7 GLINT AND GLARE

7.1 Introduction

This chapter presents the issues of glint and glare from the Proposed Development. Glint and glare occurs when sunlight is reflected by a surface towards an observer, which can present an effect on amenity or a safety hazard. The term ‘glint’ describes a momentary flash originating from a moving source whilst ‘glare’ relates to a continuous source of light from a stationary source. Both occur due to the same underlying physical characteristics.

This chapter is supported by Appendix 10.1 – Solar Photovoltaic Glint and Glare Study. The assessment is based on the project description and site context as set out Chapter 2: Project Description.

The glint and glare assessment was undertaken by Pager Power Limited. Pager Power has undertaken over 1,000 glint and glare assessments in the UK, Europe and internationally. The company’s own glint and glare guidance is based on industry experience and extensive consultation with industry stakeholders including airports and aviation regulators”.

7.2 Methodology

Glint and glare effects have been considered for the relevant receptors (observer types). Full details are shown in Appendix 10.1, the receptors assessed with geometric modelling are:

- Occupants of surrounding dwellings
- Aviation activity at Wingland Airfield and Red House Farm Airfield

Further receptors have been considered within the assessment without geometric modelling are:

- Aviation activity at Lutton-Garnsgate Airfield
- Road users along local roads – specifically drivers of motor vehicles

The assessment methodology is based on industry best-practice. This is largely informed by literature review and stakeholder engagement.

The methodology for the glint and glare assessment is outlined below:

- Identify receptors in the area surrounding the Proposed Development.
- Consider direct solar reflections from the Proposed Development towards the identified receptors by undertaking technical modelling – simplistically this is a series of geometric calculations from each part of the Proposed Development towards each receptor based on the trajectory of the sun throughout the year.
- Consider the visibility of the panels from each receptor’s location. If the panels are not visible from the receptor, then no reflections can occur.
- Based on the results of the technical modelling, determine whether a reflection can occur, and if so, at what time it will occur.
- Consider both the solar reflection from the Proposed Development and the location of the direct sunlight with respect to the receptor’s position.
- Consider the solar reflection with respect to the published studies and guidance.
- Determine whether a significant detrimental effect is expected in line with the process presented within the ‘Significance of Effect’ section.

7.2.1 Assessment of Significance

Each receptor is assessed based on its magnitude of change and the sensitivity of the affected receptor.

7.2.1.1 Magnitude of Effect

The classifications of change magnitude are presented in Table 7-1 below.

Magnitude of Change	Criteria for Assessing Effect
High	**Total loss or substantial alteration to key features of the baseline conditions such that receptor attributes will be fundamentally changed.**
Medium	**Loss or alteration to one or more key features of the baseline conditions such that receptor attributes will be materially changed.**
Low	**A minor shift away from baseline conditions. Change arising from the alteration will be discernible but not material. The underlying attributes of the baseline condition will be largely unchanged.**
Negligible	**Very little change from baseline conditions. Change barely distinguishable, approximating to a 'no change' situation.**

Table 7-1 Defining Magnitude of Change

7.2.1.2 Sensitivity of Receptor

The classifications of receptor sensitivity are presented in Table 7-2 below.

Sensitivity	Examples of Receptor
High	**The receptor has little ability to absorb change without fundamentally altering its present character or is of international importance.**
Medium	**The receptor has moderate capacity to absorb change without significantly altering its present character or is of high importance.**
Low	**The receptor is tolerant of change without detriment to its character or is of low local importance.**

Table 7-2 Defining Sensitivity of Receptor

7.2.1.3 Significance of Effect

The significance of an environmental effect is determined by the interaction of magnitude and sensitivity. The Effect Significance Matrix is set out in Table 7-3 below.

Magnitude of Change	Sensitivity of Receptor		
	High	**Medium**	**Low**
High	**Major Adverse**	**Major Adverse**	**Major Adverse**
Medium	**Major Adverse**	**Moderate Adverse**	**Moderate Adverse**

Low	**Moderate Adverse**	**Minor Adverse**	**Minor Adverse**
Negligible	**Negligible**	**Negligible**	**Negligible**

Table 7-3 Matrix for Assessing Significance of Effect

The level of effect is considered 'Significant' if the resultant significance of effect is 'Moderate Adverse' or 'Major Adverse'.

The classification of duration of effects are presented in Table 7-4 below.

Duration of Effect	Criteria for Assessing Effect
Permanent	**Effects are possible for the entire lifetime of the Proposed Development.**
Temporary	**Effects are possible for a restricted period following introduction of the Proposed Development.**

Table 7-4 Duration of Effects

7.2.1.4 Application of Criteria to Road User Receptors

The magnitude of effect upon road users (discussed in Appendix D of ES Appendix 10.1) is predominantly dependent on the following factors:

- whether a solar reflection is predicted to be experienced;
- the type of road – in the context of traffic speeds and likely densities; and
- the location of the reflecting panels relative to a road user's direction of travel – a solar reflection directly in front of a road user is more hazardous than a reflection from a location off to one side.

A 'Negligible' magnitude would occur if solar reflections are not geometrically possible, or are not predicted to be experienced by a road user.

A 'Low' magnitude would occur if solar reflections would all originate from outside a road user's main field of view or towards local roads with the lowest traffic densities. Reflections originating within a road user's main field of view can be of 'Low' magnitude based on consideration of the following mitigating circumstances:

- Whether visibility is likely for elevated drivers (applicable to dual carriageways and motorways only) – there is typically a higher density of elevated drivers along dual carriageways and motorways compared to other types of road.
- The separation distance to the panel area – larger separation distances reduce the proportion of an observer's field of view that is affected by glare.
- The position of the sun – effects that coincide with direct sunlight appear less prominent than those that do not.

A 'Medium' magnitude would occur if solar reflections were experienced from within a road user's main field of view and there are insufficient mitigating factors.

A 'High' magnitude would occur if solar reflections were experienced from directly in front of a road user's direction of travel with no mitigating factors.

In terms of sensitivity for road user receptors, it is relevant to consider that road types can generally be categorized as:

- Major National – Typically a road with a minimum of two carriageways with a maximum speed limit of up to 70mph. These roads typically have fast moving vehicles with busy traffic.
- National – Typically a road with a one or more carriageways with a maximum speed limit of up to 60mph or 70mph. These roads typically have fast moving vehicles with moderate to busy traffic density.
- Regional – Typically a single carriageway with a maximum speed limit of up to 60mph. The speed of vehicles will vary with a typical traffic density of low to moderate.
- Local – Typically roads and lanes with the lowest traffic densities. Speed limits vary.

Local roads would be considered as 'Low' sensitivity and Regional, National, and Major National roads would be considered of 'Medium' sensitivity.

To determine the mitigation requirement, a general guidance is:

- A 'Major Adverse' effect would result in a requirement for mitigation.
- A 'Moderate Adverse' effect would result in a recommendation for mitigation.

The flowchart for determining the mitigation requirement for road receptors can be found in Appendix 10.1.

7.2.1.5 Application of Criteria to Aviation Receptors

Aviation receptors are essentially of two types:

- Air Traffic Control Tower.
- 2-mile approach paths.

Sensitivity of receptor, significance and magnitude of effect will differ depending on the type of receptor.

ATC Tower

The magnitude of effect upon the ATC Tower receptors is dependent on the following main factors:

- Whether a reflection is predicted in practice and the reflective area is visible.
- The location of the reflecting panels relative to key locations of the aerodrome (a reflection generated near sensitive areas such as the runway threshold or in the general area where sky surveillance is expected to have a higher impact upon the ATC Tower operations).
- Duration of the glare (a reflection that occurs for a prolonged time period is expected to have an higher impact upon ATC Tower operations).

A 'Moderate' or higher magnitude of effect on an ATC Tower would be considered to have a 'Moderate adverse' or 'Major adverse' significance. This is where a technical or operational effect would materially affect safety i.e. potential for airport traffic accidents to occur due to solar reflections obscuring the vision of or distracting the ATC Tower personnel.

A 'Moderate' magnitude would occur if solar reflections were experienced by ATC personnel and effects occasionally and marginally affected the safeguarding operations while a 'High' magnitude would occur if solar reflections were experienced by ATC personnel and the safeguarding operations were regularly and substantially affected.

The receptor sensitivity in the case of an ATC Tower can vary between 'Medium' and 'High'. Cases where operations were significantly affected beyond baseline conditions, a significant effect would occur.

Overall, the level of effect which would be considered 'Significant' with respect to EIA if the resultant significance of effect was 'Moderate Adverse' or higher.

A 'Moderate Adverse' or 'Major Adverse' effect would result in a requirement for mitigation.

Approach Paths

The magnitude of effect upon the aircrafts approaching the runway[1] (also referred as Approach Paths) receptors is dependent on the following main factors:

- Whether a reflection is predicted in practice and the reflective area is visible.
- The intensity of the reflected light and weather it has potential for afterimage.
- The location of the reflecting panels relative to key locations of the aerodrome (a reflection generated near sensitive areas such as the runway threshold is expected to have a higher impact upon the pilots landing).

A 'Moderate' or higher magnitude of effect to pilots approaching the runaway would be considered significant. This is where a technical or operational effect would materially affect safety i.e., potential for airport traffic accidents to occur due to solar reflections obscuring the vision of pilots or distracting them during the delicate plane's manoeuvres.

As a general guide, a 'Moderate' magnitude would occur if a solar reflection was predicted to be experienced, would have "Potential for After Image" or higher intensity and occur without significant mitigating factors.

The receptor sensitivity in the case of a pilot approaching the runway is "Medium". Cases where operations were significantly affected beyond baseline conditions, a significant effect would occur.

Overall, the level of effect which would be considered 'Significant' with respect to EIA if the resultant significance of effect was 'Moderate Adverse' or higher. The Approach path receptors considered for the assessment are shown in section 5.3 of Appendix 10.

A 'Moderate Adverse' or 'Major Adverse' effect would result in a requirement for mitigation.

7.3 Policy Framework

The National Planning Policy Framework (NPPF) under the planning practice guidance for Renewable and Low Carbon Energy (specifically regarding the consideration of solar farms, paragraph 013) states:

'Particular factors a local planning authority will need to consider include:

- *the proposal's visual impact, the effect on landscape of glint and glare (see guidance on landscape assessment) and on neighbouring uses and aircraft safety;*
- *the extent to which there may be additional impacts if solar arrays follow the daily movement of the sun;*

The approach to assessing cumulative landscape and visual impact of large scale solar farms is likely to be the same as assessing the impact of wind turbines. However, in the case of ground-mounted solar panels it should be noted that with effective screening and appropriate land topography the area of a zone of visual influence could be zero (our emphasis).'

[1] Only planes approaching are considered for the assessment. It is expected that for planes departing pilots will be looking upwards and will either not focus on objects on the ground or not be significantly affected by reflection generated at ground level.

The Department for Business, Energy & Industrial Strategy (BEIS) has published its Draft National Policy Statement for Renewable Energy Infrastructure (EN-3), which addresses glint and glare in sections 2.48.4 and 2.52. The document identifies the issue as one of two main impact issues in the context of visual influence and that in some instances a glint and glare assessment may be necessary as part of the planning application. Details pertaining to impact classification or a recommended strategy for quantifying effects in any form are not given.

In a wider context, guidance of various kinds has been produced by industry stakeholders in the UK and internationally. Further information pertaining to the available guidance and how this has informed the assessment process is presented in Appendix 10.1.

There is no known local policy and guidance related to glint and glare, other than a general reference in the South-East Lincolnshire Local Plan that renewable energy developments can result in changes in sun light reflection and it is important that proposals assess the potential impact on residential amenity, highway safety and aviation safety.

7.3.1 Limitations to the Assessment

The technical assessment that underpins the conclusions in this chapter is desk-based, relying on geometric modelling and inputs from the design team. No site surveys have been undertaken which could provide supplementary or more accurate data. Available imagery and satellite mapping as per OSGB 50 DTM has been used to evaluate the level of visibility in the context of existing obstructions. In some cases, this imagery may not be up to date and may not give the full perspective of the installation from the location of the assessed receptor. The resulting limitations are minimal and are inherently minimised by taking a conservative approach, whereby the reasonable worst-case is assumed if there is a significant level of uncertainty around the associated parameters.

Co-ordinates of the Proposed Development and that of the identified receptors are based on the available imagery and sight drawings. This limitation is unlikely to meaningfully impact the conclusions of the analysis based on the likely level of error.

The altitude at each reference point is based on a digital elevation model. An additional figure is then added to represent the solar panel height above ground level. The same process has been undertaken for receptor locations. It is assumed that the panel elevation angle provided by the Applicant represents the elevation angle for all of the panels within each defined solar panel area. These assumptions are reasonable and do not significantly affect the robustness of the resulting conclusions.

Only a reflection from the face of the panel has been considered. The frame or the reverse frame of the solar panel has not been considered. Reflections from the reverse of the panel are not significant because it is not directly illuminated by the sun. Any reflections from a frame would represent a small percentage of the panel surface area and moreover would be aligned with the reflector area that has already been modelled.

The model assumes that a receptor can view the face of every panel within the Proposed Development area whilst in reality this, in the majority of cases, will not occur. Therefore, any predicted solar reflection from the face of a solar panel that is not visible to a receptor will not occur in practice. This limitation makes the results more conservative.

Any screening in the form of trees, buildings etc. that may obstruct the sun from the view of the solar panels is not considered within the model output. This makes the results conservative. The effect of such screening is evaluated separately within the overall assessment.

Overall, the impact of these limitations is minimal due to their influence on the overall result and/or the inherently conservative approach taken within the assessment, which has followed industry best practice.

7.4 Baseline Conditions

7.4.1 Site Description and Context

A 1km buffer is considered appropriate for glint and glare effects on road safety and residential amenity. Receptors within this distance are identified based on mapping and aerial photography of the region. The analysis therefore considered relevant road and dwelling receptors that:

Are within one kilometre of the Proposed Solar Development.

Have a potential view of the panels.

The analysis therefore considered relevant aviation receptors that:

Are within 10 kilometre of the Proposed Development.

The main source of irradiance in the area will be the sun, which is a more intense source of light than solar reflections. Road users are already aware of safety implications when driving in bright sunlight. Dwellings will experience the most noticeable source of irradiance at sunset and sunrise.

7.4.2 Baseline Survey Information

No field work/site surveys were undertaken as part of this assessment.

The necessary technical specification of the Proposed Development was defined within the plans and project description as set out in Chapter 2.

Identification of relevant roads, residential infrastructure and aviation infrastructure was based on mapping and aerial imagery.

7.5 Assessment of Likely Significant Effects

Effects during Construction

Glint and glare effects can occur from any solar panels that are installed at the Site. The modelling has evaluated the effects based on the proposed fixed and tracking panels.

In addition, effects during construction may be sensitive to variable factors such as where panels are stored and in what orientation at the site, prior to operation of the site.

In general terms, as not all panels will be installed simultaneously, the overall level of effect of the construction phase will be less than or comparable to the level of effect during the operational phase.

Effects during Operation

Minor adverse impacts are predicted at worst and therefore mitigation is not a requirement. Effects upon the identified receptors are discussed in section 4 of Appendix 10.1.

7.6 Mitigation and Enhancement

Mitigation by Design

Mitigation has not been implemented within the proposed design.

7.6.1 Residual Effects

No significant impacts are predicted upon road safety, residential amenity, or aviation activity; therefore, mitigation is not required.

7.7 Cumulative and In Combination Effects

No cumulative effects are predicted because existing solar developments that are located such that they would cause simultaneous significant effects do not appear to be present.

7.8 Summary

7.8.1 Introduction

This chapter describes the baseline conditions, assessment approach and the potential glint and glare effects from the Proposed Development upon surrounding road safety, residential amenity, and aviation infrastructure.

7.8.2 Baseline Conditions

The assessed one kilometre area, for ground-based receptors, and 10km area for aviation receptors surrounding the Proposed Development is rural with some dwellings, roads, and airfields. The following have been identified and modelled in detail:

- Residential dwellings
- Wingland Airfield
- Red House Farm Airfield

7.8.3 Likely Significant Effects

No significant effects are predicted under baseline conditions towards road safety, residential amenity, or aviation activity at Wingland Airfield and Red House Farm Airfield (see Appendix 10.1).

7.8.4 Mitigation

No significant impacts are predicted upon road safety, residential amenity, or aviation activity at Wingland Airfield and Red House Farm Airfield and therefore mitigation is not required.

7.8.5 Conclusion

The Proposed Development is predicted to have a ‘Minor Adverse’ effect at worst upon surrounding road safety, residential amenity, and aviation activity at Wingland Airfield and Red House Farm Airfield.