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c/o Francesca Egan
Bargate Homes,
The New Barn,
Winchester Road,
Eastleigh,
SO50 7HD

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

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EXECUTIVE SUMMARY

Tetra Tech was commissioned by Bargate Homes Ltd to prepare a lighting assessment to support the planning application for a residential development on land west of Pagham Road, Pagham.

Lighting plans have been provided by Bargate Homes and used to produce a model of porch and back door lighting 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 local residential receptors will be low.

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.

Overall, there is a low risk of significant adverse impacts on local sensitive ecological receptors.

The assessment demonstrates that the proposed 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 |
| 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 was commissioned by Bargate Homes Ltd to prepare a lighting assessment to quantify potential impacts associated with the planning application for a residential development on land west of Pagham Road, Pagham.

1.1 SITE LOCATION AND CONTEXT

The development site currently consists of open land, the approximate national grid reference of which is 489149, 098968. Bargate Homes Ltd is seeking planning permission for the proposed residential development on land west of Pagham Road, Pagham.

The site of the proposed development is bounded by:

- Residential dwellings off Pagham Road and arable fields to the north;
- Pagham Road to the east;
- Residential developments along Millview Close, Old Barn Close, and Barley Close to the south;
- Residential developments along Honeysuckle Drive and a small, wooded area to the west.

Reference should be made to **Figure 1-1** 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:

- 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 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;
- National Planning Policy Framework, Department for Levelling Up, Housing & Communities, December 2024;
- Planning Practice Guidance on Light Pollution, Ministry of Housing, Communities & Local Government, 1st November 2019;
- The Conservation of Habitats and Species Regulations, as amended, 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;
- Bat Conservation Trust Guidance - Artificial Lighting and Wildlife, 2014;
- Bats and artificial lighting in the UK, Institution of lighting professionals, Bat Conservation Trust, 2023;
- The Arun Local Plan 2011 – 2031 Part 1 (Adopted 18th July 2018).

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

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 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), December 2024 principally brings together and summarises the suite of Planning Policy Statements (PPS) and Planning Practice 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 198 states that:

“198 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. limit 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 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 Arun Local Plan 2011 – 2031 Part 1 (Adopted 18th July 2018), the following policies

were identified as being relevant to potential light impacts associated with the proposed scheme:

“Policy QE SP1 Quality of the environment

The Council requires that all development contributes positively to the quality of the environment and will ensure that development does not have a significantly negative impact upon residential amenity, the natural environment or upon leisure and recreational activities enjoyed by residents and visitors to the District.

The location of existing industrial and commercial uses, including waste management uses, must be taken into consideration when assessing proposals for development sensitive to noise, light, odour and outputs to air. This is to ensure that land allocated for these uses are protected and to ensure that the amenity of new developments and facilities is safeguarded from the impacts of incompatible land uses.”

“Policy QE DM2: Light Pollution

Planning permission for proposals which involve outdoor lighting must be accompanied by a lighting scheme prepared according to the latest national design guidance and relevant British Standards publications. Outdoor lighting schemes will be considered against the following criteria:

- a) No adverse impact on neighbouring uses or the wider landscape, particularly with regard the South Downs International Dark Sky Reserve designation;*
- b) Light levels being the minimum required for security and working purposes;*
- c) Minimising the potential glare and spillage; and d. The degree to which outdoor lighting can be powered by on-site renewable sources.*

Where appropriate, the Local Planning Authority will seek to control the times of illumination.”

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 design used in this assessment sets out the porch and back door lighting for the residential properties within the proposed development.

The design of the lighting has been undertaken in a manner such as to address two potentially conflicting needs; on the one hand, to provide a safe environment for the movement of residents 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.

Modelling for the assessment includes luminaires considered appropriate for residential development porch lights and back lights, which will also be controlled by a passive infrared system (PIR) to avoid unnecessary potential light spillage. Within the modelling all lights are active, so the assessment represents a worst-case scenario for the porch and back lighting.

Lighting modelled within proposed development:

- Porch Light: Trumpeter Lantern LED
- Porch Light: Half Lantern LED
- Back Light: DETA GF6010

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 3-5**.

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 m²) | | | | | |
|---|------------------------|-------------|--|-------------------------|------------------------|------------------------|------------------------|-------------|
| | | | $0 < A_p \leq 0.002$ | $0.002 < A_p \leq 0.01$ | $0.01 < A_p \leq 0.03$ | $0.03 < A_p \leq 0.13$ | $0.13 < A_p \leq 0.50$ | $A_p > 0.5$ |
| 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 through the baseline survey. 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 3-5**. 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:

- The development is predicted to exceed the maximum sky glow ULR at any surrounding receptor; 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.

Table 3-5 - P Lighting Class

| Class | Horizontal Illuminance | | E_0 GR _L | |
|-------|-------------------------------------|----------------------------|----------------------------|-----------------------------|
| | \bar{E}_a [minimum maintained] lx | E_{min} [maintained] lx | E_{vmin} [maintained] lx | E_{scmin} [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

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 the 25th September 2024. Due to the time of year the survey was undertaken after 20:00 to establish the existing post curfew lighting conditions.

4.1.2 Existing Light Sources

Existing light sources surrounding the site include street lighting along Pagham Road and light spillage from nearby residential properties.

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**. The results from the survey are presented 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 | Access road off Pagham Road | Street lighting nearby |
| L2 | Access road off Pagham Road | Street lighting nearby |
| L3 | Field boundary to East | Street lighting nearby |
| L4 | Field boundary to South | Lighting from residential properties |
| L5 | Field boundary to South | Lighting from residential properties |
| L6 | Field boundary to South | Lighting from residential properties |
| L7 | Field boundary to South | Lighting from residential properties |
| L8 | Field boundary to South | Lighting from residential properties |
| L9 | Field boundary to South | Lighting from residential properties |

| Reference | Monitoring Location | Key Local Sources of Light |
|-----------|-----------------------------|--------------------------------------|
| L10 | Field boundary to South | Lighting from residential properties |
| L11 | Field boundary to South | Lighting from residential properties |
| L12 | Field boundary to West | lighting in this area |
| L13 | Field boundary to West | lighting in this area |
| L14 | Centre of field | No lighting in this area |
| L15 | Centre of field | No lighting in this area |
| L16 | Centre of field | No lighting in this area |
| L17 | Field boundary to the North | Lighting from residential properties |
| L18 | Field boundary to the North | Lighting from residential properties |
| L19 | Field boundary to the North | Lighting from residential properties |
| L20 | Millview Close | Lighting from residential properties |
| L21 | Millview Close | Lighting from residential properties |
| L22 | Old Barn Close | Lighting from residential properties |
| L23 | Barley Close | Lighting from residential properties |

4.1.4 Survey Results

The results of the light monitoring survey are shown in **Table 4-2**.

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 | 0.01 | 0.00 | 0.01 | 0.02 | 0.02 | 19.24 |
| L2 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 18.18 |
| L3 | 0.03 | 0.03 | 0.02 | 0.06 | 0.09 | 19.82 |
| L4 | 0.02 | 0.13 | 0.14 | 0.07 | 0.18 | 18.63 |
| L5 | 0.02 | 0.03 | 0.04 | 0.02 | 0.01 | 18.09 |
| L6 | 0.01 | 0.03 | 0.02 | 0.00 | 0.01 | 17.35 |
| L7 | 0.02 | 0.03 | 0.01 | 0.00 | 0.02 | 17.94 |
| L8 | 0.03 | 0.03 | 0.05 | 0.01 | 0.02 | 19.54 |
| L9 | 0.02 | 0.04 | 0.02 | 0.01 | 0.03 | 17.10 |
| L10 | 0.02 | 0.03 | 0.01 | 0.00 | 0.01 | 18.22 |
| L11 | 0.01 | 0.03 | 0.00 | 0.00 | 0.02 | 17.93 |
| L12 | 0.01 | 0.01 | 0.00 | 0.00 | 0.01 | 17.99 |
| L13 | 0.01 | 0.01 | 0.01 | 0.00 | 0.01 | 18.02 |
| L14 | 0.01 | 0.02 | 0.00 | 0.00 | 0.02 | 17.94 |
| L15 | 0.01 | 0.02 | 0.00 | 0.00 | 0.01 | 17.77 |
| L16 | 0.01 | 0.02 | 0.01 | 0.00 | 0.01 | 17.86 |
| L17 | 0.01 | 0.02 | 0.00 | 0.00 | 0.01 | 17.89 |
| L18 | 0.01 | 0.01 | 0.00 | 0.00 | 0.00 | 18.01 |
| L19 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 18.25 |
| L20 | 0.03 | 0.07 | 0.17 | 0.09 | 0.09 | 17.35 |
| L21 | 0.03 | 0.31 | 0.32 | 0.07 | 0.13 | 18.46 |
| L22 | 0.05 | 0.62 | 0.57 | 0.21 | 0.08 | 18.05 |
| L23 | 0.05 | 0.82 | 1.26 | 0.46 | 0.65 | 17.66 |

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**, 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.

4.2 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 and employment 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 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.

Receptors were also included at 4 points to the east of site where a proposed residential development 'P/30/19/OUT Land North of Hook Lane Pagham' has been approved for outline permission pending a S106 Agreement. The included receptors are included along the western boundary of the proposed development to represent potential future residential properties on site.

Table 4-3 - Residential Receptors

| ID | Description | ILP Environmental Zone |
|-----|---|------------------------|
| R1 | 275 Pagham Road, PO21 3PY | E2 |
| R2 | Mill Lodge, Pagham Road, PO21 3TD | E2 |
| R3 | 8 Millview Close, PO21 3UF | E2 |
| R4 | 9 Millview Close, PO21 3UF | E2 |
| R5 | 10 Millview Close, PO21 3UF | E2 |
| R6 | 11 Millview Close, PO21 3UF | E2 |
| R7 | 23 Millview Close, PO21 3UF | E2 |
| R8 | 22 Millview Close, PO21 3UF | E2 |
| R9 | 21 Millview Close, PO21 3UF | E2 |
| R10 | 6 Old Barn Close, PO21 3UG | E2 |
| R11 | 7 Old Barn Close, PO21 3UG | E2 |
| R12 | 8 Barley Close, PO21 3UQ | E2 |
| R13 | 9 Barley Close, PO21 3UQ | E2 |
| R14 | 25 Barley Close, PO21 3UQ | E2 |
| R15 | 24 Barley Close, PO21 3UQ | E2 |
| R16 | 64 Oaktree Close, PO21 3PW | E2 |
| R17 | 59 Oaktree Close, PO21 3PW | E2 |
| R18 | 57 Oaktree Close, PO21 3PW | E2 |
| R19 | 50 Honeysuckle Drive, PO21 3PT | E2 |
| R20 | 44 Honeysuckle Drive, PO21 3PT | E2 |
| R21 | Windmill Barn, Pagham Road, PO21 3PY | E2 |
| R22 | Commonmead Barn, Pagham Road, PO21 3PY | E2 |
| R23 | Fieldview, Pagham Road, PO21 3PY | E2 |
| PR1 | Proposed Receptor - Hook Lane, PO21 3PD (P/30/19/OUT) | E2 |
| PR2 | Proposed Receptor - Hook Lane, PO21 3PD (P/30/19/OUT) | E2 |
| PR3 | Proposed Receptor - Hook Lane, PO21 3PD (P/30/19/OUT) | E2 |
| PR4 | Proposed Receptor - Hook Lane, PO21 3PD (P/30/19/OUT) | E2 |

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 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 30 points along the length of hedgerows and trees that are to be retained, at heights of 2m. **Table 4-4** provides a reference for these locations, whilst a full spatial illustration of modelled ecological receptors is included in **Figure 4-3**. Modelled receptors have included tree lines, areas of high roosting potential for bats and foraging areas for bats.

Table 4-4 - Ecological Receptors

| ID | Description |
|-----|--|
| E1 | Tree line along southeastern boundary |
| E2 | Tree line along southeastern boundary |
| E3 | Tree line along southeastern boundary |
| E4 | Tree line along southeastern boundary |
| E5 | Hedges along southern boundary |
| E6 | Hedges along southern boundary |
| E7 | Hedges along southern boundary |
| E8 | Hedges along southern boundary |
| E9 | Hedges along southern boundary |
| E10 | Hedges along southern boundary |
| E11 | Hedges along southern boundary |
| E12 | Vegetation along western boundary |
| E13 | Vegetation along western boundary |
| E14 | Vegetation along western boundary |
| E15 | Vegetation along western boundary |
| E16 | Vegetation along western boundary |
| E17 | Vegetation along western boundary |
| E18 | Vegetation along western boundary |
| E19 | Vegetation along northern boundary |
| E20 | Vegetation along northern boundary |
| E21 | Vegetation along northern boundary |
| E22 | Vegetation along northern boundary |
| E23 | Vegetation along northern boundary |
| E24 | Vegetation along northern boundary |
| E25 | Vegetation along northern boundary |
| E26 | Hedgerow along access road to the east |
| E27 | Hedgerow along access road to the east |
| E28 | Hedgerow along access road to the east |
| E29 | Hedgerow along access road to the east |
| E30 | Tree line along southern boundary |

Figure 4-3 - Modelled Ecological 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 indicative lighting design is shown in **Figure 5-1**. Building plans were provided and were used in combination with the provided design to produce a DIALux model of the proposed development. 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 assessment has been undertaken with consideration for appropriate types of lighting used for the scheme, as shown below. The model consists of the proposed porch lights and back lights which will be controlled by a passive infrared system (PIR) so as to avoid lighting being active when not necessary for resident visibility. Within the model all lights are active, so the assessment represents a worst-case scenario for the porch and back lighting.

Lighting modelled within proposed development:

- Porch Light: Trumpeter Lantern LED
- Porch Light: Half Lantern LED
- Back Light: DETA GF6010

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 lighting model. The assumed baseline illuminance levels are ILP Environmental Zone E2.

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 3-5**.

Figure 5-1 - Indicative Outline Lighting Design



Figure 5-2 - Visual Representations of Proposed External Lighting Model



Figure 5-3 - Visual Representations of Lux Contour Plot



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 E2, in accordance with the classifications detailed in **Table 3-2** to **Table 3-5**.

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 | 0.07 |
| R2 | 5.00 | 1.00 | 0.10 |
| R3 | 5.00 | 1.00 | 0.17 |
| R4 | 5.00 | 1.00 | 0.35 |
| R5 | 5.00 | 1.00 | 0.12 |
| R6 | 5.00 | 1.00 | 0.17 |
| R7 | 5.00 | 1.00 | 0.25 |
| R8 | 5.00 | 1.00 | 0.33 |
| R9 | 5.00 | 1.00 | 0.38 |
| R10 | 5.00 | 1.00 | 0.26 |
| R11 | 5.00 | 1.00 | 0.31 |
| R12 | 5.00 | 1.00 | 0.12 |
| R13 | 5.00 | 1.00 | 0.02 |
| R14 | 5.00 | 1.00 | 0.03 |
| R15 | 5.00 | 1.00 | 0.01 |
| R16 | 5.00 | 1.00 | <0.01 |
| R17 | 5.00 | 1.00 | <0.01 |
| R18 | 5.00 | 1.00 | 0.05 |
| R19 | 5.00 | 1.00 | 0.07 |
| R20 | 5.00 | 1.00 | 0.02 |
| R21 | 5.00 | 1.00 | 0.17 |
| R22 | 5.00 | 1.00 | 0.21 |
| R23 | 5.00 | 1.00 | 0.29 |
| PR1 | 5.00 | 1.00 | 0.05 |
| PR2 | 5.00 | 1.00 | 0.02 |
| PR3 | 5.00 | 1.00 | 0.04 |
| PR4 | 5.00 | 1.00 | 0.03 |

As the proposed development site includes the installation of a public road, post-curfew lighting levels may be up to 1 lux as stated in **Table 3.2**. Therefore, the ILP pre-curfew and post-curfew criteria does 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

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. **Table 5.2** presents the modelled proposed light trespass values (vertical and horizontal) along sections of potential bat commuting/foraging routes on the site boundary

As a worse case, any exceedance of 1 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).

Table 5-2 - Ecological Receptor Assessment Results

| ID | Predicted Model Illuminance (lx) |
|-----|----------------------------------|
| E1 | 0.05 |
| E2 | 0.08 |
| E3 | 0.17 |
| E4 | 0.03 |
| E5 | 0.27 |
| E6 | 0.12 |
| E7 | 0.64 |
| E8 | 0.65 |
| E9 | 0.39 |
| E10 | 0.38 |
| E11 | 0.44 |
| E12 | 0.07 |
| E13 | 0.07 |
| E14 | 0.04 |
| E15 | 0.07 |
| E16 | 0.20 |
| E17 | 0.03 |
| E18 | 0.02 |
| E19 | 0.26 |
| E20 | 0.39 |
| E21 | 0.17 |
| E22 | 0.19 |
| E23 | 0.26 |
| E24 | 0.50 |
| E25 | 0.48 |
| E26 | 0.31 |
| E27 | 0.22 |
| E28 | 0.35 |
| E29 | 0.37 |
| E30 | 0.18 |

As illustrated by **Table 5-2**, light trespass associated with the proposed site does not exceed 1 lux at any of the 30 modelled ecological receptor locations adjacent to the site boundary and within the proposed site. As such, lighting from the proposed development is not predicted to result in any significant adverse impacts with respect to local sensitive ecological receptors.

5.1.1.3 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 3-5** the ILP sky glow limitation for an area classified as Environmental Zone E2 is 2.5% ULR. As such the indicative lighting scheme meets the ILP sky glow limitations and is therefore will result no impacts on the dark sky landscape.

6.0 CONCLUSIONS

Tetra Tech was commissioned by Bargate Homes Ltd to prepare a lighting assessment to support the planning application for a residential development on land west of Pagham Road, Pagham.

Lighting plans have been provided by Bargate Homes and used to produce a model of porch and back door lighting 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 local residential receptors will be low.

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.

Overall, there is a low risk of significant adverse impacts on local sensitive ecological receptors.

The assessment demonstrates that the proposed development does not conflict with any national or local planning policies.

APPENDIX A – REPORT CONDITIONS

This Report has been prepared using reasonable skill and care for the sole benefit of Bargate Homes Ltd (“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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