predicted to result in any significant 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 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. As such, the assessment criteria represent a worst-case scenario in terms of impacts on emergence, commuting and foraging (Bat Conservation Trust, 2011).

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. The following sections present the modelled proposed light trespass values along sections of potential bat commuting/foraging routes on page 22 of the ILP guidance document 'Bats and artificial lighting in the UK' states:

"*It is therefore very difficult to demonstrate 'complete darkness' or a 'complete absence of illumination' on vertical planes where some form of lighting is proposed on site despite efforts to reduce them as far as possible and where horizontal plane illuminance levels are zero. Consequently, 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 adverse behaviour (Stone, 2012). If this is the case, further consideration should be given to mitigation measures."*

As a worst case, any exceedance of 0.4 lux will be considered significant and require additional mitigation.

As such, the assessment criteria represents a worst-case scenario in terms of impacts on emergence, commuting and foraging (Bat Conservation Trust, 2011).

Receptors were placed in the lighting model 1m from the windows to obtain a range of lux values were analysed that will have differing implications on the amount of light spill onto the Steamer Point Nature Reserve tree line. The lux values analysed 1m from the proposed windows were 10lux, 5lux, 2lux and 1lux based on surrogate data from similar sites. For context details of lighting results from other Tetra Tech surveys of light levels from windows can be found in Appendix C in tables B4 and B5.

- 10 lux is the illuminance from a typical medium sized living room window with no curtains (near window).
- 5 lux is the illuminance from a typical medium sized living room window with no curtains (lighting away from window).
- 2 lux is the illuminance from a typical medium sized living room window with curtains or venetian blinds closed.
- 1 lux is the illuminance from a typical medium sized living room window with smart glass.

Following this analysis (results of the 10, 5 and 2 lux can be found in Appendix C in Table B1, Table B2 and Table B3) only the 1 lux from windows scenario resulted in illuminance levels along the eastern and southern boundary at or around 0.4 lux. The luminaires were added to the model facing downwards from the upper part of each window.

Therefore, in order to achieve 1 lux at 1m from the window, mitigation by way of inbuilt smart glass will be included within the design of the southern and eastern facing windows, as shown in Figures 7-8 of Appendix B. Further details of this mitigation are given in the Lighting Management Plan. All other windows on site have been assessed and have an output of 10 lux at 1m, other than the windows highlighted in Figures 7 and 8 in Appendix B having an output of 1 lux at 1m.

Lux Level 1m from Window: 1 lux

The tables below shows the illuminance levels at each of the ecological receptors at the various different heights.

Table 5.2 - *Ecological Receptor Assessment Results (Based on 1 Lux from Southern and Eastern Windows fitted with smart glass) Vertical Illuminance*

	Modelled Horizontal Illuminance [Height 3m](Lux)			Modelled Horizontal Illuminance [Height 6m] (Lux)			Modelled Horizontal Illuminance [Height 9m] (Lux)			Modelled Horizontal Illuminance [Height 12m] (Lux)		
ID	1m from window or Boundary Edge (Lux)	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary
Eco a	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eco b	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eco c	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eco d	0.03	0.03	0.02	0.03	0.02	0.01	0.03	0.01	0.00	0.00	0.00	0.00
Eco e	0.06	0.03	0.02	0.05	0.02	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Eco f	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eco g	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00
Eco h	0.02	0.02	0.01	0.03	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00
% over 0.2 lux	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 5.3 - *Ecological Receptor Assessment Results (based on 1 Lux from Southern and Eastern Windows fitted with smart glass) Horizontal Illuminance*

ID	1m from window or Boundary Edge (Lux)	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary
Eco a	0.13	0.17	0.34	0.38	0.17	0.11	0.39	0.35	0.24	0.25	0.27	0.23
Eco b	0.34	0.27	0.22	0.25	0.29	0.23	0.22	0.26	0.21	0.24	0.24	0.21
Eco c	0.30	0.15	0.13	0.15	0.19	0.15	0.13	0.17	0.14	0.17	0.18	0.15
Eco d	0.34	0.24	0.20	0.31	0.3	0.21	0.39	0.27	0.2	0.33	0.23	0.19
Eco e	0.34	0.19	0.17	0.27	0.21	0.17	0.23	0.18	0.15	0.14	0.15	0.14
Eco f	0.17	0.1	0.08	0.14	0.1	0.07	0.11	0.08	0.06	0.07	0.06	0.06
Eco g	0.25	0.2	0.13	0.25	0.17	0.12	0.18	0.14	0.1	0.11	0.1	0.09
Eco h	0.26	0.17	0.09	0.32	0.17	0.09	0.22	0.12	0.08	0.1	0.08	0.06
% over 0.4 lux	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

As illustrated by Table 5-2 and 5-3 , worst-case light trespass associated with the proposed development when the lux levels are 1 lux at 1m from the windows fitted with smart glass does not result in significant exceedance of 0.4 lux at the modelled locations adjacent to the site boundary and along the dark corridor.

The results in Table 8 show the horizontal illuminance levels across the site are expected to be below the 0.2 lux criteria. This is due to the presence of smart glass and also the placement of the proposed internal luminaries of which would be set within the ceiling of the rooms above the top of the window. These results are shown in a false contour plot and a lux contour plot in Figure 6 Appendix B and in Appendix C (the lux contour plots show horizontal levels at 3m and 1m).

The results in Table 7 show that no receptors will exceed the 0.4 criteria.

However, BCP Council in comments dated 31/07/2020 on the previous report state that:

"We accept that bats commuting east-west along the coast do have the option to keep further back or fly slightly below the cliff top, which could give more flexibility along the southern boundary and address the issue of light exceeding 0.4 lux at ECO 11, although forcing bats to change their routes, could lead to greater expense of energy which is not ideal. The main concern relates more to bat use along the woodland edge in the dark corridor to the east of the development."

The results in Tables 5-2 and 5-3 show that lighting levels along the eastern dark corridor adjacent to the Steamer Point Nature Reserve will be below the vertical and horizontal lux criteria.

The results in Tables 5-2 and 5-3 show that at the boundary of the site and beyond towards the beach, lux levels from the proposed development are significantly below 0.1 lux, which reduces the potential impact of lighting from the site on the commuting and foraging routes south of the development.

It is important to note that the above assessment is based upon worst case assumptions of all windows unobstructed by curtains or blinds with lights on in every room. In reality this is not likely to be the case. Therefore, the effect of lighting on bats along the eastern and southern dark corridors at the boundary of the site is not considered to be significant, whilst also being both temporary in nature and short term.

It should also be noted that there are no building regulations requiring the external spiral staircases to be illuminated therefore they have not been illuminated within the lighting model. With regards to light from the balcony areas and people opening doors for access to these areas, any light spill onto the dark corridor is considered temporary as the likelihood of people leaving doors open with internal lights on during the summer is low, due to heat loss, privacy and unwanted insects entering the house. However, information will be provided to owners on keeping light spill to a minimum as well as blinds/curtains being used on these accesses to the balcony areas.

6.0 MITIGATION

In order to achieve required illuminance levels below 0.4 lux at ecological receptor locations, the following mitigation measures have been included within the design, as illustrated in Figure 5 of Appendix A:

- Screening around the car park perimeter to the north of the site will help to limit the light spillage onto the tree line from the car park area. Fencing has been used in the modelling to the north-east section of the car park area to limit the effects of car headlights on the adjacent tree line.

- Windows facing the bat corridor to the south and east of the site will have smart glass installed in accordance with recommendations within ILP Bat Guidance. The smart glass results in a reduction in lux levels being emitted through the glass and can also be set to operate remotely or by timer. The locations where smart glass will be required include the southern and eastern facades of the apartment block and the southern facades of houses 2 – 4, as shown in Figures 7-8 in Appendix B. Bathroom windows on these facades will be treated with a permanent obscure glass that meets the 1 lux at 1m requirement.

- The certain windows on the southern façade of the apartment block do not require smart glass due to the shielding provided by the above overhanging balconies and windows being set back from the edge of the building as well as the higher flight path of the bat species on site. For houses 2-4, the windows overlooking the balconies on the first floor do not require smart glass fitted as they are set back and the buildings themselves provide further shelter for the bat species on site.

- Roads within the development will be illuminated using Dark Sky Low Level Bollards which are directional and have a zero upward light ratio, allowing light to be focused on the road without spillage towards sensitive receptor locations.

- Glazing on south facing elevations will have a minor tint added to help reduce the effects of overheating. This tint will also help further mitigate lux levels from the window.

The mitigation measures described above will assist in keeping the illuminance at the sensitive ecological receptor locations as a result of the development below the required level of 0.4 lux.

7.0 ENFORCEMENT AND CONTROLS

To provide additional controls and as a safeguard against future changes to lighting levels by occupiers, it is proposed to offer a Lighting Management Plan. A draft is shown in appendix C.

This is intended to be a working and updatable document to address any concerns as they are raised. The primary elements include :

- Initial compliance survey and Annual March repeat survey
- External Lighting Design
- Internal Lighting Design
- Covenant with Future Residents and Apartments Management Company.
- Maintenance and operation of the Smart Glass (dusk till dawn 01 March to 30 Nov) .
- Ongoing Management

It is proposed that the Lighting Management Plan be enforced by condition and subject to annual review.

Suggested wording as below :

L1 Following the construction of each individual plot, a lighting survey will be undertaken and submitted in writing for approval to the Local Planning Authority to determine that the illuminance levels within the 10m dark corridor on the eastern and southern boundaries of the site are below 0.2 lux on the horizontal plane and below 0.4 lux on the vertical plane.

L2 Prior to first occupation, a Lighting Management Plan will be submitted to the Local Planning Authority for approval. The Lighting Management Plan will be submitted to the LPA for review and approval, on a minimum of an annual basis, following the annual light monitoring.

It should be notes that the currently proposed lighting management plan includes for a variety of additional controls such as ‘any external lighting on the apartment block will have zero upward light ratio, low luminous intensity (<1000 candelas) and face away from the southern and eastern dark corridors’.

This monitoring will consist of observations and vertical lux readings being taken from the adjacent footpath to the south of the development as shown on Figure 1D below to ensure that the smart glass is still in operation and that the external lighting covenant is being followed.

8.0 CONCLUSIONS

Pennyfarthing Homes has commissioned Tetra Tech Limited to prepare a Lighting Assessment to quantify potential impacts associated with the planning application for a proposed residential development at Steamer Point in Christchurch, Dorset, BH23 4JQ.

This assessment follows previous reports which concluded that the risk of the proposed residential development resulting in ecological disturbances will be high without mitigation. With the implementation of mitigation measures described in Section 6, the risk of the proposed development resulting in significant exceedances of 0.4 lux along the wildlife and landscape corridor to the east and south of the site is considered to be low.

With inclusion of the mitigation measures in the Lighting Management Plan the assessment demonstrates that the proposed development does not conflict with any national or local planning policies.

This assessment has been using new methodology (ILP Guidance Note 1 – for the reduction of obtrusive light 2021) and the new layout compared to previously assessed (December 2020).

The updated layout submitted under the Wheatcroft Planning principles does not alter the findings of the original lighting assessment dated December 2020.

The mitigation Plan remains unchanged from that previously published. The mitigation plan should be used for the purposes of the Section 106 agreement.

APPENDIX A – ADDITIONAL FIGURES

Figure 1 - *Site location*

Existing Site

Proposed Site

Figure 2- *Light monitoring locations*

Figure 3 - *Modelled Residential and Ecological Receptor Locations*

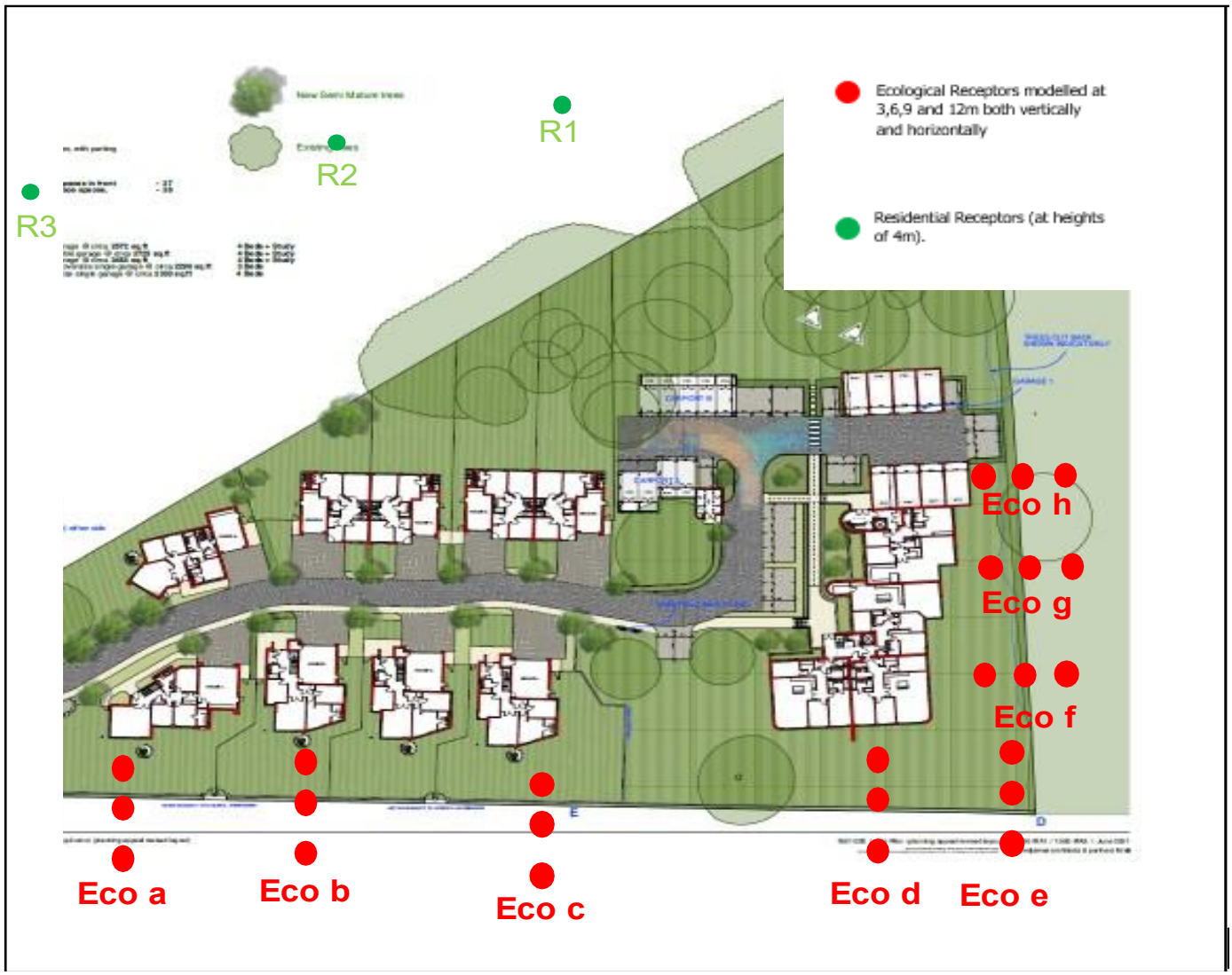


Figure 4 – *Mitigation Measures*

Figure 5 – Lux Contour Plot

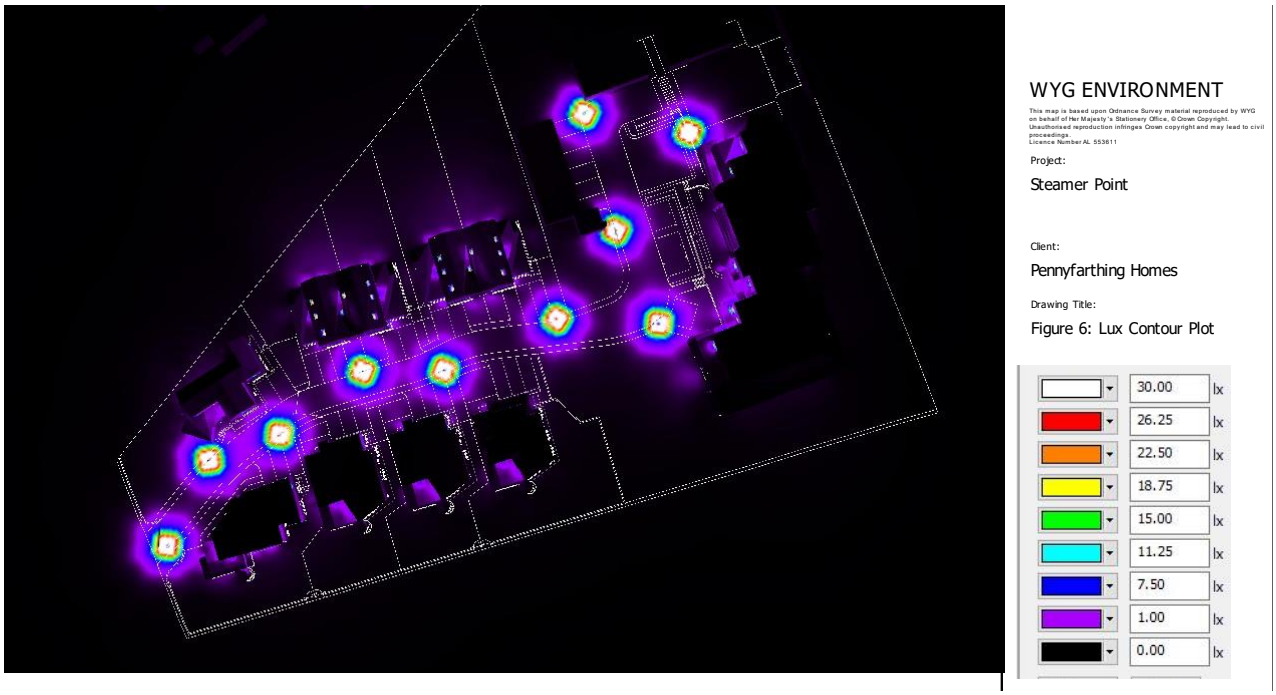
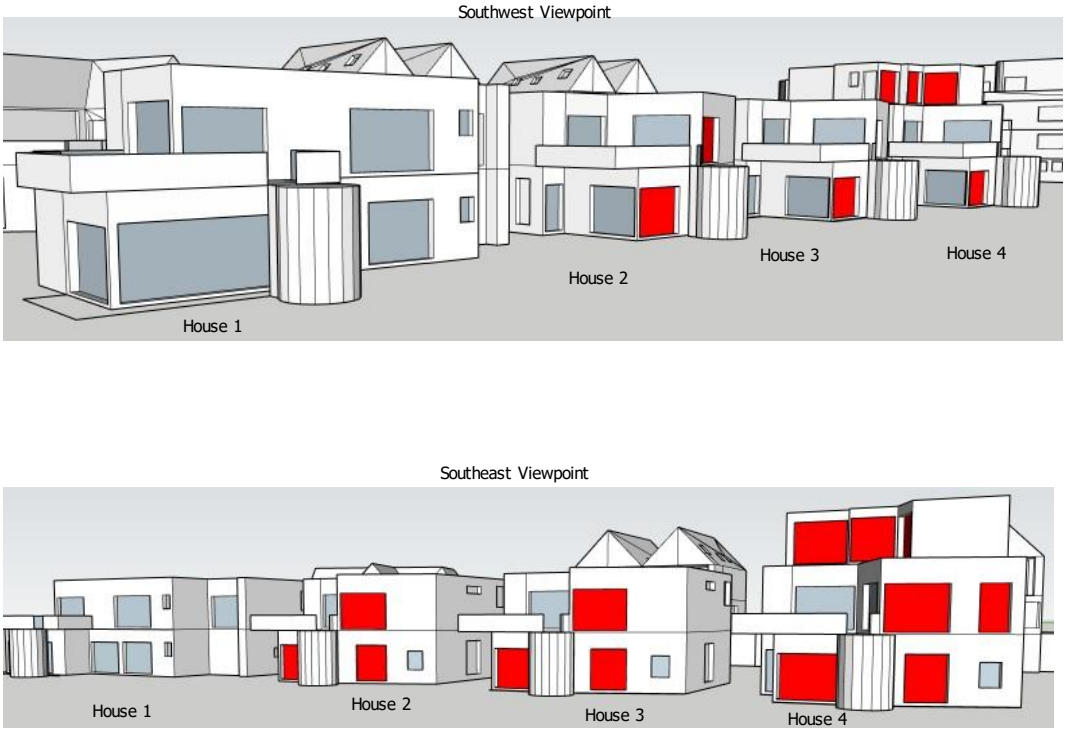


Figure 6 - *Apartment Block, Eastern and Southern Façade, Smart Glass Installation Windows*

Figure 7 - *Houses 1 – 4, Southern Façade, Smart Glass Installation Windows*



APPENDIX B – ASSESSMENT RESULTS

Lux Level 1m from Window: 10

Table B1 below shows the illuminance levels at each of the ecological receptors at the various different heights.

Table B1 Ecological Receptor Assessment Results: 10 Lux from Windows

	Modelled Vertical Illuminance [Height 3m](Lux)			Modelled Vertical Illuminance [Height 6m] (Lux)			Modelled Vertical Illuminance [Height 9m] (Lux)			Modelled Vertical Illuminance [Height 12m] (Lux)		
ID	1m from window or Boundary Edge (Lux)	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary
Eco a	2.00	0.66	0.28	0.67	0.49	0.27	0.39	0.35	0.24	0.25	0.27	0.23
Eco b	1.59	0.66	0.45	0.89	0.60	0.42	0.38	0.44	0.36	0.28	0.35	0.32
Eco c	4.20	0.95	0.54	1.87	0.90	0.50	0.50	0.56	0.42	0.34	0.40	0.35
Eco d	1.98	1.13	0.75	2.22	1.23	0.75	1.66	1.01	0.66	0.90	0.78	0.58
Eco e	1.40	0.85	0.67	1.68	0.96	0.68	1.45	0.87	0.64	0.83	0.71	0.57
Eco f	1.76	1.08	0.75	1.45	0.97	0.69	1.04	0.79	0.61	0.64	0.60	0.52
Eco g	2.51	1.97	1.24	2.50	1.71	1.13	1.84	1.39	1.00	1.07	1.01	0.81
Eco h	2.75	1.81	1.01	4.03	1.89	0.91	3.05	1.45	0.81	1.47	0.96	0.64
% over 0.4 lux	100.00	100.00	87.50	100.00	100.00	87.50	75.00	87.50	75.00	62.50	75.00	62.50

As illustrated by Table B1, worst-case light trespass associated with the proposed development when the lux levels are 10 lux at 1m from the window does exceed 0.4 lux at the majority of modelled locations adjacent to the site boundary. At heights of 3m and 6m, ecological receptors exceed the 0.4 lux criteria at 95.83% of the locations. At heights of 9m, ecological receptors exceed the 0.4 lux criteria at 79.16% of the locations. At heights of 12m, ecological receptors exceed the 0.4 lux criteria at 66.66% of the locations. Over all the heights, 84.37% of the ecological receptors in this scenario exceeded the 0.4 lux criteria.

Lux Level 1m from Window: 5

Table B2 below shows the illuminance levels at each of the ecological receptors at the various different heights.

Table B2 Ecological Receptor Assessment Results 5 Lux from Windows

	Modelled Vertical Illuminance [Height 3m](Lux)			Modelled Vertical Illuminance [Height 6m] (Lux)			Modelled Vertical Illuminance [Height 9m] (Lux)			Modelled Vertical Illuminance [Height 12m] (Lux)		
ID	1m from window or Boundary Edge (Lux)	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary
Eco a	1.04	0.36	0.16	0.36	0.27	0.16	0.25	0.21	0.14	0.17	0.17	0.14
Eco b	0.82	0.34	0.23	0.46	0.31	0.22	0.20	0.23	0.19	0.15	0.18	0.17
Eco c	2.17	0.49	0.28	0.97	0.47	0.27	0.26	0.30	0.22	0.18	0.21	0.19
Eco d	1.02	0.58	0.39	1.13	0.64	0.39	0.84	0.53	0.34	0.47	0.40	0.30
Eco e	0.75	0.44	0.35	0.87	0.50	0.35	0.75	0.45	0.33	0.43	0.37	0.29
Eco f	0.91	0.56	0.39	0.75	0.50	0.36	0.54	0.41	0.31	0.33	0.31	0.27
Eco g	1.29	1.02	0.64	1.29	0.88	0.58	0.95	0.72	0.52	0.55	0.52	0.42
Eco h	1.42	0.94	0.52	2.08	0.98	0.47	1.58	0.75	0.42	0.72	0.50	0.33
% over 0.4 lux	100.00	75.00	25.00	87.50	75.00	25.00	62.50	62.50	25.00	50.00	37.50	12.50

As illustrated by Table B2, worst-case light trespass associated with the proposed development when the lux levels are 5 lux at 1m from the window does exceed 0.4 lux at the majority of modelled locations adjacent to the site boundary. At heights of 3m, ecological receptors exceed the 0.4 lux criteria at 66.66% the locations. At heights of 6m, ecological receptors exceed the 0.4 lux criteria at 62.5% of the locations. At heights of 9m, ecological receptors exceed the 0.4 lux criteria at 46.66% of the locations. At heights of 12m, ecological receptors exceed the 0.4 lux criteria at 33.33% of the locations. Over all the heights, 52.29% of the ecological receptors in this scenario exceeded the 0.4 lux criteria.

Lux Level 1m from Window: 2

Table B3 below shows the illuminance levels at each of the ecological receptors at the various different heights.

Table B3 Ecological Receptor Assessment Results 2 Lux from Windows

	Modelled Vertical Illuminance [Height 3m](Lux)			Modelled Vertical Illuminance [Height 6m] (Lux)			Modelled Vertical Illuminance [Height 9m] (Lux)			Modelled Vertical Illuminance [Height 12m] (Lux)		
ID	1m from window or Boundary Edge (Lux)	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary	1m from window or Boundary Edge	5m into the boundary	Boundary
Eco a	0.42	0.20	0.09	0.19	0.16	0.10	0.17	0.13	0.09	0.13	0.12	0.09
Eco b	0.41	0.17	0.12	0.23	0.15	0.11	0.10	0.11	0.09	0.08	0.09	0.08
Eco c	1.08	0.25	0.15	0.48	0.24	0.14	0.13	0.15	0.12	0.10	0.12	0.10
Eco d	0.51	0.29	0.20	0.57	0.32	0.20	0.42	0.26	0.18	0.24	0.20	0.15
Eco e	0.37	0.22	0.17	0.44	0.25	0.18	0.37	0.22	0.16	0.21	0.18	0.15
Eco f	0.45	0.28	0.19	0.37	0.25	0.18	0.27	0.20	0.16	0.17	0.16	0.13
Eco g	0.64	0.51	0.32	0.64	0.44	0.29	0.47	0.36	0.26	0.27	0.26	0.21
Eco h	0.71	0.47	0.26	1.04	0.49	0.24	0.79	0.37	0.21	0.36	0.25	0.17
% over 0.4 lux	87.50	25.00	0.00	62.50	25.00	0.00	25.00	0.00	0.00	0.00	0.00	0.00

As illustrated by Table B3, worst-case light trespass associated with the proposed development when the lux levels are 2 lux at 1m from the window does exceed 0.4 lux at the majority of modelled locations adjacent to the site boundary. At heights of 3m, ecological receptors exceed the 0.4 lux criteria at 37.5% of the locations. At heights of 6m, ecological receptors exceed the 0.4 lux criteria at 29.16% of the locations. At heights of 9m, ecological receptors exceed the 0.4 lux criteria at 8.33% of the locations. At heights of 12m, ecological receptors exceed the 0.4 lux criteria at 0.00% of the locations. Over all the heights 18.75% of the ecological receptors in this scenario exceeded the 0.4 lux criteria.

Surrogate Window Monitoring

In order to accurately model light from the flat windows, a number of indicative lighting surveys have been undertaken by WYG to determine light levels from existing houses with similar windows to the proposed development.

Light monitoring was undertaken at a number of survey locations to determine variations in indicative trespass levels. Readings were taken at a distance of 1m, 3m and 10m from outside the property to provide an accurate view of the distribution of light from windows. All surveys were undertaken with all available light sources within a room turned on so as to achieve worst case light levels.

Light measurements were taken at a height of approximately 1.5m with the meter lens held in the vertical plane in general accordance with the recommended monitoring method in the statutory guidance issued by Defra. Illuminance levels at a resolution of 0.01 lux can vary quite significantly over relatively small distances and even with slight changes in the plane of the lens. Therefore, a range of measurements were taken and the highest reading from each was used so as to display the worst-case scenario from existing windows.

Table B4 Indicative Light Monitoring Locations

Reference	Monitoring Location	Key Local Sources of Light
WYG 1	Garden of property with Large ground floor windows	Internal residential lighting
WYG 2	Garden of property with French doors	Internal residential lighting
WYG 3	Garden of property with windows	Internal residential lighting

Survey Results

The results of the monitoring are displayed in Table B5.

Table B5 Survey Results

Reference	Illuminance at 1m (lux)	Illuminance at 3m (lux)	Illuminance at 10m (lux)
WYG 1	14.9	4.4	N/A
WYG 2	7.4	1.0	0.2
WYG 3	9.0	3.7	0.5

These results show a wide variety of light levels from existing scenarios, this is due to the amount of lighting from within the property, glazing and surrounding light levels.

APPENDIX C – REPORT CONDITIONS

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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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